International Journal of Agriculture Innovations and Research
Volume 7, Issue 2, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy):
Received: 20/08/2018 | Accepted on: 28/08/2018 | Published: 24/09/2018

Determinants of Farmers' Willingness to Pay for Attributes of Improved Variety Maize Seed in Western Mid-Hills of Nepal

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Abstract – **Development of open pollinated improved varieties and make them available for seed multiplication and distribution among maize growers is the important interventi--on made by public sector maize research program in Nepal. Twenty improved maize varieties has been developed and most of them carry farmer preferred attributes for different agro ecological conditions. However, the coverage of such varieties is still low. This is mostly due to less focus on multiplication and marketing of improved variety maize seed with proper pricing strategy based on farmer's willingness to pay. Questionnaire survey was conducted among two hundred households selected through purposive random sampling in western mid hills of Nepal to assess the determinants of farmer's willingness to pay and their preferred attributes for improved variety maize seed. Secondary data also used and focus group discussions were carried out as required. Farmers ranking of seven promising varieties was carried out based on their preferred attributes. Contingent valuation method with five price bands was used to estimate the farmer's willingness to pay for improved variety maize seed.**

The Tobit regression model was employed with dependent variable, farmer's willingness to pay for improved variety maize seed to determine the effects of explanatory variables. The result showed that educational level of the household head, cultivated land holding size, availability of agriculture training, frequency of contact with extension agent and awareness about market price of product were positively and significantly contributing to the probability of willingness to pay whereas, availability of farm worker i.e. number of economically active household member and distance from nearest road head has negative effect.

The major implication of this study is to design the policy and programs for the development of new improved varieties of maize with aggressive and farmer friendly marketing strategy, together with private sector involvement to reap the benefits of improved maize varieties, and get return on research investment. Farmer's willingness to pay showed that there is enough room for private seed enterprises participation if proper marketing strategy is employed to promote improved variety maize seed among growers. However, there is still need to develop nonprofit community based seed production and distribution system and at the same time provide price subsidy to reach maize growers with improved variety maize quality seed characterizing, small holders, residing in remote areas, low level of education, sporadic extension contacts and untrained in modern agriculture production system. Efforts are also needed to enhance farmer's willingness to pay through promotion of positively contributing variables.

Keywords – **Determinants, Maize, Attributes, Willingness to Pay.**

I. INTRODUCTION

The seed market has experienced large spectrum of changes from public good to private proprietary patented varieties during last 50 years. It is largely traded as private good and public sector free varieties are declining every year. With this, seed market is becoming rapidly growing business led by different multinational companies and with diverse brands. The end users i.e. farmers need to pay for improved variety quality seed of their choice irrespective of its development from private or public sector. Now agriculture growth and achievement of national goal of productivity gain, food security, poverty reduction and trade balance largely depend on increased coverage of improved variety quality seed which is directly associated with development of improved varieties by private and public sector agencies and their marketing among farming population. In this ground different agencies working for agriculture and seed enterprise development need to analyze farmer's behavior, satisfaction, preference, their willingness to pay (WTP), market forces, seed value chains and perform accordingly to promote their seed market and reach larger farming population. Within value chain framework the behavior, satisfaction and perception of final customers is important for proper functioning of the commodity value chains in the market. Customer satisfaction is key factor of customer desire for future purchase and furthermore; the satisfied customers will probably talk to others about their good experiences and promote the market [1]. Although satisfaction has been defined as the difference between expectation and performance, but there are differences between quality and satisfaction, i.e satisfaction need experience [2]. Experience is not needed for evaluating service quality, and service can be evaluated on the basis of the knowledge about service provider, while satisfaction is an inner view, resulted from customers own experience from the service [3]. The research conducted by [4] shows that, there is a two-way relation between satisfaction and service quality. Ultimately both satisfaction and quality associated with any products determines customer's willingness to pay and are more important among farming population where social capital largely shape their behavior and play vital role in innovation dissemination. End users farmers and their satisfaction, perception and willingness to pay for particular variety quality seed determine functioning, sustainability resilience and dynamics of a seed value chain in the market. Understanding of farmer willingness to pay and seed pricing strategy based on such understanding certainly help

the enterprise to increase their market share and ultimately contribute to increase agriculture production. Valid estimates of WTP is essential for developing an optimal pricing strategy. Similar arguments about the importance of WTP and perceptions of value by customers can also be found by many other authors [5]-[6]-[7]. In recent years in value chain analysis, focus has been shifted from producer focused approach to a consumer targeted approach [8]-[9]. The supply of products become more competitive when it is supply based on end users demand [10]-[11].

Studies have demonstrated that seed quality alone contributes about 15–20 percent to total agricultural production [12] which is projected higher 20-30 percent in seed vision 2013 in Nepal [13]. In spite of this fact more than 88 percent of maize growers use farm saved seeds [14] for which quality and variety is uncertain this is due to either unavailability of improved variety quality seed or are not willing to pay for that. The availability of improved variety quality based on farmers need and preferred attributes is most important, generally improved varieties have focused more on raising yields under optimal, agronomically well-managed conditions [15] and farmers either perceive little advantage in growing them because they are not designed for their needs [16].

Support for the promotion of seed market has been prioritized by government of Nepal in recent agriculture development strategy and seed vision [17]-[13]. There are twenty maize varieties developed by national agriculture council and more than thirty hybrid varieties registered and being marketed in Nepal [18]. Marketing research and promotional activities for hybrid varieties mostly carried out by concerned companies but in case of public sector open pollinated improved maize varieties promotional efforts and market research is absent. It is not enough for public sector agencies to develop new varieties, run seed multiplication program but need to focus on marketing to increase coverage of such varieties and get return on research investment. Without proper marketing strategy, mechanism and understanding farmers behavior developed varieties remain underutilized. An open pollinated are good enough to achieve desired output and well adapted to the areas for which they are recommended and can be recycled, which is a big advantage for the farmer. In spite of these advantages poor adoption of such varieties is because of missing adequate knowledge of the farmer's willingness to pay (WTP) for such varieties, seed enterprises involved in multiplication and marketing fail to pursue a pricing strategy suitable to maize growers to establish stable market independent of public sector subsidy. Furthermore availability of the farmers preferred attributes in the promoted variety and pricing within the radius of their willingness and capacity to pay are the key drivers for adoption rate of such varieties. The increasing market price of improved and hybrid variety maize seed without understanding the farmer willingness to pay has degraded competitiveness of the maize production by small holders.

The seed replacement rate (SRR) is largely dependent on farmer WTP and their capacity to pay for improved variety quality seed available in the market. The question is why do farmers are not willing to pay for improved variety quality seed, which needs to be answered. Availability of information on that helps public sector agencies to set the seed price subsidy regime to reach farming population and get national goal of food security and self-sufficiency.

Currently information and studies on farmer valuation of current improved variety maize benefits, their attributes, willingness to pay for seed, types of services they are willing to pay for are very scanty in Nepal. This study has attempted to provide some insights into this direction and also help to form a basis for pricing strategy by the seed enterprises, determine seed subsidy regimes by the public sector policy makers.

1.1. *Maize Seed Market and Farmers Accessibility*

In Nepal maize is grown in 28 percent of cultivated area which is 0.87 million ha and second staple crop after paddy, the area coverage for hills is higher i.e. 78 percent [17]. The annual production of maize is 2.15 million metric tons during 2015. In spite of government efforts to increase maize production and growing demand of maize in the market, the annual growth rate of maize in terms of area production and productivity is 0.7 percent, 3 percent and 2 percent which is very low.

In Nepal seed marketing system is categorized into formal supplies led by private, public, cooperative and community seed enterprises and informal through exchange and recycled seed by growers themselves. It is difficult to determine the effective demand size of the maize seed however estimations based on import, domestic production and distribution can be made. The total requirement for maize seed is about 17900 metric tons/ year but annul domestic seed supply is about 13 percent from domestic production [17] and 8-10 percent from imported hybrid maize seed, this makes total supply of 21-23 percent of total requirement [19]-[20]. The 79 percent of farmers use farm saved seed some literature's reported it up to 88 percent [14]. The domestic supply is of open pollinated varieties and distributed under different subsidy regimes thus it is not real market demand. The estimated effective market demand is less than 15 percent of total seed requirement. This shows the estimated demand of improved maize seed in the country is about 4000 metric tons including unrecorded import through porous Nepal and India border [17]. Thus large number of maize growers do not renew their seed stock for long time due to price and physical inaccessibility or unable to trace preferred attributes in available varieties. The amount of seed that enters in the market is not known, but the area sown with improved seed, including hybrids from India that are grown mainly in the Terai and seed of improved varieties that have been recycled for one or more seasons, is estimated to be between 54 percent and 58 percent [21]-[22].

Annual compounded growth rate of improved maize seed production over 13 year's period (2000 to 2012) is estimated to be 34.36 percent. This growth rate has significant contribution to increase SRR from 5.81 percent in 2007 to 9.5 percent in 2011 [23]. Outside the domestic seed production large quantity of hybrid maize seed enters in the domestic market which has created more competitive seed market for non-hybrid maize seed producers in the market. The annual import of hybrid maize seed ranges

from 1579 to 3149 metric tons during 2009 to 2015 with initial decline and constant trend. The entry price of the imported maize increased seven fold during the period, the market price increased fivefold in the market. This shows market price is increasing exponentially for hybrid seed [17]. The import of hybrid maize seed do not follow any trend but it is about constant at 8 percent during 2013 to 2015. The availability of improved variety and hybrid maize seed is limited to accessible areas and in the remote areas it is only available when distributed through public sector programs.

Table 1. Hybrid maize seed import.

Year	Quantity Metric tons	Value Million (NRs)	Price /kg	Retail price	Coverage ha
2009	1579	30	19	80	78956.1 (9 percent)
2010	9632	172	18	100	481616 (55 percent)
2011	2792	192	69	150	139619 (15 percent)
2012	3150	158	50	180	157492 (18 percent)
2013	1369	199	145	200	68439.8 (8 percent)
2014	1413	211	149	225	70629.3 (8 percent)
2015	1317	155	118	300	65847 (7.5 percent)

Source: export and import data and field survey.

Table 2. Volume and transaction in study sites non hybrid varieties.

Year	Purchase		Sale	
	Volume	Rate/Kg	Volume	Rate/kg
2010	22	24	20	30
2011	35	24	32	32
2012	45	28	40	45
2013	55	30	50	50
2014	60	32	55	50
2015	65	32	60	50

Source: CBSP Dadeldhura, Field survey.

1.2. *Farmers Willingness to pay and its Determinants*

In this study WTP is considered as maximum amount a person is willing to pay or sacrifice in order to receive a good. The theoretical basis of WTP is equivalent to the compensating variation (CV) measure. The CV is a measure of how much a consumers income needs to increase or decrease in order to keep utility constant in the case of a price change of goods, a change in product quality or if new products are introduced. Farmer's willingness to pay and their satisfaction regarding any agriculture innovations and services carry important bearing on agriculture development of the country at the time when availability free services and innovations are limited by different factors. Experiences in a number of locations around the world demonstrated that inefficiencies in resource allocation are unavoidable if a service such as extension is provided free of charge to stakeholders who might be able or willing to contribute in order to obtain appropriate service [24]-[25]-26]-[27]-[28]. Similar is the case for seed subsidy where farmers are willing to pay for improved variety quality seed just create inefficiency and market distortion. Thus shifting policies and programs from free agriculture innovation and services to market based approaches or vice versa it is necessary to analyze determinants of farmer's willingness to pay for them. Commercialization of extension services is only possible if farmers are willing to pay for these services and where extension services have previously been provided free of charge, assessment should be made to understand commercial demand for agricultural information [29]. While studying individual's willingness to pay for quality water supply found family size is important determinants [30]. Age and education level of household head, family size, credit utilization, total annual income and rain-fed agriculture productivity are the important factors that determine farmer willingness to pay for irrigation water [31]. Household income and connection charges to the alternative source are the two determinant of household willingness to pay for improved water services and private investment in the provision of potable water is recommended [32]. While studying the farmers willingness to pay for extension service large number of farmers are willing to pay for the extension services if the service can satisfy their needs, they can pay even a lot depending on the improvement on their farm income and five variables namely listening to the radio/mass media, farm size, household income, age of household head and family size contribute significantly to their WTP [33]. Consistent with consumer theory, higher the preference for the variety and its attributes, the higher is the willingness to pay for seed [34]. Similar results were obtained in India, where analysis of demand for agricultural services revealed a higher WTP among better educated farmers [35]-[36]. Varietal yield has served as a defining factor for promoting a new variety for official release, high yield was not a significant determinant of farmer WTP for new rice varieties in West Africa [37]. Estimation of WTP at the household level has both theoretical and empirical implications, because farm investment decisions depend on consumption as well as production parameters [38].

Farmers both in drought prone and submergence prone areas are generally willing to pay a significant premium for a reduction in yield variability offered by new rice varieties [39]. Gender, non-farm income, farmland size, farming

experience, land acquisition means, market access, trust and agro-ecological conditions significantly contribute in farmer's participation in crop intensification program [40]. Farmers decision to purchase seed potato is influenced by supplier farmer relationship based on satisfaction, trust and long term commitment [41]. Fertilizer is main input for agriculture production, and farm size, food security status and radio ownership are important determinant for farmers willingness to pay for fertilizer [42]. The willingness to pay for improved forage seed is positively and significantly determined by on-farm income, land holding, total livestock, access to credit, family size and contact with extension agents while initial bid prices, off-farm income, distance to all weather roads and input supplier institutions had negative and significant effects [43]. Reference [44] studied consumers' willingness to pay for organic products in Kathmandu valley and concluded agricultural technologies is a function of demographic, socio-economic and market characteristics such as accessibility and prices affect purchase behavior and ultimately farmers' willingness to pay. Socio-economic characteristics such as age, sex and income also shape a consumer's willingness to pay.

Generally perceived difference between products is translated into WTP thus fundamental thing is farmers perceive difference or not among varieties, once difference is perceived and valued willingness to pay is determined. The most important determinants of growth of seed market is growth of effective demand of seed by the farmers and viability of such growth further need demand and supply side balance, i.e. demand side ask for higher quality with preferred attribute, capacity and willingness to pay for that whereas supply side need the level of willingness to pay enough to cover the cost and generate enough benefit to attract the seed suppliers. The farmer's acceptance is also most important for the seed market, this needs exploration on how do the farmers perceive difference on improved variety quality seed and locally farm saved seed and if they perceive positively how much additional premium they are willing to pay for such positive perception. Identification of the varietal attributes for which farmers are willing to pay premium price and promotion of such attributed varieties in seed production and marketing is important to grow seed market.

In some communities of Southern Africa apart from yield related traits, farmers frequently mentioned early maturing varieties, hard endosperm (flint) types and good husk cover for the maize varieties they would prefer [45]. A study conducted in the Guinea savannas of Nigeria also indicated diff erence by farmers in their preferred choice of maize varieties. For example, farmers from the relatively market-driven production systems in the communities of Borno State, preferred the early maturing and high-yielding drought-tolerant varieties [46]. Low adoption of hybrids and improved open pollinated varieties in the area was attributed mainly to the high cost of seed and inputs, and that the modern varieties lacked the traits the farmers preferred mainly taste, and tolerance to acid soils and low nitrogen that are a problem in the area. One key and significant observation was that the farmers still preferred high yielding varieties and were thus willing to grow hybrids, but only if their preferred traits were incorporated [47].

II. Objective of the Study

In general the objective of this study is to identify the farmers' preferred attributes of the improved variety maize seed and determinants of willingness to pay for such attributes in the western mid hills of Nepal. The specific objectives are as follows:

- To assess the farmers preferred attributes in maize seed varieties;
- To estimate the farmers willingness to pay for improved new maize varieties and evaluate different premiums that they are willing to pay; and
- To identify the factors affecting farmers' willingness to pay for the attributes.

III. Methodology

The data used in the study were collected from four mid hill districts of western Nepal namely Dadeldhura, Doti, Dailekh and Surkhet during November to March 2015. The four districts were selected purposively to capture the mid hill farming system. For the questionnaire survey 200 maize growing farmers fifty from each selected district were selected randomly. The respondent farmers for questionnaire survey were selected by getting information on maize growing clusters and familiar with currently available improved maize varieties provided under extension activities. Four focus group discussions and key informants survey were conducted to get explanatory information on cropping patterns and farmers preferred attributes for improved variety maize seeds. Focus groups discussion involved farmer's seed processers, and retailors to capture maize seed demand supply and farmer's preferences.

Farmer's willingness to pay for crop insurance in Malaysia was analyzed by using contingent valuation method and logistic regression model, and found age, farm size and price are significantly contributing factors to WTP. [48]. Reference [49] used field experiment and bidding auction method to determine the farmer's willingness to pay for improved variety quality bean seed in Tanzania. Becker-DeGroot-Marschak (BDM) method used to elicit information on how much cowpea farmers are willing to pay for certified, quality declared seed and recycled seeds based on their perceived/observed differences in their performance in Burkina Faso [50].

This study used direct survey of customer preference within stated technique of WTP estimation while revealed preference approach is found costly and time consuming. In this method respondents (e.g., selected customers) were asked to state how much they would be willing to pay for stated products [51]. One of the first applications of direct surveys was a psychologically motivated method for estimating WTP developed by Stoetzel [52]. Stoetzel's idea was that there is a maximum and minimum price for each product which can be elicited by directly asking the

customers. Studies based on this idea consist of the following two questions formulated by Marbeau [53].

1. Above which price would you definitely not buy the product, because you can't afford it or because you didn't think it was worth the money?
2. Below which price would you say you would not buy the product because you would start to suspect the quality?

Under direct survey contingent valuation method (CVM) was used to determine the farmers willingness to pay for improved variety maize quality seed with modification of above two questions. In CVM four types of survey are used namely open ended questionnaire survey, payment card, biding game and dichotomous choice. In this study five price bands were used to know the farmers willingness to pay for improved variety maize quality seed. The respondent farmer was asked to know the date of access to improved variety quality seed with high level of your preferred attributes and amount paid for such seed and their response was noted. Five options were given to them - NRs 25, 50, 100, 150, 200 per kg in which first one is nearly half of the cost of production of per kg improved variety quality seed by a processer, second one is whole seller price at the point of production and others are projected one through focus group discussion. The highest band of NRs 200/kg is upper band after which farmers are not willing to pay. This is quite similar to payment card method and respondents were well explained about the attributes of the varieties and they were familiar with these varieties.

The farmers preferred attributes in varieties were categorized in plant height (high, medium, low), plant cycle (short, medium, long), grain size (flat, round), grain color (yellow, white), milling (easy, difficult), production in marginal fertility (low, medium, high), nutrient absorption (high, low, medium), and post crop ploughing (easy, difficult). These are the attributes generally farmers seek in varieties.

Empirical Model and Analysis

In this study tobit model used to identify the determinants of willingness to pay (WTP) per kg of improved variety maize seed by the individual farmer. Strata 12 software was used for this analysis.

The contingent valuation method that is stated preference for given product which is cost effective and time efficient and mostly used in literature used to collect data on individual WTP for improved variety quality maize seed. In WTP estimation literatures, three models OLS, Probit and Tobit used to estimate WTP, probit is mostly used in conjoint analysis. The Tobit model has an advantage over other discrete models like linear probability model, logistic and Probit. Tobit model revealed both the probability of WTP and its maximum WTP by the respondent when data are based on contingent valuation method [31].

The coefficient values estimated using Tobit analysis may differ substantially from those estimated using OLS. In addition, the direction of this difference in coefficient values is not consistent. Since Tobit analysis is the more theoretically correct method for willingness-to-pay (WTP). Tobit also allows decomposition of the data set to examine more closely the effects of the independent variables on current non-zero WTP [54]. When the model's dependent variable is censored, least squares estimation yields biased and inconsistent parameter estimates [55]. The maximum likelihood estimation techniques of Tobit analysis provide unbiased and consistent parameter estimates, and also allow inclusion of more information than logit or probit techniques [56]. With this ground and CVM survey design Tobit model is used for WTP estimation.

Tobit model can be defined based on Maddala [55] and Johnston and Dindaro [57] as follows.

$$MWTP = \beta + \beta' X_i + \varepsilon_i$$

Where:

MWTP = Maximum willingness to pay by each farmers for 1 kg of imrpoved variety maize seed.

$X_i = Vector\ of\ factors\ affecting\ WTP.$

$\beta' = Vector\ of\ unkown\ parameters.$

$\varepsilon_i = Error\ term\ that\ are\ independently\ and\ normally.$

$Distributed\ with\ mean\ zero\ and\ common\ variance\ \delta^2$

The threshold value in above equation is 25 and 200, the threshold value can be assumed to be any known or unknown value [58]. This model is censored regression as observations are censored.

IV. Result and Discussion

1.1. *Agro Ecology and Cropping Pattern*

Western Nepal lies on marginal agro ecological zone with shorter monsoon as it start from east, move toward west and recedes earlier. There is sporadic winter rain in west than in east due to western air. Western Nepal comprises from tropical flat land, river basins, subtropical terrains and alpine himalayan range endowing wide range of cropping patterns, agro biodiversity and farming systems. These cropping patterns and farming systems evolved in given conditions, carry narrow resilience and inherit diverse crop varieties to fit the niche environment. In lower high hills and mid hills the crop duration is short, best fit two crops so longer duration rainy season crops are not preferred. In the river basins farmers grow short duration maize varieties as summer crop. The soil fertility is generally poor and farm operation are mostly manually operated and animal power used for traction. Hilly area of the region cover a range of agro-ecological zones within which agricultural production is determined by a combination of altitude (400-3500 m), rainfall (1500-5000 mm, per annum) and aspect of the topography [59]. In recent years there is the breakdown of the traditional linkages between forest, livestock, and cropping systems and adversely affecting fertility. Livestock numbers have decreased, free grazing in forest is contained due to expansion of community forests, new high yielding varieties are introduced and labor availability has declined [59]. Increased connectivity through road transportation and external markets has exposed farmers to modern varieties of different crops and production inputs and technology. This nexus of crop production system largely shape farmer's behavior regarding adoption of new crop varieties and their willingness to pay for that.

Table 3. Agro ecology and Cropping Pattern in study region

Agro ecology	Winter season	Summer season	Rainy season
High hills (> 1600 MSL	wheat/mustard/ garden peas/lentil /fallow	fallow	maize/soybean/ millet/upland paddy
Mid hill slopes (1000-1600 MSL)	wheat/mustard/ garden peas/lentil /fallow	fallow	maize/soybean/millet /uplandpaddy /irrigated paddy
River basins (< 1000 MSL)	wheat/mustard/ garden peas/lentil	short duration maize	Irrigated paddy/maize

1.2. *General Characteristic Sample Population*

Farm households in the study area are headed by aged (48 years), poorly educated (7th grade) and males (84 percent) which is general characteristic of farming population in Nepal. Women headed household are common in ethnic areas where society is matriarchal. The average family size is about 5.96 person out of which 66 percent are economically active, 56 percent of which contribute in farming. Only 40 percent of economically active members fully work for farming as their main occupation. This shows out of six members of household two members stay as farmers and others are part time worker in farming or seasonal migrants. The farming occupation in study area is largely carried out by above forty age group which indicates farming is in hands of ageing population. The average annual household income among sample population is NRs 379795.0 out of which only 26 percent is contributed by gross farm income. This shows farming is marginal occupation in terms of its contribution to annual gross household income. Gross agriculture income per Ropni is NRs 10665.0 and NRs 30065 per farm worker when we divide gross farm income to dedicated member for farming it is about NRs 62958. This income level from farming is very low to retain youths in farming against flow to non-agriculture sector. Average cultivated land per household is nearly half hectare in which 16 percent allocated for rice, 38 percent for maize, 21 percent for soybean and 11 percent for cash crops. The largest area is dedicated to maize which shows maize as major crop for study area followed by soybean, rice and cash crops.

The road and market connectivity is almost good in study area within half an hour farmer can reach at road head and within one hour can reach nearest market. Institutional participation is high as 80 percent of sample household are members in groups and cooperatives however only 54 percent have contact with extension worker. Market information is key for profitable farming but only 48 percent are aware about market information. Local FM and telephone service is major source of such information.

Table 4. Socio economic characteristics of sample population.

Characteristics	Mean	Standard Deviation	Minimum	Maximum
Male headed household (percent)	0.84	0.39		
Education household head (grade)	7.18	3.83	0.00	14.00
Age of household head (years)	47.86	10.64	23.00	72.00
Family size (Number)	5.96	1.88	2.00	13.00
Economically active member (Number)	3.98	1.47	1.00	9.00
Available farm worker (Number)	3.34	1.42	1.00	8.00
Full time farming (Number)	1.60	1.35	0.00	5.00
Availability of agriculture training (percent)	0.52	0.50	0.00	1.00
Annual off farm income (NRs)	279377.74	197095.14	0.00	1246001.00
Annual Gross farm income (NRs)	100418.06	41635.02	33712.50	240900.00
Annual total income (NRs)	379795.80	204163.62	33712.50	1363026.00
Land holding (Ropni)	10.37	4.43	2.00	25.00
Cultivated area (Ropani)	9.42	4.23	2.00	25.00
Parcels (No)	2.86	1.28	0.00	6.00
Size of the parcel (Ropni)	3.45	1.49	0.00	12.00
Rice area (Ropni)	1.59	1.76	0.00	10.00
Maize area (Ropni)	3.59	3.02	0.00	14.00
Soybean area (Ropni)	2.00	2.68	0.00	10.00
Cash crops (Ropni)	1.12	1.80	0.00	8.00
Membership in group/cooperatives (percent)	0.79	0.41	0.00	1.00
Having contact with extension worker (percent)	0.54	0.50	0.00	1.00
Livestock head (Number)	5.47	3.85	0.00	21.00
Distance from road head (hr)	0.50	0.26	0.10	1.50
Nearest market distance (hr)	0.85	0.40	0.10	3.00
Availability market price information (percent)	0.48	0.50	0.00	1.00

1.3. *Variables and Definition*

Seven variables based on literature review and survey data, were selected for the Tobit model used to identify the determinants of farmers willingness to pay for improved variety maize quality seed. Six variables hypothesized positive contribution in WTP and one with negative.

Table 5. Variables and definition.

Independent Variable	Definition and measurement	Mean	SD	Hypothesized sign
AFW	Availability of farm worker (Number)	3.34	1.42	+
EDLHH	Educational level in Grade	7.18	3.83	+
TRNGYN	Training Received or not (yes , no)	0.52	0.50	+
FARMSIZE	Cultivated area (Ropani)	9.42	4.23	+
DISTANT	Distance to market/road head (hr)	0.50	0.26	-
CONTEXT	Contact with extension workers (yes, no)	0.54	0.50	+
AMPINFO	Market price information available (yes, no)	0.48	0.50	+

1.4. *General Production Aspects and uses of Maize*

Generally maize is grown in mid hills unirrigated slopes as rainfed crop in rainy season and spring crop in irrigated low lying flat land and river basins where three crops per year can be grown. In rainfed hill slopes basically maize is grown as mixed crop with soybean in marginally fertile land and sole crop in fertile land. Bullock power is main source for ploughing as mountain slopes hardly permit use of tilling machines and all intercultural operations are carried out manually. In study area maize is planted in April-May and harvested in September and immediately they plant wheat to capture residual soil moisture in mountain slopes after cessation of monsoon.

1.5. *Types of attributes for which Farmers Willing to Pay*

Maize growing farmers in study area has specific preferred attributes in maize variety. The attribute preference is based on food habit, cropping pattern, agro ecological condition, soil fertility, farm operations and accessibility to market. Following are the main attributes and farmers perception against these.

Grain Color:

Maize is main staple crop in study area however with increased road connectivity and access to external rice and wheat, people are attracted toward rice based food habit. Maize is generally used for bread and dhido for which they prefer white color, they perceive white color as better taste. In this back ground 70 percent of household in study area prefer white color maize varieties, yellow maize including quality protein maize are not so popular. Although yellow maize has better market price and sellability as it is basic raw material of poultry feed industries, growers mid hills still prefer white one due to food habit. Thus additional production of white maize in mid hills not connected with poultry feed industry and low sellability.

Stalk and Height:

This attribute of maize varieties generally correlated with maize grain yield, thick stalk and height supposed to produce more yield. 72 percent of farmers in the study area prefer thin stalk and medium height varieties. As per farmers perception medium height thin stalk varieties are less prone to lodging, less soil exhausting, easy to plough due to medium root system. Summer and early rainy season is windy and lodging is major problem among maize growers, basically thick stalk, strong deep root systems varieties are less prone to lodging, but they have trade off high nutrient uptake and difficulty in ploughing. In such trade off they prefer to thin stalk which medium varieties use high planting density to resist lodging.

Yield:

64 percent of farmers in the study area prefer high yielding varieties however mean yield is not only their focused attribute and most of the farmer do not obtain said yield under their growing conditions, and yield stability and other attributes are important for them. This finding is similar to [60] while studying the drought tolerance maize variety farmers focused yield stability and other attributes under different moisture conditions.

Shading Effect:

75 percent of farmers prefer maize varieties with low shading effect, this is because, generally they follow mixed cropping with soybean and other legumes, large foliage varieties even though produce higher yield reduce soybean yield. In recent years with road connectivity and market accessibility soybean price is increasing and considered as cash crop by the study area farmers.

Duration:

74 percent of farmers prefer medium duration variety, long duration varieties do not fit their wheat based cropping pattern in unirrigated condition and same time early varieties are more damaged by birds and wild animals. Early varieties only preferred in irrigated areas as spring crop. The study area lies in mid hill slopes so spring maize is not common.

Nutrient Uptake:

88 percent of farmers prefer medium nutrient uptake attribute in their preferred variety. Farmer in the study area operate in marginally fertile land and partially use chemical fertilizers. They perceive chemical fertilizers are also expensive in the area and continuous use of such fertilizers in upland terraces reduces soil fertility and ultimately production. Same time use of chemical fertilizers reduces production of grain legumes which are integral part of their farming system. Use of chemical fertilizer basically urea also reduce soybean yield which is important cash crop in the area.

Product Price:

Generally farmers in the study area are not sensitive to market price still 88 percent of farmers prefer the varieties having high market price. It is contrary to their low adoption of yellow varieties which carry high market price and sellability.

Table 6. Types of attributes for which farmers willing to pay.

S. No.	Attribute area	Attributes	Percentage preferring farmers
1.	Grain Color	White	70
		Yellow	30
2.	Stalk height and lodging	Thin stalk and medium height	72
		Thick stalk and more height	28
3.	Yield	Medium	36
		High	64
4.	Shading effect	High	25
		Low	75
5.	Duration	Long	15
		Short	11
		Medium	74
6.	Nutrient uptake	High	12
		Medium	88
7.	Product price	High	90
		Medium	10

1.6. *Farmers Preferential Ranking on Attribute*

The Preferential score of different attributes of importance are listed in table 7 five point Likert scale was used for the measurement. One as highly important to five uncared or important but not cared during seed purchase. Grain color, stalk height and lodging, yield and duration are equally high importance attributes for the farmers. Shading effect, nutrient uptake and product price are moderately important attributes for farmers however during discussion farmers nearby road head and production objective is to sell consider product price in the market is very important attribute. Thus significance of attributes changing with markets and production objective in recent years among farming population.

Table 7. Preferential ranking of different attributes.

S. No.	Attribute area	Preferential ranking
1.	Grain Color	4.2
2.	Stalk height and lodging	3.9
3.	Yield	4.5
4.	Shading effect	3.2
5.	Duration	4.1
6.	Nutrient uptake	3.3
7.	Product price	3.5

1.7. *Farmers Satisfaction with available Varieties*

Farmers were asked to rank their level of satisfaction with currently available non hybrid improved varieties in 1-5 point scale, highly satisfied, moderately satisfied, satisfied, moderately unsatisfied and unsatisfied (1 for unsatisfied , 2 for moderately unsatisfied, 3 moderately satisfied, 4 for satisfied and 5 for highly satisfied) and their responses were analyzed. Five available varieties were considered for the survey. Farmers are found more satisfied with Mankamana -3, 1 and Deuti variety but their reservation is with regard to difficulty in removal of grain from cob, milling, ploughing, long duration. Inspite of such limitations high yield and good taste are attribute that has led farmers' satisfaction. Satisfaction toward Rampur composite and Arun -2 is average but spring and winter maize growers though not popular in study area, are more satisfied with these varieties because of short duration maturity.

Table 8. Different varieties and farmers level of satisfaction.

S. No.	Variety	Farmer level of satisfaction
1.	Mankamana -3 (white)	4.1
2.	Mankamana-1 (white)	3.5
3.	Deuti (white)	3.9
4.	Ram pur composite (yellow)	3.2
5.	Arun 2 (yellow)	3.3
6.	Sitala	2.5
7.	Posilo	2.3

1.8. *Farmers Willingness to pay for Improved Variety Quality Seed*

Farmers willingness to pay is measured with five options of price bands which is based on contingent valuation theory. Farmers in the area mostly use their farm saved improved variety seed and such seed is replaced with government supported programs. Small number of farmers purchase hybrid seed from nearby agro vets. Twenty three percent of farmers are willing to pay only NRs 25/kg which is nearly half of the cost of processed seed production (Table 9). This is because they do not find difference between improved variety quality and farm saved seed but they do not have capacity to pay and regularly use farm saved seeds. This segment of maize growers replace maize seed either when government subsidized improved variety seed kits are available or exchange with neighbors.

International Journal of Agriculture Innovations and Research
Volume 7, Issue 2, ISSN (Online) 2319-1473

Table 9: Price band and farmers willingness to pay

Parameters	WTP band NRs/kg				
	25	50	100	150	200
WTP as percentage of grain price/kg	114	227	455	682	909
WTP as percentage of cost of production of processed seed/kg	54	108	217	326	435
WTP as percentage of factory gate price of processed seed/kg	50	100	200	300	400
WTP as percentage of retail price /kg	41	83	166	250	333
WTP as percentage of hybrid maize seed price /kg	8	16	33	50	66

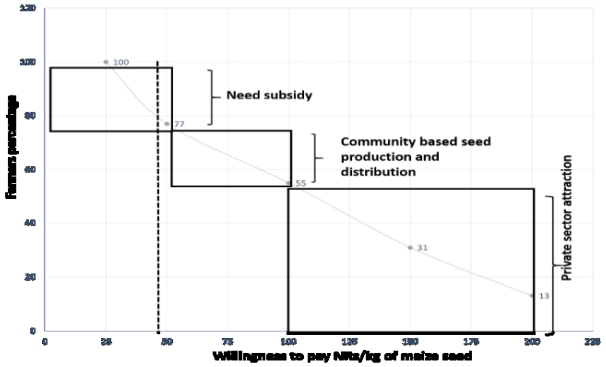

Fig. 1. Farmers WTP for improved variety maize seed.

There is NRs 45.9/ kg processed seed production cost at industry gate, in such case these farmers cannot be reached with private sector seed production and distribution mechanism. Twenty two percent of farmers willing to pay NRs 50/kg which is industry outlet price and they are also limited by low capacity to pay. Their tendency is similar to first category of growers but they can by seed from community based seed production and distribution enterprise like coopratives. Twenty four percent of farmers willing to pay NRs 100/kg, 18 percent farmers willing to pay NRs 150/kg and only 13 percent of farmers willing to pay NRs 200/kg these are upper segment of maize growers willing to pay and have capacity to pay for maize seed available in the market. This indicates smaller segment of farmers willing to pay market based higher price band among maize growing population (Figure 1). Private sector need sufficient profit margin and sales volume to operate sustainably in seed business which is NRs 100 /kg and above price band, this is about 55 percent of growers. The hybrid maize seed price is in the market is up to 300 per kg, in this case hybrid maize seed price is so high large segment of farmers are not willing to pay that much in the study area.

In community based seed production and distribution mechanism, community organizations can work under nominal profit i.e. they can sell in NRs 50/kg to their member clients but they also need support for processing and storage infrastructure development. This can cover 45 percent farmers and there is need of seed production, processing and price subsidy to bring these growers under improved variety maize cultivation. The 55 percent farmers who are willing to pay NRs 100/kg or more can be reached with proper seed supply and extension mechanism in the area through private sector involvement.

1.9. *Determinants of Farmers Willingness to pay*

Seven variables hypothesized during review were included in the econometric analysis and tobit model used to identify the effect of explanatory variables for farmers willingness to pay for improved variety maize quality seed.

Availability of Farm Worker:

Family members are main source of farm labor which is less available in the area due to outmigration of males. The coefficient of this variable has negative but significant effect on willingness to pay for improved variety quality maize seed. This is contrary to hypothesized positive effect, the households having higher number of family farm labor may go for more labor intensive and profitable cash crop production and they are less willing to pay for improved variety quality maize seed as maize is comparatively less profitable.

Education Level of the Household Head:

The education level of the household head expected to have positive effect on WTP for improved variety maize quality seed. The educated individual can analyze the benefits of improved variety quality seed, seek information by different sources to make decision. The regression coefficient shows the positive and significant effect of education level (grade). This indicates farming population with educated household heads can pay higher in comparison to poorly educated households. The one grade increase in education level of household head there is 1.47 unit increase in WTP for improved variety quality maize seed. This shows seed business is more profitable and sustainable in educated farming communities.

Training on Agriculture:

Agriculture trainings on improved farming practices increase awareness and build confidence for adoption of new innovations among farming population. With this ground it was hypothesized that individuals exposed to agriculture training and listened about the innovation are willing to pay more for the innovation. The regression model showed significant positive coefficient for willingness to pay. There is 1.97 point increase in WTP when farmers are trained in modern farming.

Cultivated Area:

The cultivated area is hypothesized as positive effect on WTP and regression showed that it has positive and significant effect. For one unit increase in cultivated area of the individual household there is 8.217 point increase in WTP of the individual for improved variety maize quality seed.

Distance to Nearest Market:

Generally it was hypothesized that increased distance from market decrease farmer willingness to pay which is found correct in the regression coefficient. Maize growers residing far from road head are less willing to pay for improved variety quality seed.

Contact with Extension Worker:

Increased contact with extension worker provides detailed information about innovation, its benefit, risk and

limitations that provides basis for farmers decision making. It was hypothesized contact with extension worker increases farmers willingness to pay for maize seed and result has shown there is significant positive effect on WTP. There is 12.66 point increase in WTP of individuals when there is contact with extension worker.

Availability of Product Price Information:

Farmers produce maize either for home consumption or selling purpose, generally in recent years most of the growers connected with road transportation produce for selling purpose. With this it was hypothesized that availability of maize price information in the market have positive effect on WTP for maize seed and regression result has shown it is true. There is significant positive effect of availability maize price information in the market in WTP for maize of individual farmer. There is 13.077 point increase in WTP for individual farmers for improved variety maize quality seed when there is availability of market price information to the farmers

Table 10. Tobit estimates and beta value.

Variables	Coefficient	Std. Error	Standardized coefficients
Constant	-40.846	22.018	-3.644
Education level of household head (Grade)	2.006**	1.141	1.479
Availability of farm worker (No)	-1.620*	3.025	-0.854
Training Received or not (yes, no)	4.576***	8.894	1.956
Cultivated area (Ropni)	10.898***	1.077	8.217
Distance to market/road head (hr)	-5.765***	16.961	-4.112
Contact with extension workers (yes, no)	-13.40***	16.961	12.662
Market price information available (yes, no)	13.087 ***	8.654	13.077
Number of observations 200, 46 left-censored observations at WTP primi~_kg < = 25, 154 uncensored observations, 0 right-censored observations. LR chi2(7) = 98.00, Prob > chi2 = 0.0000, Log likelihood = -877.74951			

***, **, * significant at 1, 5, and 10 percent levels

V. Conclusion and Recommendation

In western mid hills of Nepal one third of household members who are mostly above forty age group work for farming and farming only contribute 26 percent of annual gross household income. Thus low land and labor productivity are two main characteristics of farming in the region. Among rainy season crops maize occupies 38 percent area and making it first important crop followed by rice and soybean among farming population. Most of the farmers use farm saved recycled seed for crop production. Farmers of western mid hills prefer maize varieties with attributes like white grain color, medium nutrient uptake, less shading effect, medium maturity duration, thin stalk with average height and comparatively high but stable yield pattern that fit in their rainfed wheat based cropping patterns. These preferred attributes carry both synergistic effect and trade off among them, however most of the varieties developed by public sector research system ranked satisfactory level by the maize growers. The white grain color, high yield and medium duration are three most prioritized attributes by the maize growers.

Maize growers in western mid hills are found willing to pay higher price for the maize seed provided with preferred attributes but still 45 percent unable to pay market price. The tobit model result has shown that positively contributing factors for farmers willingness to pay for improved variety quality maize seed are, contact with extension worker, closer to road head, farm size, education level of household head, availability of market price information of the product and training on agriculture. Implementation of the activities to enhance farmer's willingness to pay like increased frequency of extension agent visits, marketing agent visits, farmers training, educated youth engagement in farming, road connectivity in remote areas and dissemination of output price information to promote improved variety seed market can easily promote maize seed market in western mid hills. Public sector maize research system in Nepal has developed number of open pollinated improved varieties and made them available for seed production and distribution system but the market size of such varieties and private sector attraction in this business is very low. The development of new improved varieties of maize is not enough to reap the benefits of such varieties, get return on investment but also need aggressive marketing strategy with private sector involvement and proper support mechanism. Now a days seed is marketed as private proprietary good like other consumer products in the market and popularization of any variety seed, demand wider understanding of grower's behavior, satisfaction, marketing strategy within different streams of seed value chain. WTP analysis has shown that there is still need of nonprofit community based seed production and distribution system and same time price subsidy to reach maize growers with improved variety quality maize seed in remote areas with low level of education, sporadic extension contacts and untrained in modern agriculture production system.

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