

Site Selection Report of Farmer-led Participatory Maize Breeding Programme for the Middle Hills of Nepal.

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1. Introduction

Maize (*Zea mays* L.) is the second most important crop after rice in Nepal. Maize is grown largely on *bari*¹ land during summer, usually relayed with millet or beans. It is also grown as sole crop at lower altitude (below 1000 m asl) and higher altitude (above 1600 m asl). Maize is also grown in *khet*² land at altitudes below 1000 m asl during spring season. Maize cultivation occupies nearly 0.8 million hectares (almost 30% of the total cultivated area) and 80% of this is under terraced hill farming, producing over 1.3 millions tones per annum (MoA, 1995). The productivity of maize is quite low (about 1.7 tones/hectare), which is reflected by high incidence of food deficit households in the hills of Nepal. A number of factors appears to be in play for the low productivity of maize in the middle hills of Nepal. These include rainfed farming and uncertainty of rainfall, poor access to chemical fertilizers and declining compost application, and lack of varietal options and access to improved genetic materials suitable to the local conditions. In areas where improved maize varieties have been introduced, farmers tend to grow the same seed for a number of years without replacing it or practicing standard selection procedures. As a result, these varieties rapidly deteriorate due to genetic contamination with poorer landraces and/or due to improper selection pressures.

Maize is the most important cereal crop for farmers living in complex, diverse and risky environments of Nepalese mountain. Farmers' existing maize varieties of Palpa and Gulmi districts are the products of continuous seed selection carried out by farmers, consciously or unconsciously, over many generations. In spite of a large choice for recommended modern high yielding variety of maize, farmers continue to search for better varieties to suit specific growing conditions and to satisfy their specific preferences depending on their food culture. Palpa and Gulmi farmers maintain a number of maize varieties³ primarily through seed selection, in which women farmers play important role. Likewise, they contribute in keeping the local seed flow systems alive by exchanging seeds among neighbours, and friends and relatives within and outside the village. Married women have been reported to carry seeds of good maize varieties back and forth between their parental and in-law's house. Such practices have also contributed in maintaining and strengthening local seed supply systems. The access for new sources of maize germplasm in the traditional seed supply system, that closely match to farmer-preferred traits⁴, is limited. As a result, improving existing landraces using local crop development approach has been either very slow or non-existent in majority of areas in the mid-hills of Nepal.

It is interesting to note that farmers who have adopted modern varieties of maize do not discard their landraces altogether. On the contrary, modern varieties are transformed from uniform populations to highly heterogeneous ones through farmers' own management practices. The occasional introduction of exotic/modern varieties has helped to increase or maintain productivity of landraces their contribution to the local gene pool. *Kaude*, reported to be a good yielder, is a landrace with mixed grain coloured cob (xenia effect) and has developed as a result of random mating. This process can be termed as a farmer-led breeding. The question is then whether the morpho-phenological and preferred traits diversity of landraces can be enhanced through the introduction of both improved and landraces utilizing farmers (both male and female) expertise and strengthening local seed supply system or not? To address this question, LI-BIRD has formulated a project on farmer-led participatory maize breeding with the financial assistance from System Wide Programme for Participatory Research and

¹ Rainfed fields (not banded) commonly associated with farm forestry

² Banded land where at least one crop of rice is cultivated

³ *Thulo Pinyalo* (Large yellow), *Sanu Pinyalo* (small yellow), *Kaude* (mixed), *Rato makai* (red maize), *Thulo Seto* (large white), *Sanu seto* (small white), *Sathiya* (early maturing pop corn) and *Bikase makai* (introduced modern variety) are commonly reported landraces in Gulmi Arghakhanchi (Subedi et al., 1998; Sthapit et al., 1997).

⁴ Preferred trait survey carried out in 16 villages of Gulmi resulted several groups of ideotypes; grain and fodder yield, aato (grit) recovery, taste for various cuisine, grain colour, non-lodging and maturity are most commonly cited preferred traits (Subedi et al., 1998; Kadayat et al., 1997).

Gender Analysis (SWP-PR/GA) at International Center for Tropical Agriculture (CIAT). The main objectives of the project are to:

- Develop maize variety suitable for the specific niches of Gulmi and Palpa districts,
- Test the participatory approach in improving open-pollinated crops,
- Strengthen farmers' breeding and informal seed supply system.

In this context, a survey using PRA methodologies was conducted in Palpa, Gulmi and Arghakhanchi districts to select suitable sites to implement the project activities. The report presents findings of this study.

1.1 Rationale:

The project proposes implementation of its research activities in one or two sites of Palpa and Gulmi districts (800-1200 m asl) in Western Development Region of Nepal, where maize is a most important parts of the livelihood strategies. A majority of villages in these districts is remotely located and few have access to dry weather roads in winter. The impact of formal research system in these areas is meagre and there is a large scope for the improvement of maize productivity through strengthening farmers' breeding. The underlying rationale for selecting Gulmi and Arghakhanchi districts for the project are:

- Farmer participation in research will be spontaneous as research problems address their immediate need
- Approach provides access to new sources of variation (in last 10 years only 16 tonnes seed distributed for 58,000 ha maize area)
- Impact of research is potentially large
- Combines farmers knowledge with researcher new technology to solidify sustainable partnership
- Opportunity to evaluate farmer-led breeding in solid manner as intervention from previous research and development inputs are minimal

2. Methodology:

2.1 A process led approach

The following processes were followed during the site selection:

- Review of existing literature and analysis of secondary information to identify a list of potential villages.
- Consultation with various organizations, institutions, and individuals.
- Reconnaissance survey by a small team of experts.
- In-house meeting and discussion among team members for further planning.
- Site selection trip by a multi-disciplinary group from different partner organization in order to conduct Rapid Rural Appraisal (RRA).
- Analysis of the information collected and matrix ranking of potential villages against important criteria.
- Site selection and delineation of geographic boundary of the site on the basis on the basis of group discussion and reaching consensus based on quantitative information and direct observation.

After a series of brain storming session, following parameters were agreed as criteria for the site selection:

1. Highest contribution of maize in the livelihood strategy.
2. Mid hill agro-ecological zone.
3. High proportion of *bari* land.
4. Low varietal intervention/ widespread use of local landraces.
5. Low seed replacement rate.
6. Low productivity of existing maize varieties.
7. Farming as a main occupation of the majority of the people in the village.
8. Diversity in aspects of the landscape.
9. Diversity in ethnicity.
10. 4-5 hours walk from the main road.
11. High interest of the community.

Reconnaissance survey was done in extensive area of Palpa, Gulmi, and Arghakhanchi districts from 18-27 December 1998. A total of 28 villages were visited and surveyed rapidly. Out of these, six villages were identified as potential sites for the project. The sort listing of the surveyed villages was done based on the parameters 1, 2, 3, 8, and 10 mentioned above. A site selection survey to these selected villages was then done by a multidisciplinary team comprising Plant Breeders, Outreach Agronomists, Socio-economist/ Gender Specialist, Extension expert, Research assistants, farmers and local leaders from 10 to 17 January 1999 and 14 to 22 February 1999 (Annex-I). The team visited the sort listed 6 villages to conduct PRA, and for field observation and discussion with farmers. A checklist was used to collect the required information (Annex-II).

2.2 Indicators

Following indicators were used to confirm the major selection criteria:

- Contribution of maize in livelihood strategy
- Domain
- Proportion of khet/bari
- Level of varietal intervention
- Seed replacement rate
- Productivity of existing maize varieties
- Main occupation of the majority of the people in the village
- Physiographic diversity
- Ethnic diversity
- Accessibility

Matrix ranking of visited sites has been done against the criteria set for the site selection.

3. Findings of the site selection survey:

3.1 Agro-ecological settings of study villages

The surveyed villages were situated between 83°13.35 to 83°13.35 East longitudes, and 27°52.85 to 28°03.42 N North latitudes. The altitude ranged from 1240m to 1720m asl. Two villages are situated near to all season road-head while others are situated far from the road head. However, all the villages are near to mud road (1 to 2 hour walk from the mud road head) which remains closed during peak monsoon (June to September) period (Table 1).

Table 1. Description of the surveyed villages of Palpa, Gulmi, and Arghakhanchi districts, 1999.

Parameters	Sites					
	Digam, Gulmi	D-Devisthan, Gulmi	Simichaur, Gulmi	Chaun bari, Palpa	Banjha, Palpa	Kaule Bhaga, Arghakhanchi
VDC	Digam	D-Devisthan	Simichaur	Tansen	Bandipokhara	Bhagawati
District	Gulmi	Gulmi	Gulmi	Palpa	Palpa	Arghakhanchi
Latitude	27°58.76 N	28°00.12 N	28°03.42 N		27°52.85 N	28°02.03 N
Longitude	83°21.74 E	83°19.93 E	83°14.77 E		83°13.35 E	83°13.35 E
Altitude (m)	1240	1460	1500	1280	1340	1720
No. of H/holds	100	1100	1200	110	150	96
Distance from all season road head (hr)	5	6.5	8.5	1	2	11
Willingness of the farmers	Very high	Very High	Very High	Very High	Very High	High

3.2 Area, aspect and land use system

Major proportion of the land area (67 to 100%) of the surveyed villages lies in middle hills (Table 2). The cultivated land is distributed in all aspects (Table 3). Some villages were lacking cultivable land in one or two aspects. However, all the surveyed villages lack the flat land, except Kaule village of Arghakhanchi district. The surveyed villages of Palpa districts has higher percentage of irrigated land (20 to 25 %) compared to Gulmi and Arghakhanchi districts, where the area of khet land is less than 5 percent (Table 4). The proportion of area of the village under share cropping was studied. Only less than 5% of the total cultivable land was on share cropping. Insufficient family labour has been reported to be the reason for share cropping. Which indicates that agriculture is the main occupation of the village people.

The area comprised unbunded, untterraced, sloppy hills and is characterized by low rainfall leading to acute moisture stress particularly during the winter. Winter crop is grown with the expectation of winter shower during January. Some years the winter crop fails completely due to lack of winter rain. The rain water quickly runs off to down stream from the untterraced sloppy hills leading to very low leaching and deposition in local aquifers. And, moisture availability to the plant roots through capillary movement is not possible where aquifers are present far away in the deep gorge. Such type of situation prevails in the east Palpa, Gulmi, Arghakhanchi districts extending towards Pyuthan and further west.

Table 2. Area of surveyed villages under different domains, 1999.

Domain	Percentage land area					
	Digam, Gulmi	D-Devisthan, Gulmi	Simichaur, Gulmi	Chaun bari, Palpa	Banjha, Palpa	Kaule, Arghakhanchi
Low hill (600-1000m)	-	33	-	-	25	-
Mid hill (1000-1500m)	100	67	90	100	75	100
High hill (>1500m)	-	-	10	-	-	-

Table 3. Area of surveyed villages under different aspects, 1999.

Aspect	Percentage land area					
	Digam, Gulmi	D-Devisthan, Gulmi	Simichaur, Gulmi	Chaun bari, Palpa	Banjha, Palpa	Kaule, Arghakhanchi
East	-	30	12	50	5	28
West	B	45	50	-	65	19
North	A	10	28	-	20	Negligible
South	C	15	10	50	10	15
Flat land	-	-	-	-	-	38

Table 4. Area of surveyed villages under different land type, 1999.

Land type	Percentage land area					
	Digam, Gulmi	D-Devisthan, Gulmi	Simichaur, Gulmi	Chaun bari, Palpa	Banjha, Palpa	Kaule, Arghakhanchi
<i>Khet</i> land	-	5	3	20	25	Negligible
<i>Bari</i> land	100	95	97	80	75	100

3.3 Ethnic composition

Brahmins and Chhetris were the dominant group across the surveyed site (Table 5). Newar, Magar and KDS⁵ were found in minority with few households of Gurung and Yogi. Ethnic variation was higher in Darbar-Devisthan and Simichaur compared to other villages.

Table 5. Ethnic composition of surveyed villages, 1999.

Ethnic groups	Percentage households					
	Digam, Gulmi	D-Devisthan, Gulmi	Simichaur, Gulmi	Chaun bari, Palpa	Banjha, Palpa	Kaule, Arghakhanchi
Brahmin	95	20	75	10	1	94
Chhetri	-	60	-	90	74	-
Newar	-	5	-	-	-	-
Magar	-	5	22	-	25	-
KDS	5	10	3	-	-	6

3.4 Role of different crops in livelihood strategy

Maize is the most important crop across the surveyed villages (Table 6). Lack of khet lands, irrigation facility, and prevalence of sloppy hills are the reason for growing almost only maize during the summer season. Summer legume, viz. rice bean, bean, soybean, horse gram is inter-cropped under maize. There is no tradition of cultivating maize during winter and spring season primarily due low temperature and soil moisture. Wheat and oilseed are important winter season crops of the region. Rice is important crop in Palpa districts, where the proportion of khet land is relatively higher than in other surveyed area. Ginger is increasingly becoming popular as a cash crop among the farmers. It is grown in association with maize.

The exercise on ranking of crops was conducted with the reason to understand the contribution of maize in the livelihood strategy of farmers. It was intended to launch the programme where the maize

⁵ Occupational castes, *Kami*, *Damai* and *Sarki*

contributes significantly to their livelihood strategy. It is important in order to ensure that benefit from the project output could reach to large chunk of the village population with increased rate.

Table 6. Importance of different crops in livelihood strategy of surveyed villages, 1999.

Crops grown	Importance (Rank)					
	Digam, Gulmi	D-Devisthan, Gulmi	Simichaur, Gulmi	Chaun bari, Palpa	Banjha, Palpa	Kaule, Arghakhanchi
Maize	1	1	1	1	1	1
Rice		7	6	2	3	
Wheat	5	3	2	5	2	2
Fingermillet		2	5	3	4	
Barley	7					3
Buckwheat		4	4			
Oilseed	2	5	3	4	5	4
Ginger	3					
Sugarcane	4					
Legume	6	6	7	6	6	5

3.5 Situation of maize

Thulo Pinyalo was the most popular varieties in the area (Table 7). Level of varietal diversity is mainly dictated by the diversity in growing condition and use. The variety is chosen on the basis of fertility status of soil, as *Thulo Pinyalo* and *Thulo Seto* are grown in fertile land, while *Sano Pinyalo* and *Sano Seto* are grown in medium soil and *Kaude* in marginal soil. Farmers reported that different varieties are adapted to different niches, and thus one variety is less likely to replace the other variety. So varietal comparison based just on the yield performance and without considering the growing situation does not make sense.

Most of the sites were found to grow three or more varieties. Major proportion of land was under local landrace or out cross of HYV. Most of the HYVs were introduced before 5 years or more (Table 8). Heavy in-flow of genes from local landraces to these HYV have resulted a highly heterogenous hybrid leading to development of different gene pool having wide genetic base. Farmer's conscious/unconscious selection in such hybrid has resulted in the development of varieties suitable for that particular growing condition. Adaptability of such hybrid increased during the course of time. Though the new gene pool is different than the original HYV, farmers use to recognize the gene pool with the same old name.

Table 7. Varietal diversity of maize in surveyed villages, 1999.

Varieties grown	Area coverage by different varieties (Rank)					
	Digam, Gulmi	D-Devisthan, Gulmi	Simichaur, Gulmi	Chaun bari, Palpa	Banjha, Palpa	Kaule, Arghakhanchi
<i>Thulo Pinyalo</i>		1 (80%)	1 (80%)	2 (2%)	3 (5%)	*
<i>Sano Pinyalo</i>		2 (15%)	2 (10%)			*
<i>Thulo Seto</i>			Negligible			*
<i>SanoSeto</i>			3 (6%)			*
<i>Amrikane</i>		Negligible				
<i>Thorgeli</i>	3					

<i>Pinyalo</i>					
<i>Kaude</i>					*
Khumal Yellow	1		4 (3%)		1 (85%)
Manakamana-1	4	3 (5%)	5 (1%)	1 (98%)	2 (10%)
Rampur	2				
Composite					

Note: * = grown but rank could not estimate

Table 8. History of introduction of High Yielding Varieties (HYVs) of maize in surveyed villages, 1999.

Varieties grown	Time of introduction (years before)					
	Digam, Gulmi	D-Devisthan, Gulmi	Simichaur, Gulmi	Chaun bari, Palpa	Banjha, Palpa	Kaule, Arghakhanchi
Khumal Yellow	14	-	20	-	12	NR
Manakamana-1	11	10	5	15	6	NR
Rampur Composite	10	-	-	-	-	NR

The area under HYV as reported by the farmers has been presented in Table 9. In this case also farmers considered the outcross as HYV. In fact all the HYV has undergone for at least five recurrent crosses with local landraces. The adoption of HYV was found to be influenced by access. Villages of Palpa district, which are relatively more accessible than other villages, reported to have more area under HYV.

Table 9. Proportion of total maize area under improved varieties in surveyed villages, 1999.

Locations	Area under HYV (%)
Digam, Gulmi	60
D-Devisthan, Gulmi	5
Simichaur, Gulmi	<5
Chaun bari, Palpa	98
Banjha, Palpa	85 (covered by outcross of HYV)
Kaule, Arghakhanchi	Negligible

Characteristics of some important local landraces

A total of six different varieties have been reported by the farmers in the surveyed villages. Brief characteristics of these varieties perceived by the farmers have been presented below:

- *Thulo Pinyalo*: Literary meaning Large Yellow. Out cross of more than one HYV, good fodder yield, soft and palatable husk and fodder liked by livestock, good taste in all recipe, very tall, semi-dent to flint grain, high grit recovery, low insect infestation, light to dark orange yellow grain, cob size- thin and slender to broad and short, 2 ears/plant, good yield even under no fertilizer condition. Yield is very unstable depending upon the intensity of lodging. Produce highest grain yield if not lodged. Yield reduction is severe in case of lodging. Low yield in marginal area and lodging are the two major traits not liked by the farmers.
- *Thulo Seto*: Literary meaning Large White. White grained variety, very similar to *Thulo Pinyalo*, however due to following reasons the variety is less popular among the farmers and consequently area under this variety is decreasing;

- more lodging
 - more insect infestation/problem
 - more rotting in the case of lodging
 - low *aanto* (grit) and more *pitho* (flour) recovery
- *Thorgeli Pinyalo*: Literary meaning 'yellow variety from *Thorga* (name of the village)'. This is the same *Thulo Pinyalo*, however it is called as *Thorgeli Pinyalo* in *Digam* village, and it's vicinity.
 - *Sano Seto*: Literary meaning Small White. Also known as *Barmeli*. Early maturing, resistant to lodging, performs well in marginal areas, no barrenness, good taste, good for maize/millet system. Low yield- small cob, low fodder yield- short stature, and low grit- high flour recovery have been considered as the bad characteristics of this variety.
 - *Sano Pinyalo*: Literary meaning Small Yellow. Similar to *Sano Seto* except yellow grain colour.
 - *Amrikane*: Literary meaning variety from USA. Good yield, high fodder yield (good for livestock owner), inferior taste in all recipe so beneficial to sell, can be grown only in fertile land, taller than *Thulo Pinyalo*- more lodging problem.
 - *Kaude*: Literary meaning mixed grain colour. *Kaude* is in fact not a variety. When an ear appears with mixed and spotted grains, it is called *Kaude*. The *Kaude* is due to the presence of red and/or blue coloured grains present in an ear.

3.6 Varietal traits of interest

Varietal performance for the trait of interest was discussed with farmers in order to understand farmers' need and varietal strength/ weakness in particular trait. This exercise was important in order to develop need/ problem based breeding programme. In this process, desirable and undesirable characteristics of both local and recommended improved varieties were collected.

Farmers of all the surveyed village (except *Banjha*) perceived that good taste, high yield potential and high fodder yield are the major desirable characters in local variety, while lodging is the most important undesirable character (Table 10). The farmers of *Banjha* were more concerned and worried about the lodging problem of local variety and were reluctant to report the good characters. It seems that farmers expressed their view, considering the performance of *Thulo Pinyalo*, as this is the widely grown variety and the good or bad trait of this variety affect the farmers more than any other variety.

Table 10. Desirable and undesirable traits of local varieties of maize grown in surveyed villages, 1999.

Parameters	Percentage households					
	Digam, Gulmi	D-Devasthan, Gulmi	Simichaur, Gulmi	Chaun bari, Palpa	Banjha, Palpa	Kaule, Arghakhanchi
1. Desirable traits						
• High yield potential	*	*	*	*		*
• High fodder yield	*	*	*	*		*
• High flour recovery		*				
• Good taste	*	*	*	*		*
2. Undesirable traits						
• Lodging	*	*	*	*	*	*
• Head smut						*

Resistance to lodging due to thick stalk and strong/ stout plant has been perceived by the farmers of the surveyed villages as the most desired character in recommended improved variety (Table 11). And Low grain and fodder yield were the most undesired characters of improved maize varieties followed by inferior taste. The low fodder yield has been found to be associated with low height of improved maize compared to local varieties. Farmers of Banjha reported that all the improved varieties being grown in the village were introduced at least 6 years before, and now there is no difference between local and improved due to heavy and recurrent cross fertilization with local.

Table 11. Desirable and undesirable traits of improved varieties of maize grown in surveyed villages, 1999.

Parameters	Percentage households					
	Digam, Gulmi	D-Devisthan, Gulmi	Simichaur, Gulmi	Chaun bari, Palpa	Banjha, Palpa	Kaule, Arghakhanchi
1. Desirable traits						
Non- lodging/ thick stalk	*	*	*	*		
Early maturity	*					
Strong / stout plants			*			
2. Undesirable traits						
Lodging						*
Low yield	*	*	*	*		*
Low fodder yield	*	*	*	*		*
Inferior taste			*			*
More insect problem				*		

Farmers of the surveyed villages reported that high yield potential and resistant to lodging were the most preferred trait of maize followed by good taste and high stover yield (Table 12). Farmers perceived that the grain yield is very much associated with the extent of lodging. So they expressed that these two parameters are highly inter-related and act as synonym. Farmers of Darbar-Devisthan reported that problem of lodging is due to tall plant height, so they viewed short plant height as one of the most preferred trait of maize.

Table 12. Ranking of preferred traits of maize in surveyed villages, 1999.

Traits	Percentage households					
	Digam, Gulmi	D-Devisthan, Gulmi	Simichaur, Gulmi	Chaun bari, Palpa	Banjha, Palpa	Kaule, Arghakhanchi
Higher grain yield	1	2	2	1		1
Non-lodging	3	1	1	2		2
More stover yield	5	3	3	3		
Demands less soil fertility	6					
More <i>aanto</i> recovery		5	5			
Good taste	2	4	4			3
White grain colour				4		
Early maturity	4					
Short plant height		1				
Good husk cover				5		

3.7 Use of maize

Maize was considered very important in maintaining human and livestock life in the surveyed villages. Farmers reported that maize provides huge amount of dry matter for diverse uses. They start to use maize as green fodder just after a month of sowing by thinning the seedlings to adjust the plant density. After that they slice down the lower leaves around tasseling stage onwards to feed the livestock. Similarly the barren plants are removed and fed to the livestock. The dried plants provide serves as an important source of roughage during fodder scarce period of winter. After dehusking the ear, husk is again fed to the animals and after shelling the grain the cob serves as fuel wood. Grain is the most important produce. Out of total grain production, about 40-50% is used as livestock feed in the surveyed villages (Table 13). *Aanto*⁶, roasted green and roasted dry (pop) are the common methods of human consumption. *Aanto* is the staple food, and roasted green and roasted dry are the popular snacks. Out of the total human consumption around 75% is used as *Aanto*.

Table 13. Uses of maize grain in surveyed villages, 1999.

Uses	Amount used (Percentage)					
	Digam, Gulmi	D-Devasthan, Gulmi	Simichaur, Gulmi	Chaun bari, Palpa	Banjha, Palpa	Kaule, Arghakhanchi
1. Human food	NR	70	60	40	50	60
•Aanto (grit)	84	60	1 (rank)	30	40	40
•Roasted green	5	6	2 (rank)	5	5	15
•Roasted dry (Pop)	11	4	3 (rank)	5	5	5
2. Livestock feed	NR	30	40	60	50	40

Note: NR= Not Recorded.

3.8 Seed supply situation

Agricultural input supply system was very poor in the region. Very few private shops were being operated in the district headquarter, which deal with seed of mostly vegetable, insecticide and some fertilizers. Such private shop used to sell the product, which are available with the supplier not the commodity demanded by the farmers. The situation is even worse in rural areas, where even such market outlets are absent. So farmers were almost deprived from the access to improved seed and inputs. Some improved varieties being grown in the region were introduced in the form of Minikits⁷ by formal institutions like NARC (Nepal Agricultural Research Council) and Department of Agriculture of His Majesty's Government of Nepal (DOA/ HMGN). Farmers saved the seed of better performing varieties from experimental plot and continue to grow them. Time line indicates that the access of seed of new variety discontinued with cessation of Minikit programme around 6 years ago (Table 8). Farmers were found use the seed produced in their own farm, which was basically attributed to the lack of access to improved seed. Seed from neighbour's farm is also used only in case the seed of own farm is either not sufficient or destroyed by insects. Seed replacement is not a common practice in the region (Table 14). Farmers have been found to replace their seed with that of neighbour's seed if the crop performance in the neighbour's field is found superior than their own field. Farmers have been found to judge whether the difference in performance between is due to genetic or other factors. As it was reported that they replace the seed only if the difference in performance is due to genetic factor. Farmers were found to be able to isolate genetic contribution in crop performance with that agronomic and environmental contribution.

⁶ Thick porridge prepared from maize grit.

⁷ It is small seed kit of modern cultivars distributed free of cost by formal research system to assess the popularity of cultivars under farmers' management conditions. Term first coined by the late Bill Golden to introduce new varieties of rice in Philippines in the late 60's.

Table 14. Seed replacement rate of maize in surveyed villages, 1999.

Locations	Replacement rate (Years)
Digam, Gulmi	3-4
D-Devisthan, Gulmi	Very occasional
Simichaur, Gulmi	No distinct pattern
Chaun bari, Palpa	No distinct pattern
Banjha, Palpa	Very occasional
Kaule, Arghakhanchi	Very occasional

4. Research problem emerged

During the discussion a list of traits was prepared, which appeared to affect the farmers adversely (bad traits). Farmers of Darbar-Devisthan and Simichaur were asked to rank the listed bad traits considering the extent of problem due to that particular trait. Farmers of both the locations opined that lodging and low yield are the most important bad traits of local maize varieties. Farmers perceived that low yield of local varieties are primarily due to lodging (Table 15). This is one of the reasons for identifying lodging as a most important bad character of local variety and low yield as a second most important bad character in Simichaur. Problem of stem rot reported by the farmers of Simichaur was due to secondary infection in broken stem and torn leaf as a consequence of lodging. So farmers did not perceive the stem rot as a disease.

Table 15. Ranking of bad traits of local maize varieties in Darbar-Devisthan and Simichaur, Gulmi, 1999.

Traits	Locations	
	D-Devisthan, Gulmi	Simichaur, Gulmi
Lodging	1	1
Low grit/ high flour recovery	2	6
Low grain yield	1	2
Low fodder yield	2	5
Poor taste	2	
Hard stem (low palatability)	3	
Fertilizer requirement	3	
Hard husk (low palatability)	4	
Poor resistance against insect		3
Stem rot		4

Lodging problem has been appeared as the most important problem in local maize varieties across the surveyed villages (Table 10). This problem is high in *Thulo Pinyalo*, *Thulo Seto*, and *Amrikane* varieties compared to other varieties grown in the area. *Thulo Pinyalo* is the most popular variety of the region, which occupies as high as 80% of the maize area in some villages (Table 7). Farmers liked all of its traits. This variety has good taste in all recipe, good grain and fodder yield, the biomass, both green and dried, is very much liked by the livestock and it is easy to sell/ barter as it has bold/ flint grain with attractive grain colour. However, farmers faced lodging problem in this variety leading to as high as 85% production loss in worse season. Lodging problem is equally high in other local variety *Thulo Seto*, however the area under this variety is very low. So the lodging in *Thulo Seto* not considered as a major problem. Farmers' perception about the lodging problem in *Thulo Pinyalo* is presented below:

Lodging is the main reasons for the yield reduction in local variety particularly *Thulo Pinyalo*. Lodging in *Thulo Pinyalo* found to be due to one or more of the following reason:

- As this variety get lodged in response to high intensity of rain followed by wind during flowering stage of maize, which consequently reduces the grain yield. Very tall plant stature is the main reason for lodging under such situations. So *Thulo Pinyalo* produces more grain yield than HYVs in normal season and less in abnormal (rainy and windy) season.
- Tall stature is the main reason for lodging. Farmers reported as high as 27 leaves in one plant. In addition to tall plant height, lodging in the local variety found to increase due to luxurious growth in fertile land in addition to wind during flowering stage and/ or disease and insect attack in the stem
- According to farmers, they are facing substantial yield reduction even under mild wind blow, as very weak plants get lodged under such condition and fall upon other non-lodging plants. Which consequently drag them towards the soil surface and forces other non-lodging plants to lodge. This phenomenon occurs in cyclic order and may affect large area. This problem is severe particularly in *Thulo Pinyalo*, which is characterized by tall height and thin stem. In tall plants, ear height is also used to be more. There was no standing maize when the team visited the site, however after examining the harvested stover the team estimated the ear height to more than 2 meters. The weight of tassel and cob at such a height also might have helped thin stalked *Thulo Pinyalo* to lodge extensively even under mild wind pressure. So, variety having strong stem and root character could be the measure to alleviate lodging problem.
 - Lodging problem is severe in case of *Thulo Pinyalo* is due to tall stature. Yield loss due to lodging in this variety is up to 85%. The other varieties are shorter than this variety and accordingly lodging problem is also less in other varieties.
 - Lodging problem is more in lower elevation around the slopes of the hill than in higher elevation on the top of the hills.
 - Lodging problem is not encountered every year. However there is no distinct pattern of this problem. High wind pressure during the tasseling stage escalates the lodging problem.

After a considerable length of discussion, the group (Farmers, Plant Breeders, Agronomist, Socio-economist, Seed expert, Gender specialist, Extensionist, Research Assistants) realized that the widely adapted local variety *Thulo Pinyalo* is much superior than improved variety tested in the region. But lodging is the major problem in this variety leading to serious production losses. The problem is found to serious effect in food security of the region. So the group decided the breeding objective to be "**improvement of maize variety *Thulo Pinyalo* for disease resistance and high yield**".

5. Selection of research sites

The information collected was analyzed to identify the suitable sites for the project. The site selection was based on the selection criteria as mentioned in para 2.1 (Table 16). All the surveyed villages met the minimum criteria set for the site selection. However, ethnic diversity was higher in Darbar-Devisthan and Simichaur and there was widespread use of local landrace compared to other villages. Kaule was also good site with respect to all the criteria considered, however the community interest and commitment to the programme was reflected during the visit. Moreover, in Darbar-Devisthan and Simichaur, the village community was well organized, and interest and commitment of the community to the programme was well reflected during the visit. The site selection team also felt that Darbar-Devisthan and Simichaur are relatively accessible than Kaule during the crop season (June to September) when the mud road usually remains closed due to damages by monsoon rain. So the Site selection team came to a consensus to select Darbar-Devisthan and Simichaur as the research sites for this project.

Table 16. Matrix ranking of the surveyed villages, 1999.

Parameters	Sites					
	Digam, Gulmi	D- Devisthan, Gulmi	Simichaur, Gulmi	Chaunbari, Plapa	Banjha, Palpa	Kaule, Arghakhanchi
Highest contribution in livelihood strategy (Rank of Maize)	1	1	1	1	1	1
Mid hill (% area in mid hill)	100%	67%	90%	100%	75%	100%
Diversity in aspects of the landscape (No. of aspect)	3	4	4	2	4	5
High proportion of bari land (% area under bari land)	100%	95%	97%	80%	75%	100%
Farming as a main occupation (% HH)	100%	>95%	>99%	98%	100%	100%
Diversity in ethnicity (No. of ethnic cast in the village)	2	5	3	2	3	2
Low varietal intervention/ Widespread use of local landraces (No. of landrace present in the village)	1	3	4	1	1	5
Productivity – low due to inferior genetic materials (yes/No)	Yes	Yes	Yes	Yes	Yes	Yes
Seed replacement rate	3-4 years	V. occasional	V. occasional	V. occasional	V.occasional	V. occasional
Level of farmers interest	V. High	V. High	V. High	V. High	V. High	High
Access (distance from all season road head, hrs.)	5	6.5	8.5	1	2	11

6. Conclusion

Darbar-Devisthan and Simichaur has been selected as the research sites for this project.

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Annex-Ia:

**Farmer-led Maize Breeding Programme for the Middle hills of Nepal
Site Selection Programme**

1. Objective: To select site for PPB-SWP.

2. Participants:

- 1.1 Mr D Sharme - Outreach Agronomist, NMRP
- 1.2 Dr KB Koirala - Plant Breeder, NMRP
- 1.3 Mr CB Kunwar - Seed expert/ plant Breeder, NMRP
- 1.4 Mr T Shrestha - Extension Officer, DADO, Gulmi
- 1.5 Mr PK Shrestha - Socio-economist/ Gender Specialist, LI-BIRD
- 1.6 Mr BB Paudel - Community Organizer, LI-BIRD
- 1.7 Ms NK Khatri - Community Organizer, LI-BIRD
- 1.8 Mr M Subedi - Plant Breeder, LI-BIRD

3. Itinerary:

Date	From	To	Remarks
10 Jan 1999	Pokhara	Tansen	Travelling to Tansen and briefing about the programme
11 Jan 1999	Tansen	Bale Taksar	Visit Digam
12 Jan 1999	Bale Taksar	Tamghas	Visit Darbar Devasthan; Overview of Hunga, Jnhirbas+ Jugum
13 Jan 1999	Tamghas	Tamghas	Visit Simichaur
14 Jan 1999	Tamghas	Tansen	Travelling to Tansen and overview of Sirukharka.
15 Jan 1999	Tansen	Tansen	Visit Chaun bari and Sain tole; overview of Bhairabsthan
16 Jan 1999	Tansen	Tansen	Visit Pokharathok; wrap-up meeting
17 Jan 1999	Tansen	Pokhara	Travelling back to Rampur and Pokhara

4. Vehicle arrangement:

- Station wagon – To travel from Pokhara to Tansen on 10 Jan 1999.
- Station wagon – To assist in site selection in Palpa district from 14-16 Jan 1999 and to travel back to Pokhara on 17 Jan 1999 (Note: This date may change depending upon the progress of fieldwork).

Annex-Ib:

**Farmer-led Maize Breeding Programme for the Middle hills of Nepal
Site Selection Programme**

1. Objective:

- Select and establish sites for PPB-SWP.
- Organize village level workshop

2. Participants:

- 1.1 Mr D Sharme - Outreach Agronomist, NMRP
- 1.2 Mr T Rijal - Plant Breeder, NMRP
- 1.3 Mr PK Shrestha - Socio-economist/ Gender Specialist, LI-BIRD
- 1.4 Mr BB Paudel - Community Organizer, LI-BIRD
- 1.5 Ms NK Khatri - Community Organizer, LI-BIRD
- 1.6 Mr M Subedi - Plant Breeder, LI-BIRD

3. Itinerary:

Date	From	To	Remarks
14 Feb 1999	Pokhara	Tansen	Travelling to Tansen
15 Feb 1999	Tansen	Tamghas	Travelling to Tamghas
16 Feb 1999	Tamghas	Arghakhanchi	Visit Darjang
17 Feb 1999	Arghakhanchi	Arghakhanchi	Village level workshop at Darjang or Simichaur
18 Feb 1999	Arghakhanchi	Tamghas	Travelling to Tamghas
19 Feb 1999	Tamghas	Bale Taksar	Travelling to Darbar Devisthan
20 Feb 1999	Bale Taksar	Bale Taksar	Village level workshop at Darbar Devisthan
21 Feb 1999	Bale Taksar	Tansen	Travelling to Tansen
22 Feb 1999	Tansen	Pokhara	Travelling back to Rampur and Pokhara

Annex-II:
Farmer-led Participatory Maize Breeding for the Middle Hills of Nepal.
Site Selection Programme

Check-list

Name of the place:	Ward No.:
VDC:	District:
No. of households:	Altitude:
Latitude:	Longitude:

Distance from the road head (walking distance):hrs

Willingness of the farmers to participate in the programme:

A. General

1. Percentage area of the village in low and mid hill area.

Domain	% land area	Remarks
Low hill (600-1000 m)		
Mid hill (1000-1500 m)		
Overall		

2. Percentage area under different aspects of the village.

Aspect	% area	Remarks
East		
West		
North		
South		

3. Area under different land type.

Land type	% area	Remarks
<i>Khet</i> land		
<i>Bari</i> land		

4. a. Proportion of farmers under share cropping:%
 b. Reason for share cropping:%

5. Household distribution (%) of ethnic composition

Ethnic groups	% age households	Remarks
Brahmin		
Chhetri		
Newar		
Gurung		
Magar		
KDS		

6. Importance of different crops in livelihood strategy:

Crops grown	Importance (Rank)	Remarks
Rice		
Maize		
Wheat		
Fingermillet		
Barley		
buckwheat		
potato		

B. Situation of maize and production system

1. Uses of maize:

Uses	Proportion of consumer	Proportion used	Preferred varieties

2. Types of maize grown in the area

Production system	% area	Remarks
Summer maize		
Spring maize		
Winter maize		

3. Yield of maize varieties in different season

Varieties grown	Season	Rank	Productivity	Remarks

4. Proportion of total area under improved varieties:

5. Desirable and undesirable traits of the varieties grown:

5a. Local Varieties:

Desirable characters	Rank	Undesirable characters	Rank

5b. Improved Varieties:

Desirable characters	Rank	Undesirable characters	Rank

6. Ranking of preferred traits of maize:

Traits	Rank	Remarks
1. Higher grain yield		
2. Non-lodging		
3. Resistant to diseases		
4. More stover yield		
5. Demands less soil fertility		
6. More <i>aanto</i> recovery		
7. Good taste		
8. White grain colour		
9. Early maturity		
10. Short plant height		
11. Good husk cover		
12. Popping quality		

7. Source of maize seed:

Sources	% contribution	Remarks

8. History of introduction of HYV (Time line):

9. Seed replacement rate for:

- local variety: In every years
- improved variety: In every years

Annex-III: Matrix ranking

Parameters	Sites					
Highest contribution in livelihood strategy						
Mid hill						
Diversity in aspects of the landscape						
High proportion of bari land						
Farming as a main occupation						
Diversity in ethnicity						
Low varietal intervention/ Widespread use of local landraces						
Productivity – low due to inferior genetic materials						
Seed replacement rate						
Level of farmers interest						
Access to the road head (hrs.)						

