SURVEY FINDINGS ON MAIZE POSTHARVEST SYSTEM AND POSTHARVEST LOSSES IN CHUKHA, DAGANA AND MONGAR DZONGKHAGS AS PART OF FAO TCP MAIZE PROJECT (TCP/BHU/3603)

Food and Agriculture Organization of the United Nations

NPPC

National Plant Protection Centre
Department of Agriculture
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2018

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Email: nppcsemtokha@gmail.com
Website: www.nppc.gov.bt
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ACKNOWLEDGEMENT

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ACCRONYM

MoAF	Ministry of Agriculture and Forests
DoA	Department of Agriculture
FAO	Food and Agriculture Organization
BHU	Bhutan
TCP	Technical Cooperation Programme
NPPC	National Plant Protection Centre
NPHC	National Post-Harvest Centre
DAO	Dzongkhag Agriculture Officer
MT	Metric tons
RNR	Renewable Natural Resources
MC	Moisture Content
C	Consumption
AF	Animal feed
B	Brewing
TGM	Thousand Gram Mass
ToT	Training of Trainers
SGB	Super Grain Bags

INTRODUCTION

Maize is an important cereal crop for the rural population. In 2017, 94, 052 MT of maize was harvested from 66, 042 acres with an average yield of 1.42 MT per acre (Bhutan RNR Statistics 2017). In Bhutan, Maize crop is grown in dry land; some maize cultivation is practiced under shifting cultivation.The prevailing system of drying and storage of maize cause heavy losses both in terms of quantity and quality. Further, the harvesting period coincides with rains during the months of July/August that render improper drying and storage. As part of the FAO TCP project, asurvey was conducted by the National Plant Protection Centre (NPPC) and the National Postharvest Centre from (NPHC) from February to March in 2017 with assistance from Dzongkhag Agriculture Officers and Extension Agents (EAs) of the project sites.

The primary objective of the field survey was to ascertain the present status of the on-farm maize post-harvest system in order to determine the strengths and weaknesses and to identify the areas where 'Good Practices' have to be introduced that would significantly minimize both quantitative and qualitative losses occurring in maize during post-harvest operations. Another objective was to identify, document and quantify the losses that occur due to storage insect pests and mold to introduce effective integrated pest control techniques.

The report describes the survey findings in nine project Gewogs and, based on the findings, recommends "Systems Approach" and introducing goods practices, starting from harvesting that would significantly strengthen the management of maize storage at farmer household level in Bhutan

METHOD AND MATERIALS

1. Survey sites

The survey was conducted from February to March 2017 and was conducted by the team consisted of staffs from the National Plant Protection Centre and the National Postharvest Centre. The team was assisted by concerned Gewog Extension Agents and the village Tshogpas. The surveys were conducted in project sites which are indicated below:

Table 1: Dzongkhags and Gewogs where survey was conducted

Sl. No.	Project Dzongkhags	Project Gewogs
1.	Chukha	Bongo, Sampelling and Darla
2.	Dagana	Tsangkha, Kana and Karmalling
3.	Mongar	Thangrong, Silambi and Narang

2. Survey methodology, data collection and data analysis

The survey was conducted by interviewing farmers by introducing a structured questionnaire. The number of farmers were determined by using stratified random sampling method. A total of 232 farmers were interviewed in pilot Gewogs. Data collection were carried out on five topics which are:

- Area under maize cultivation; varieties grown; month of sowing and harvesting
- Farmers knowledge to determine maize harvest time
- Use of maize at household level
- Moisture content before storage and re-drying
- Common drying methods practiced
- Common storage structure
- Common post-harvest loss causes

Table 2: Number of respondents by Gewog

Sl. No.	Project Dzongkhags	Project Gewogs
1.	Chukha	Bongo (23), Sampelling (20) and Darla (27)
2.	Dagana	Tsangkha (19), Kana (44) and Karmalling (34)
3.	Mongar	Thangrong (22), Silambi (19) and Narang (24)

The survey data were analyzed using SPSS and Microsoft excel 2010

RESULTS:

DARLA, BONGO AND SAMPELLING GEWOGS, CHUKHA DZONGKHAG

1. Area under maize cultivation; varieties; sowing and harvesting month

The average area under maize cultivation in Bongo, Darla and Sampelling Gewogs are 1 acre, 0.6 acre and 0.7 acre respectively. The most prominent maize variety grown in all three Gewogs is local white variety (47.1% respondents) followed by Yangtsipa variety (27.1% respondents). Farmers in three Gewogs sow maize from February to March and harvest from July to August which coincides with the monsoon season.

Plate 1: Yangtsipa variety

Plate 2: White local variety

2. Farmer's knowledge to determine maize harvest time

The survey found that 30% of respondents harvest maize when the color of cob sheath turns white whereas 22.9 % of respondents harvest when leaves are dried and cob sheath turns white and 14.3 % respondents harvest when silks of ears have dried to a golden brown; leaves are dried and cob sheaths have turned white.

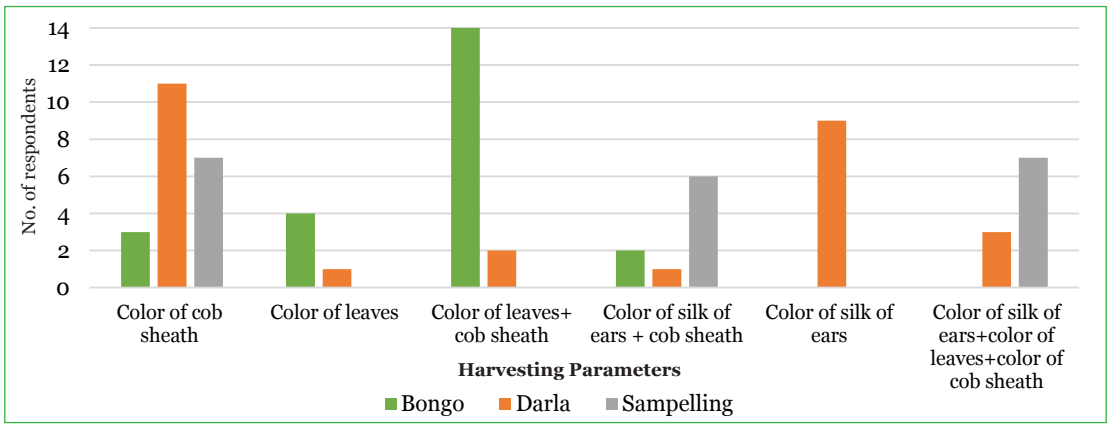

Figure 1: Farmers knowledge on harvesting parameters in Chukha

3. Use of maize at household level

The survey found that farmers use maize for various purposes. Farmers use maize for seed for next season, consumption, brewing alcohol, feeding animals and sale. As indicated in figure 2, 81.6% of the respondents uses maize for seed, consumption and feeding animals whereas 10 % respondents use for seed, consumption, feeding animals and brewing alcohol.

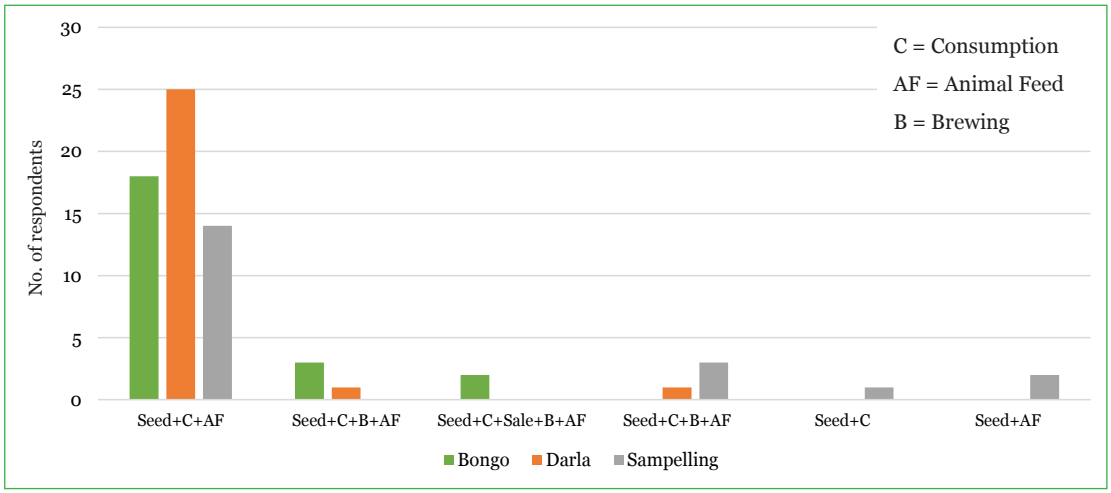

Figure 2: Use of maize in Chukha

4. Measure moisture content (MC) before storage; method of determination of MC and re-drying

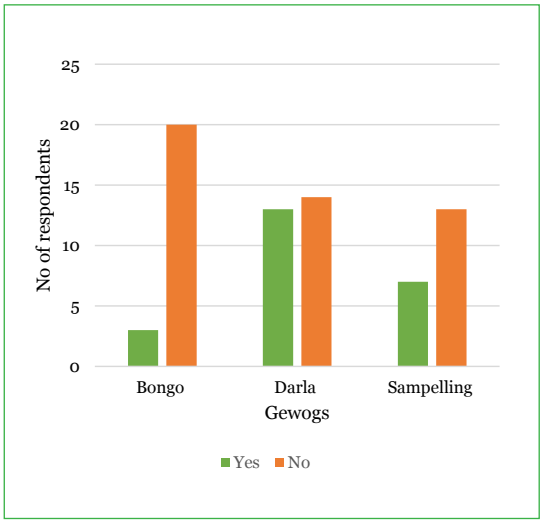

Figure 3a: Response to measuring of MC before storage

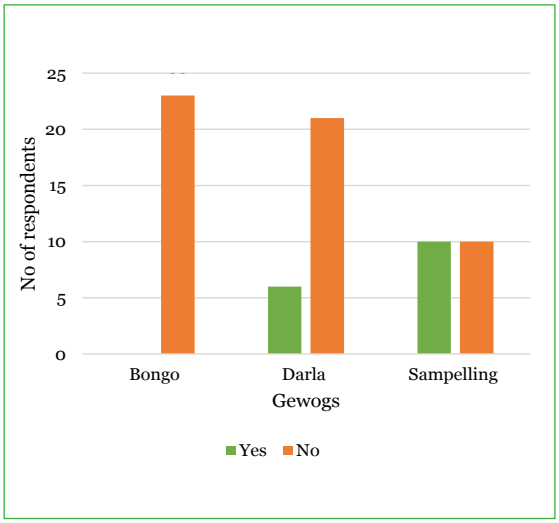

Figure 3b: Re-dying of maize in Chukha

The survey found out that approximately 40% of respondents measure moisture content of maize (Figure 3a) before storage by crunching and feeling grains with teeth or fingers.

5. Maize drying methods

The most common method of drying practiced was sun drying (22.9 % respondents).

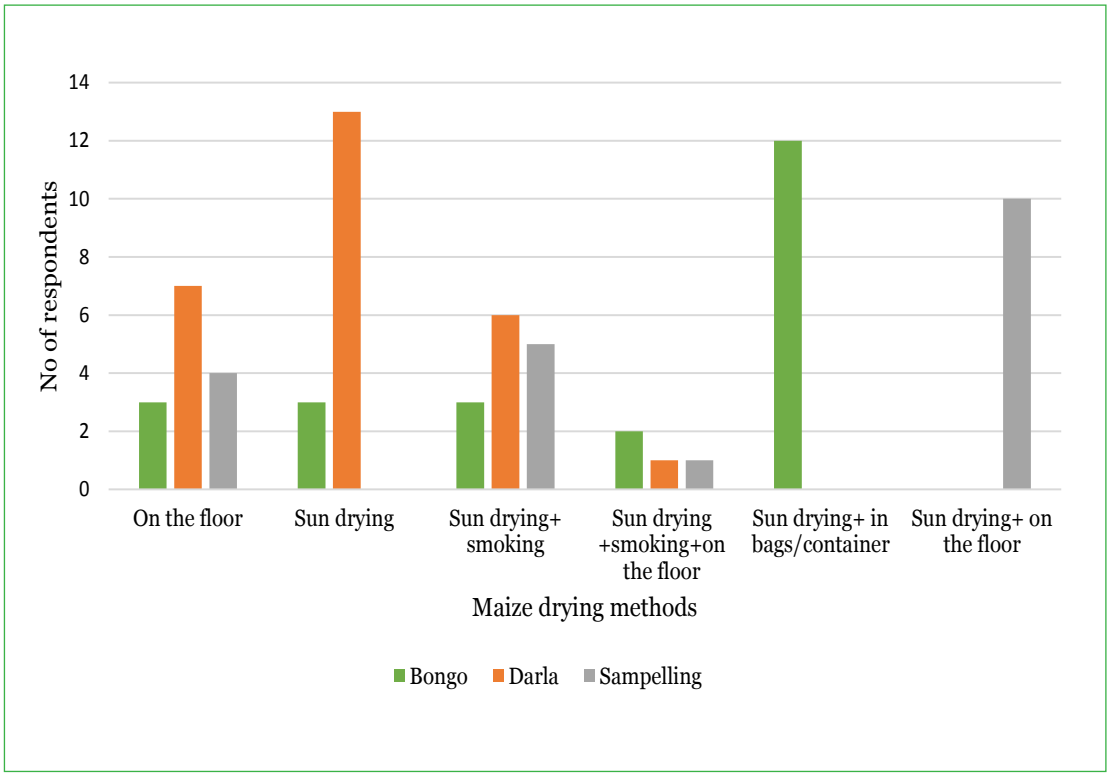

Figure 4: Maize drying methods in Chukha

6. Maize storage system

The most common storage system was hanging under roof and above the fireplace in the kitchen (70% respondents) followed by hanging under roof (12.9 % respondents) and storing in separate built structure (10% respondents).

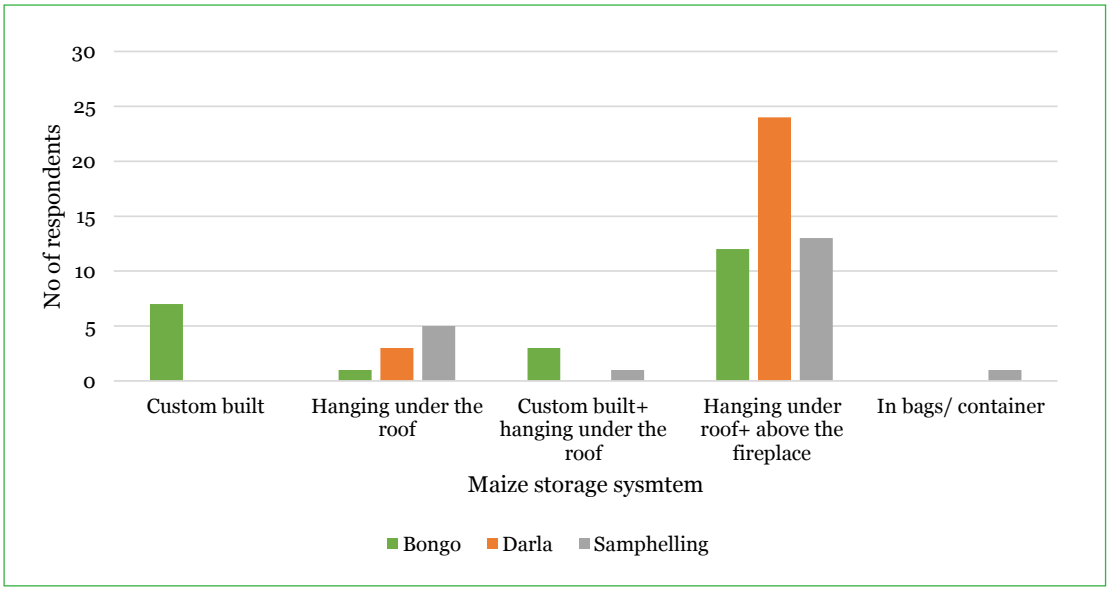

Figure 5: Maize storage structure in Chukha

Plate 3: Hanging maize cobs under the roof

7. Maize post-harvest losses

Among various causes, the main cause of post-harvest losses was due to the insects and rodents (37.1% respondents) followed by insects, mold and rodents combined (31.4% respondents) and by insects (15.7% respondents).

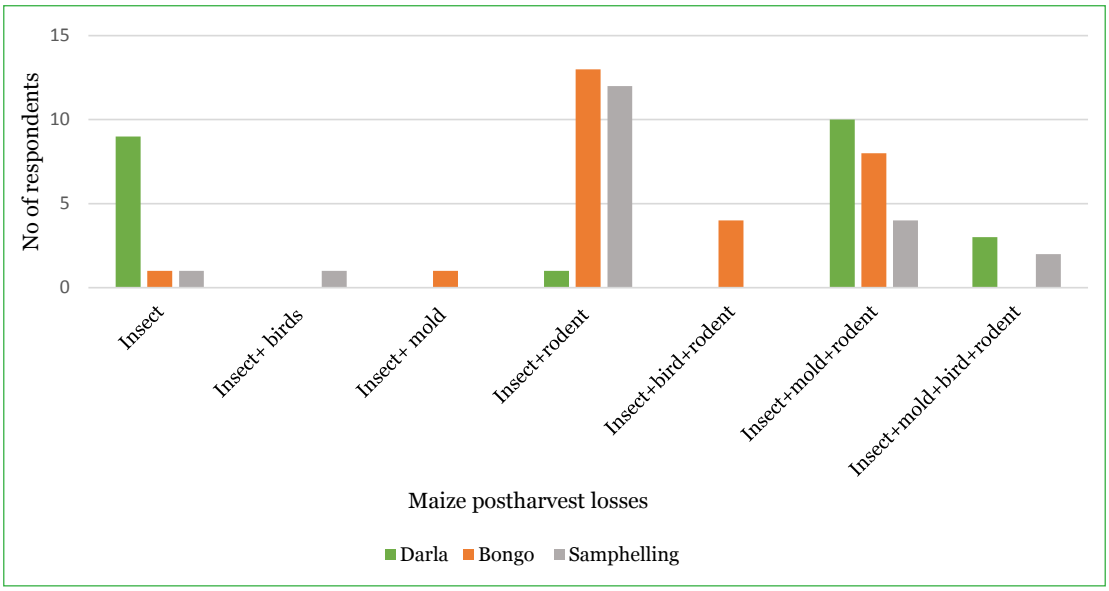

Figure 6: Casual agents of postharvest losses in maize in Chukha

Plate 4: Cobs infested by insects

RESULTS:

KANA, TSANGKHA AND KARMALLING GEWOG, DAGANA DZONGKHAG

1. Area under maize cultivation

The average area under maize cultivation in Kana, Tsangkha and Karmalling Gewogs are 1.9 acres, 2.9 acres and 2.2 acres respectively. 39.2% of the total respondents grow both the local white variety and Yangtsipa variety whereas 30.9% respondents grow only Yangtsipa and 29. 9% respondents grow only local white variety. All the farmers sow maize from February to March and harvest from July to August which coincides with the peak monsoon season.

2. Farmer's knowledge to determine maize harvest time

The survey found that 35.1% of the respondents harvest maize when the color of silk of ears have dried to a golden brown, cob sheaths have turned white and leaves are dried whereas 30.9% respondents harvest maize when the color of cob sheath have turned white.

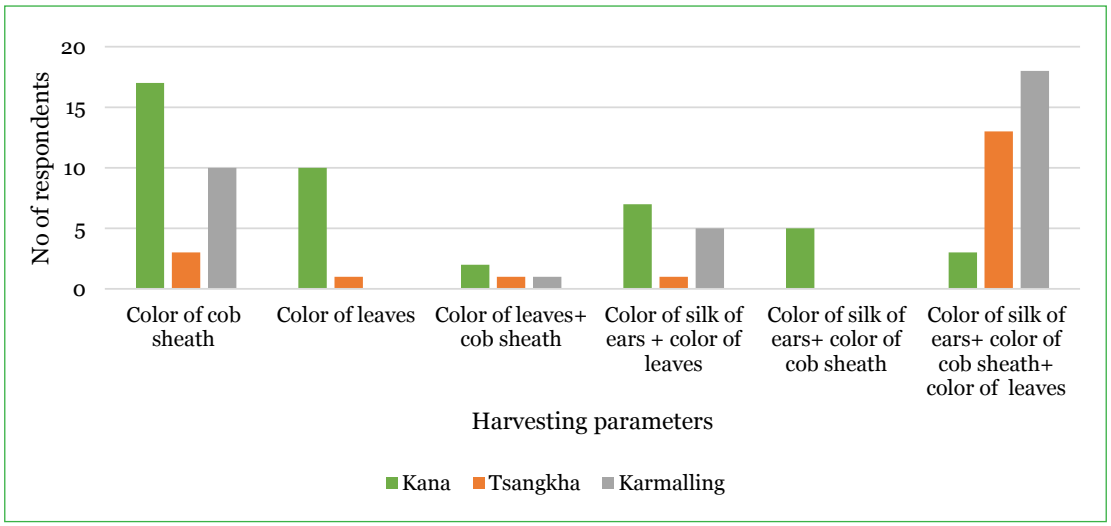

Figure 7: Farmers knowledge on harvesting parameters in Dagana

3. Use of maize at household level

The survey found that 29.9% of the respondents use maize for seed, brewing alcohol and feeding animals whereas 27.8% respondents use for seed, sale and feeding animals.

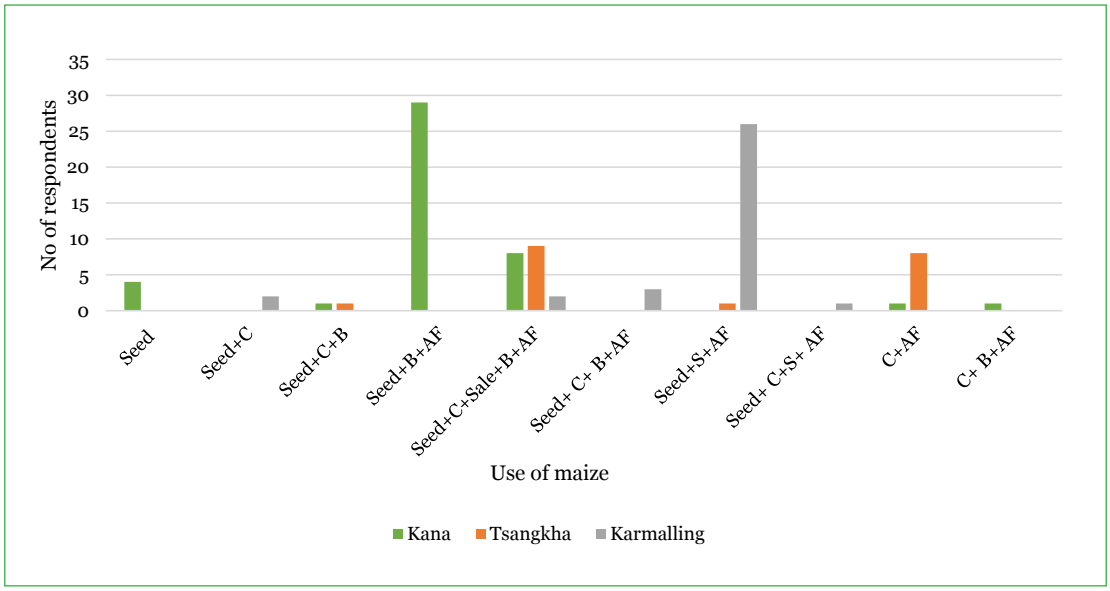

Figure 8: Use of maize in Dagana

*C= Consumption, B= brewing, AF= animal feed, S=Sale

4. Measure moisture content (MC) before storage; method of determination of MC and re-drying

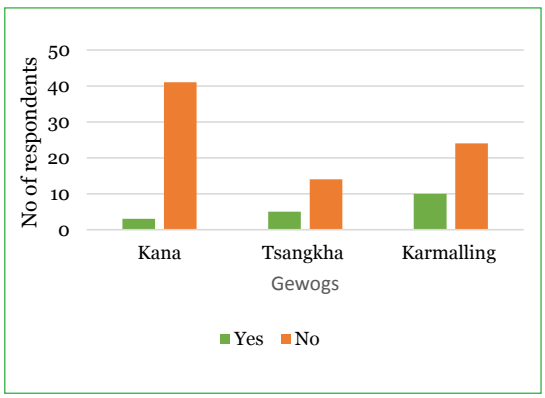

Figure 9a: Determination of MC before storage in Dagana

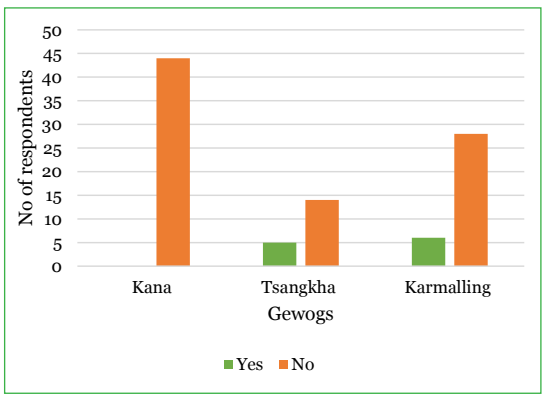

Figure 9b: Re-drying of maize in Dagana

The survey found out that approximately 18.6% of the respondents measure moisture content of maize (Figure 9a) before storage by crunching and feeling grains with teeth or fingers. Only, 11.3% of the total respondents re-dry maize if the maize is not dried properly (Figure 9b).

5. Maize drying methods

The survey found out that drying maize on the floor was the most common drying method practiced by the respondents (24.7% respondents) followed by sun drying (22.7% respondents).

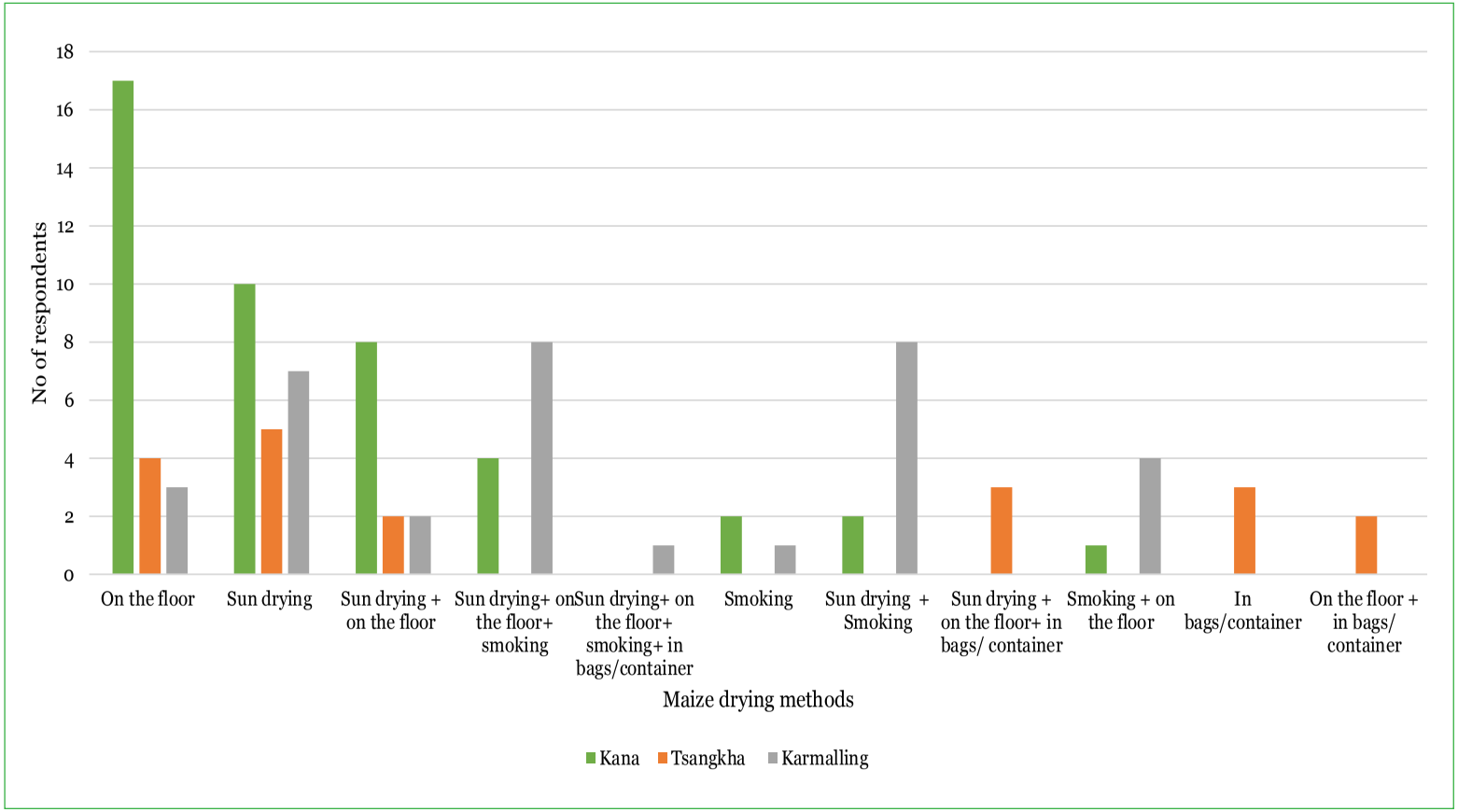

Figure 10: Maize drying methods in Dagana

6. Maize storage system

The most common storage system in Dagana was the separate custom built structure (29.9% respondents) followed by hanging under the roof (24.7% respondents).

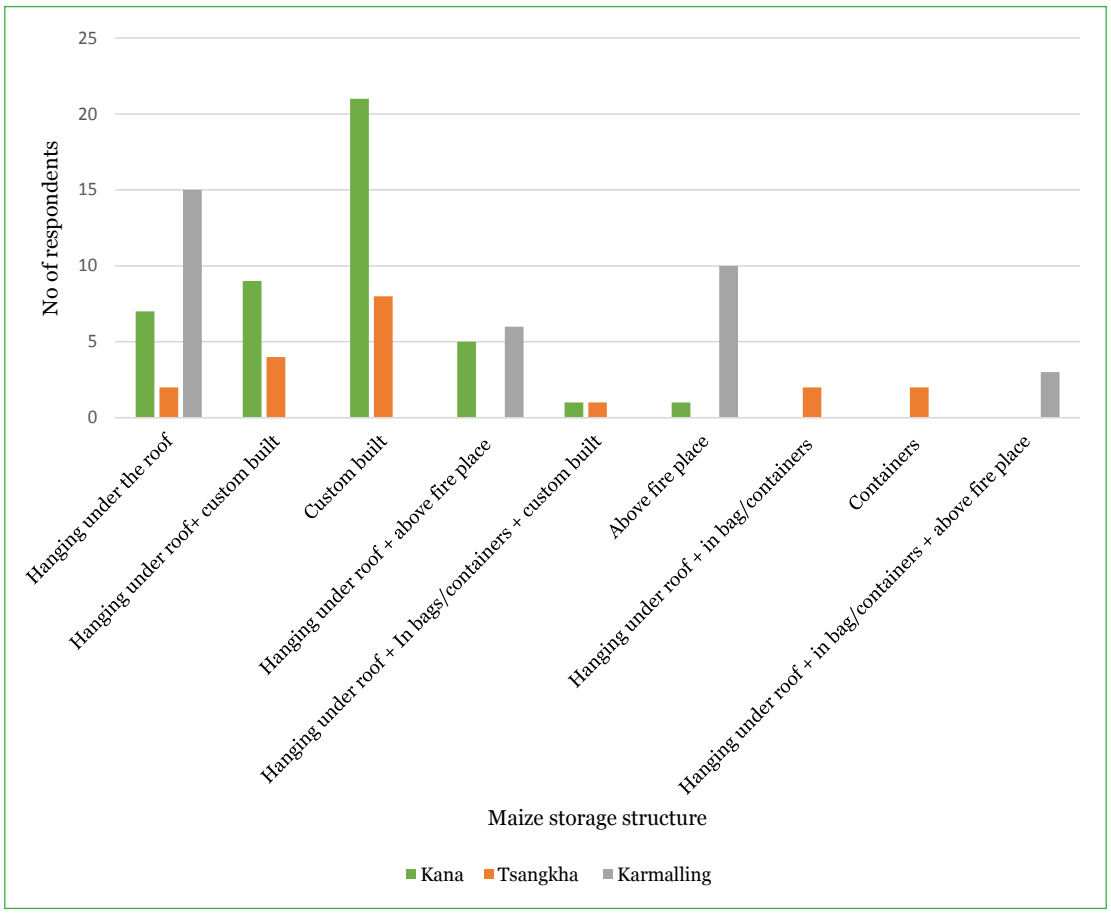

Figure 11: Maize storage structure in Dagana

Plate 5: Custom built maize storage structure in Tsangkha Gewog

Plate 6: Custom built storage structure in Karmalling Gewog

7. Maize post-harvest losses

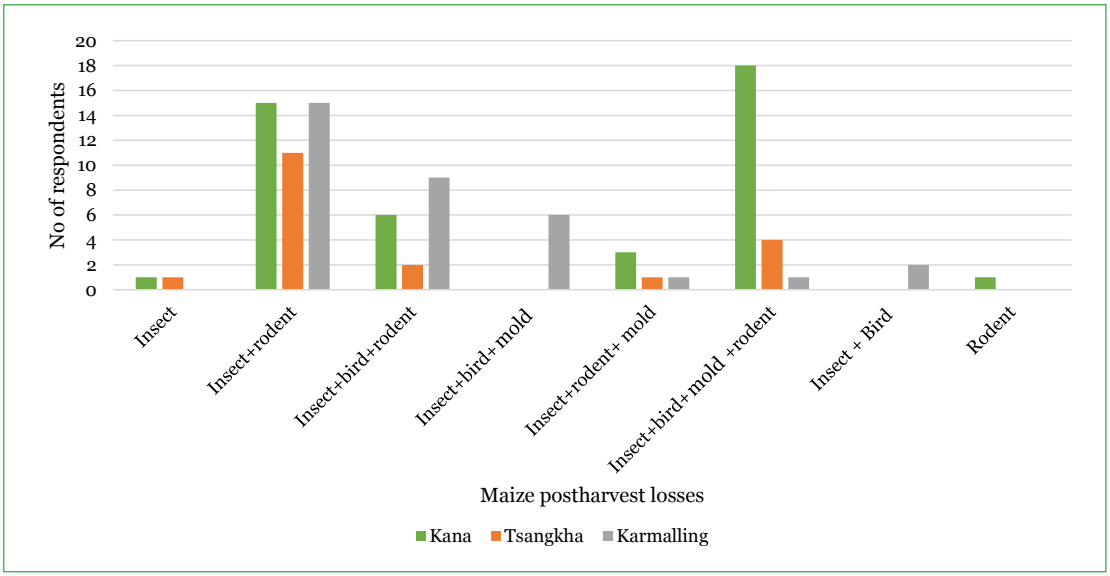

Figure 12: Postharvest maize losses in Dagana

Plate 7: Maize cobs infected with mold in stores in Dagana

NARANG, SILAMBI AND THANGRONG GEWOGS, MONGAR DZONGKHAG

1. Area under maize cultivation

The average area under maize cultivation in Narang, Silambi and Thangrong Gewogs are 1 acre, 0.9 acre and 1.8 acres respectively. 60% of the total respondents grow Yangtsipa variety whereas 6.2% respondents grow only local white variety. About 40% respondents grow both Yangtsipa and local varieties. All the farmers sow maize from February to March and harvest from July to August which coincides with the peak monsoon season.

2. Farmer's knowledge to determine maize harvest time

The survey found that 67.7 % of total respondents harvest maize when the color of silk of ears have dried to a golden brown and leaves are dried and color of cob sheaths have turned white.

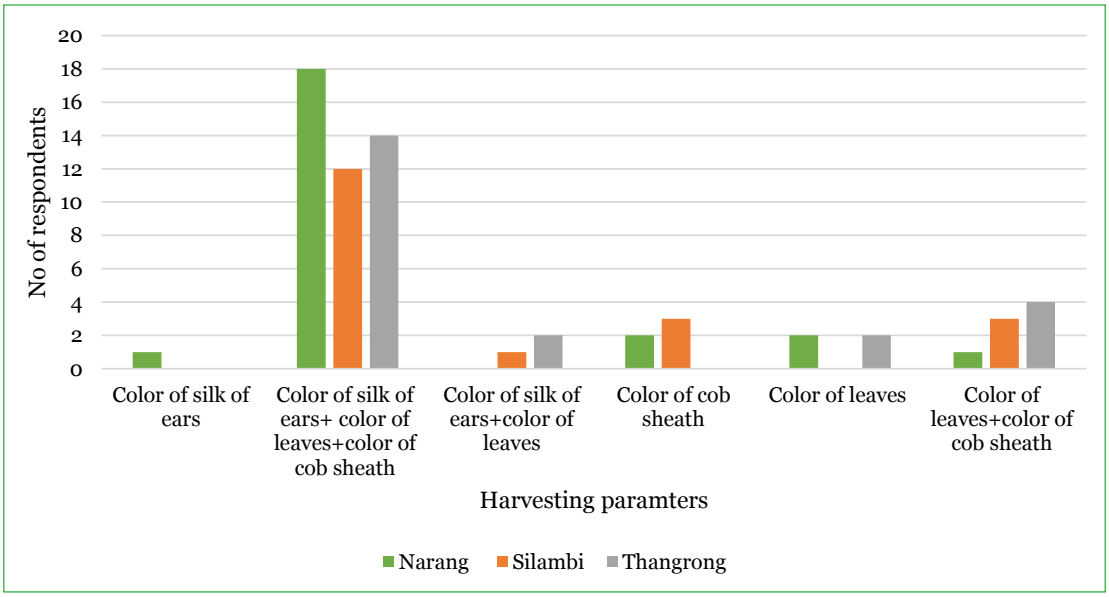

Figure 13: Farmers knowledge on harvesting parameters in Mongar

3. Use of maize at household level

The survey found out that 49.3% of the respondents use maize for seed, self-consumption and feeding animals whereas 37.7% respondents use for seed, consumption, brewing alcohol and feeding animals.

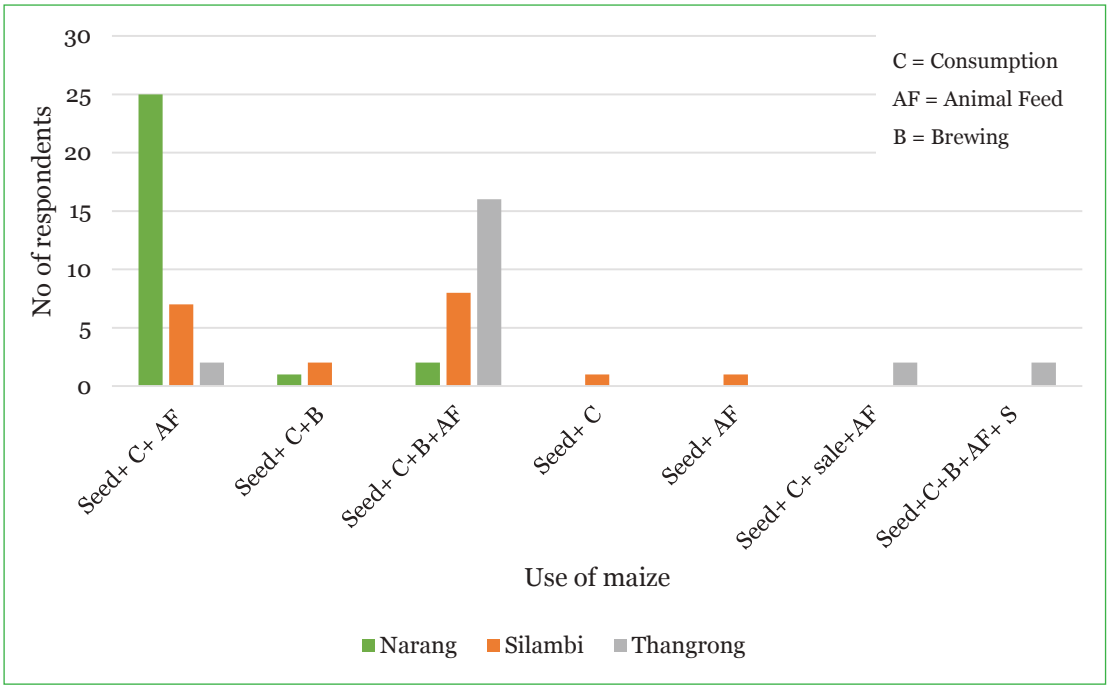

Figure 14: Use of maize in Mongar

*C= Consumption, B= brewing, AF= animal feed, S=Sale

Plate 8: Grinded maize (Kharang) for consumption in Mongar

4. Measure moisture content (MC) before storage; method of determination of MC and re-drying

The survey found out that approximately 21.5% of the respondents measure moisture content of maize (Figure 19) before storage by crunching and feeling grains with teeth or fingers. None of the respondents re-dry maize if the maize is not dried properly (Figure 20).

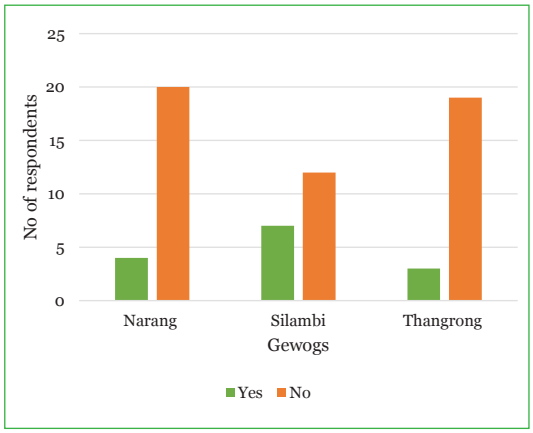

Figure 15a: Determination of moisture content in Mongar

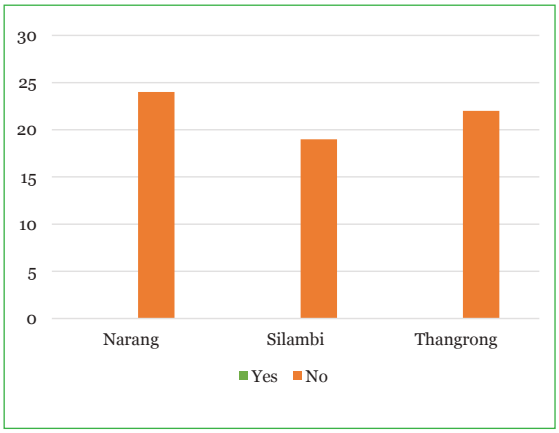

Figure 15b: Re-drying of maize in Mongar

5. Maize drying methods

The survey found out that sun and wind drying of maize was the most common drying method practiced by the respondents (49.2% respondents) followed by sun drying and drying on the floor (24.6% respondents).

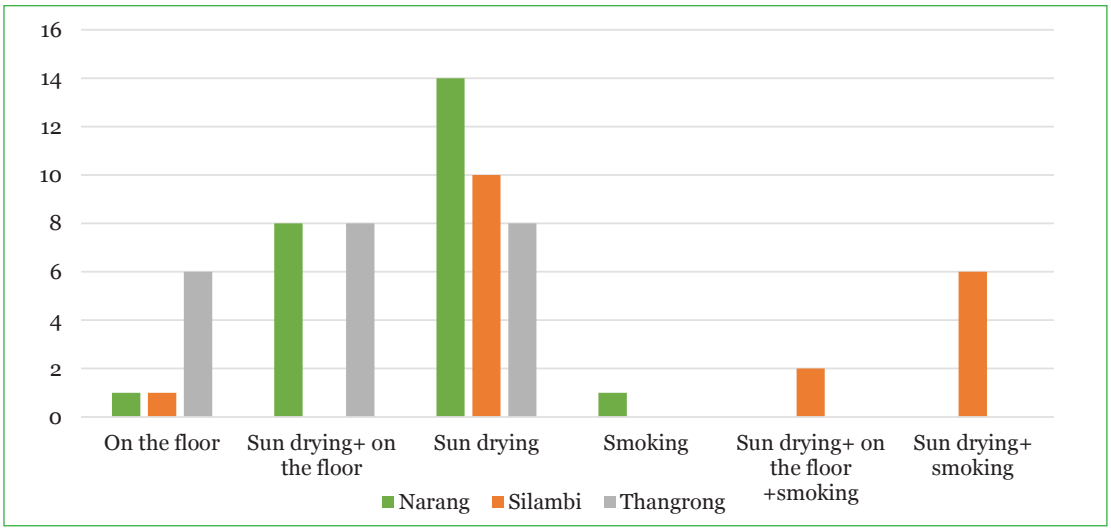

Figure 16: Maize drying methods in Mongar

Plate 9: Sun drying of maize cobs and shelled kernels in Mongar

6. Maize storage system

The most common storage system in Mongar was hanging under the roof (73.9% respondents) followed by hanging under the roof and above the fire place (12.3% respondents).

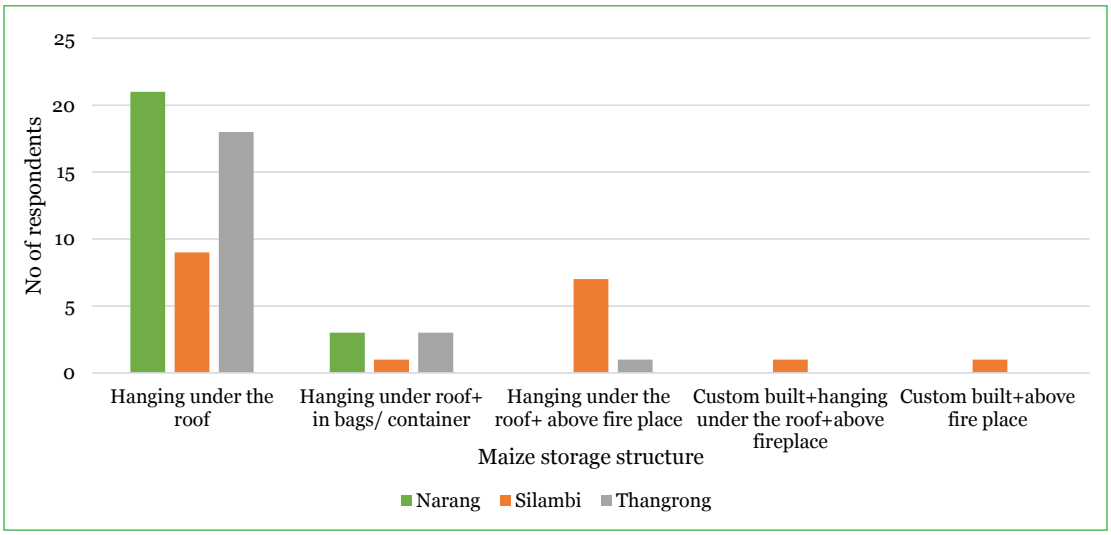

Figure 17: Maize storage system in Mongar

Plate 10: Hanging maize cobs under the roof in Mongar

7. Maize post-harvest losses

The main causes of post-harvest loss in maize was by combined agents of insect, bird and rodents (32.3% respondents) and insect and rodents (32.3% respondents). The least loss was caused by combined agents of insect, mold and bird (1.5% respondents).

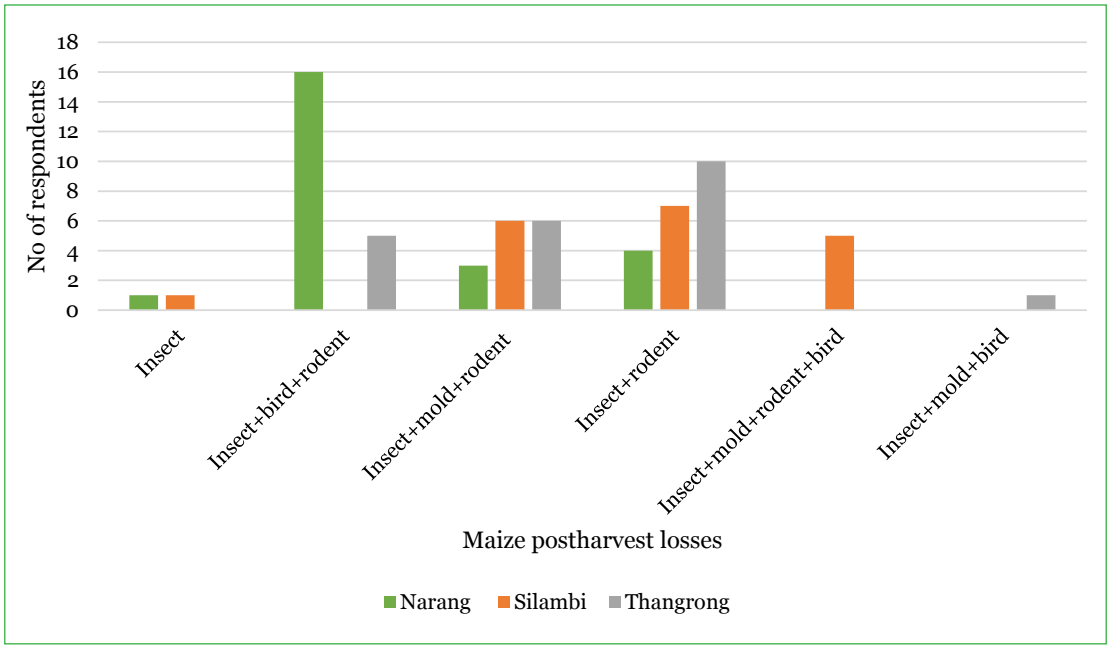

Figure 18: Causes of maize postharvest losses in Mongar

Plate 11: Fungal infection on maize cob in Mongar

OVERALL RESULTS

1. Area under maize cultivation; varieties; sowing and harvesting month

The highest average area under maize cultivation was observed in Dagana Dzongkhag (2.3 acres) followed by Mongar (1.2 acres) and Chukha Dzongkhags (0.7 acres). More than 70% farmers in Chukha and Dagana Dzongkhags grow local white variety of maize as the variety has full husk cover which prevent storage pest infestation whereas 60% farmers in Mongar grow Dzongkhag Yangtsipa variety as it is high yielding than local white variety. All farmers in nine pilot Gewogs sow maize in February to March and harvest from July to August which coincide with the peak monsoon season. Continuous rainfall hinder proper drying.

2. Farmers knowledge to determine maize harvest time

The survey found that farmers harvest maize when the color of silk of ears have dried to a golden brown; cob sheaths have turned white and leaves have dried. However, none of the farmers use moisture meter to determine the correct moisture content for harvesting.

3. Use of maize at household level

In all nine Gewogs, farmers use maize for seed, consumption, brewing alcohol and feeding animals.

4. Measuring moisture content before storage and re-drying

The survey found that 80% of respondents' measure moisture content of maize before storage by crunching and feeling with teeth or fingers. About 34% of respondents in Chukha and Dagana Dzongkhag red-dry maize if the maize is not dried properly. None of the respondents in Mongar Dzongkhag re-dry maize.

5. Maize drying methods

The common maize drying method practiced in nine Gewogs is sun drying (96% respondents) followed by drying on the floor (24.7% respondents).

6. Maize storage system

The common maize storage system in all nine Gewogs are hanging maize under roof; above fireplace and separate custom built structure.

7. Maize postharvest losses

In all nine Gewogs, the most common agent of postharvest losses were by insects and rodents (80% respondents).

Laboratory analysis of storage losses due to storage insects and moulds

Objectives

- Assess losses due to mold and insect pests

Material and Methods

From each Gewog, 100 maize cobs were collected, sealed in polythene (HDPE) bags and labelled with the information and brought to the Centre for examination. Examination of the samples was conducted within two weeks of collection in the Entomology laboratory. The methodology for assessment of losses due to mould and insect pests is given below.

Methodology for assessment of storage losses due to storage insects and moulds

From the composite sample obtained from different farmer households, take 1000g, clean and set aside the foreign matter and separate mouldy grains from the cleaned grain. Determine the following

Weight of sample =
Weight of foreign matter =
Weight of cleaned grain =
Moisture content =
Dry weight of cleaned grain =
Dry weight of mouldy grains =

Loss due to moulds (fungi) = Dry weight of mouldy grain / Dry weight of cleaned grain x 100 = ... %

Set aside the mouldy grains. Recombine the remaining grains; mix thoroughly and from 300 g, separate insect damaged grains from sound grains. Calculate the thousand grain mass (TGM) of sound grains and insect damaged grains and express on a dry basis as follows:

$$\textit{Thousand grain mass (TGM) of sound grains (dry)} = \frac{\textit{(wet to dry: wet mass x 100 - MC)}}{100}$$

$$\textit{TGM of insect damaged grains (dry)} = : \frac{\textit{(dry mass x 100 - MC)}}{100}$$

*Loss due to insects = TGM of sound grain-TGM of insect damaged grain/ TGM of sound grain*100*

RESULTS

1. Loss due to moulds

Table 3: Storage losses due to mold in nine pilot Gewogs

Dzongkhag	Gewogs	Total sample (g)	Foreign matter (g)	Cleaned grain (g)	Moisture content (%)	Cleaned grain DW (g)	Mouldy grain (g)	Mouldy grains dry weight (g)	Loss due to moulds (%)
Chukha	Bongo	1000	6.3	993.7	10.29	891.4	4	4.0	0.45
	Darla	1000	3.2	996.8	10.16	895.5	4.3	4.3	0.48
	Sampelling	1000	15.5	984	10.46	881.1	15.6	15.6	1.77
Dagana	Tsangkha	1000	0.8	999.2	9.00	909.3	3.7	3.7	0.41
	Karmalling	1000	31.4	969.6	8.33	888.8	7.8	7.8	0.88
	Kana	1000	9.2	991.8	13.89	854	50.7	50.6	5.93
Mongar	Silambi	1000	2.4	967.6	14.08	831.4	40	39.9	4.80
	Thangrong	1000	5.8	994.28	11.04	884.5	10.8	10.8	1.22
	Narang	1000	5.8	994.2	14.00	855	35.2	35.2	4.11

The highest loss due to mould damage was found in Kana Gewog (5.93%), Dagana Dzongkhag followed by Silambi Gewog (4.80%), Mongar Dzongkhag. The least mould damage was found in Tsangkha Gewog (0.41%), Dagana Dzongkhag.

2. Loss due to insects pests

Table 4: Storage losses due to insect pests

Dz-ongkhag	Gewogs	Total sample (g)	Foreign matter (g)	Cleaned grain (g)	Moisture content (%)	Cleaned grain dry weight (g)	Infested grain sub-sample (g)	No. infested kernels	Sound grain sub-sample (g)	No. sound kernels	TGM infested grains	TGM sound grains	Loss in TGM	Loss due to insects
Chukha	Bongo	1000	6.3	993.7	10.29	891.4	103	439	197	699	234.6	281.8	16.8	38.6
	Darla	1000	3.2	996.8	10.16	895.5	20.1	82	279.9	861	245.1	325.1	24.6	8.7
	Sam-pelling	1000	15.5	984	10.46	881.1	7.7	90	292.3	1232	85.6	237.3	63.9	6.8
Dagana	Tsang-kha	1000	0.8	999.2	9.00	909.3	15.6	100	284.4	970	156.0	293.2	46.8	9.3
	Kar-malling	1000	31.4	969.6	8.33	888.8	141.7	946	158.3	884	149.8	179.1	16.4	**51.7**
	Kana	1000	9.2	991.8	13.89	854	105.6	526	194.4	650	200.8	299.1	32.9	**44.7**
Mongar	Silambi	1000	2.4	967.6	14.08	831.4	4.1	22	295.9	1402	186.4	211.1	11.7	**1.5**
	Thang-grong	1000	5.8	994.28	11.04	884.5	101	414	199	626	244.0	317.9	23.3	39.8
	Narang	1000	5.8	994.2	14.00	855	52.6	193	247.4	666	272.5	371.5	26.6	22.5

*TGM=Thousand gram mass

The highest storage insect damaged was detected in Karmalling Gewog (51.7%), Dagana Dzongkhag followed by in Kana Gewog (44.7%), Dagana Dzongkhag. The least damaged was found in Silambi Gewog (1.5%), Mongar Dzongkhag.

Quantification of major storage insect pests in the Pilot Gewogs

Objectives

- Identify and quantify the major insect pests in stored maize in the pilot Gewogs

Material and Methods.

From each Gewog, 100 maize cobs were collected, sealed in polythene (HDPE) bags and labelled with the information. In the laboratory, cobs were shelled and mixed to make composite samples followed by sieving. Different insect pests were identified and counted.

Table 5: Maize storage insects found in the pilot Gewogs

Order	Family	Common name	Species name
Coleoptera	Curculionidae	Maize weevil	*Sitophilus zeamais*
	Tenebrionidae	Confused flour beetle	*Tribolium* sp.
	Tenebrionidae	Broad horned flour beetle	*Gnatocerus cornutus*
Lepidoptera	Gelechiidae	Angoumois grain moth	*Sitotroga cerealella*

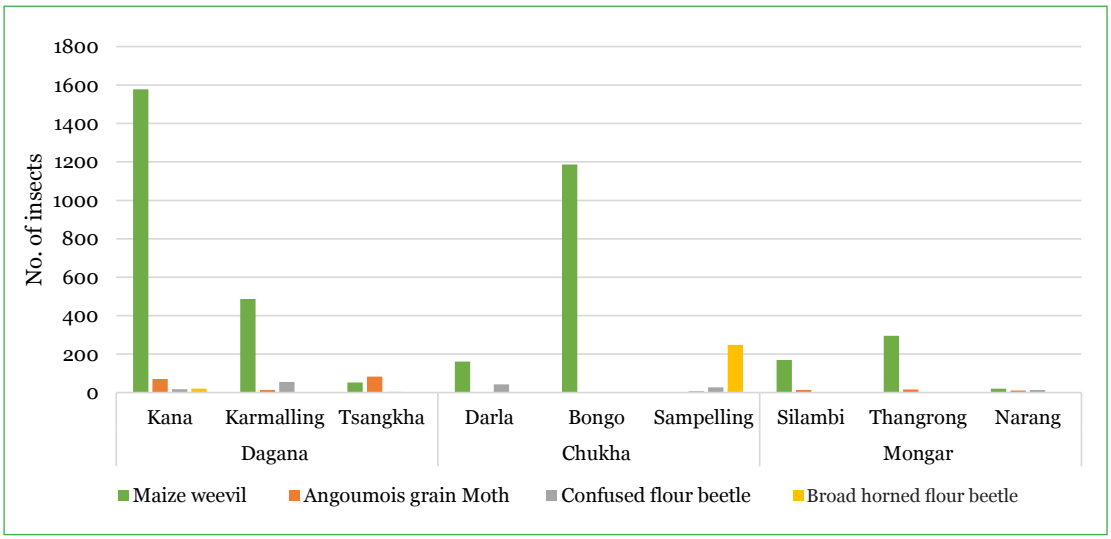

Figure 19a: Number of storage insect pests per 100 sampled cobs in nine pilot Gewogs

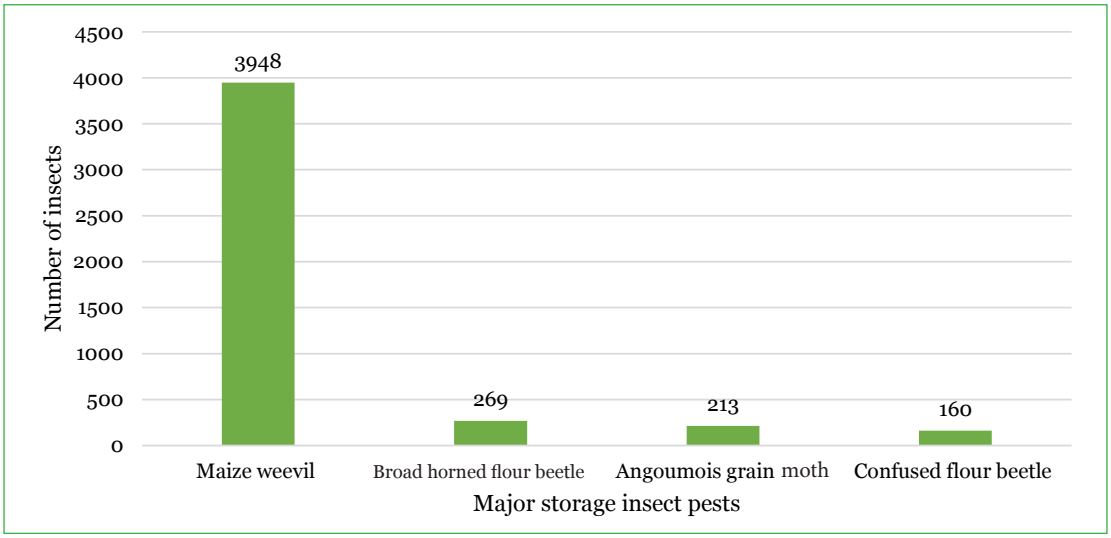

Figure 19b: Major storage insect pests found in pilot Gewogs

The survey found out that maize weevil was the most common of all the insect pests recorded followed by broad horned flour beetle, Angoumois grain moth and confused flour beetle in the decreasing order (Figure 19a & 19b).

Plate 12: Maize weevil

Detection of fungi infecting maize cobs in project pilot sites

Objective

- To detect fungi infecting maize cobs in stores

Materials and Methods

The infected kernels were collected from infected cob. The kernels were incubated for a 72 hours at 28°C in the carrot agar plate media to allow fungus on the kernel to grow. Fungus were identified by microscopic morphological structures.

Plate 13 Fungal Infection on the maize cobs (left), Microscopic view of fungus (right)

Following characteristic were observed.

- Conidiophores produced freely with swollen tip
- Conidia produced abundantly in chains forming spherical heads
- Thread like branching hyphae.
- Dense mats of mycelium with conidia

Result: The fungus is identified as Aspergillus spp.

Moisture content and mould infection in maize storage

Objective

- To determine relationship between moisture content and mould infection in maize storage

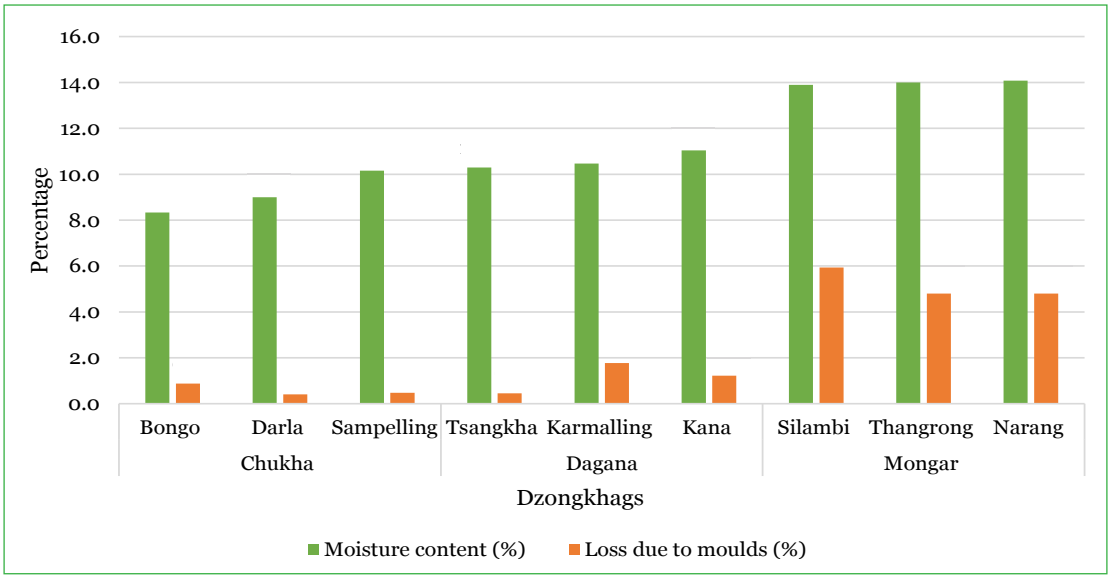

Figure 20: Relationship between moisture content and mold infection in maize storage

Result: There is a positive relationship between moisture content and mould damage in maize storage, r= 0.927, n= 9, p= 0.000. We can conclude that if maize is not dried properly (<14% MC), there is high chances of incidences of mould infection in stores.

*p= significant level, r= correlation coefficient, n= no. of Gewogs

Capacity building of farmers, extension agents and other central programs on improved management of storage system and on improved drying techniques

Training of Dzongkhag Agriculture Officer and Extension Agents

As part of Maize TCP Project funded by FAO, Training of Trainers (ToT) workshop was organized by the National Plant Protection Centre (NPPC) from 7-9th September 2017 at Phuntsholing, Chukha Dzongkhag. The main objective of the ToT program was to train the extension agents of the project pilot gewogs, Regional Plant Protection focal officers and other relevant stakeholders on maize storage pest's management, improved drying and storage methods of maize. Trained extension agents were expected to train farmers in their respective gewogs on maize storage pests' management, drying and storage methods, and the Regional Plant Protection Focal Officers are expected to provide technical backstopping to extension agents on any issues concerning maize storage pest problems.

The training workshop was formally opened by the Director of Department of Agriculture. The Director emphasized the importance of ToT program and training extension agents that will help farmers in managing storage pests, fungal diseases and enable farmers to practice proper drying and storage methods thus enhancing maize self-sufficiency.

Director of Department of Agriculture with the training participants

The workshop was facilitated by resource persons from the National Plant Protection Centre and National Post Harvest Centre. The workshop was attended by 32 participants from the Central programs, Dzongkhags, Maize Commodity Program Coordinator, Researchers from the Agriculture Research and Development centers and Agriculture Corporations.

Leaflets on maize drying and harvesting; maize storage pests' management and use of super grain bags were distributed to the extension agents for further distribution during farmers training. Also, 2700 no's of super grain bags (300 bags per Gewog) were distributed to Extension Agents.

The ToT program concluded with closing remarks by Dr. Thinlay requesting extension agents to train farmers in their respective gewogs to achieve the project objectives. Participants also expressed their gratitude and requested NPPC to organize similar programs in future.

Training of farmers

A sum of Nu. 2, 10,000 was issued by NPPC to DAOs to train farmers of project sites. DAOs and extension agents were the resource person for the farmers training. As suggested by the NPPC, farmers were trained on successful management of maize storage pests, improved drying and storage methods and farmers were also demonstrated on the use of super grain bags to store maize. As part of the program, super grain bags were distributed to farmers.

Trained farmers of Darla Gewog, Chukha Dzongkhag

Farmers training in Silambi Gewog, Mongar Dzongkhag

Trained farmers of Karna Gewog, Dagana Dzongkhag

Table 5: Number of farmers trained in three Dzongkhags.

Project Dzongkhag	Project Sites (Gewogs)	Number of farmers trained by Gender	
		Male	Female
Chukha	Darla	137	85
	Bongo	86	126
	Sampelling	89	133
Dagana	Karmalling	48	47
	Karna	178	133
	Tsangkha	41	14
Mongar	Thangrong	43	30
	Narang	32	40
	Silambi	137	50

Super Grain Bags: Low cost technology for storing maize at household level

Super grain bags are bags are made from a special plastic with low oxygen permeability. It works on the principle of "hermetic storage" where flow of oxygen and water from outer environment is completely checked. When properly sealed, respiration of grain and insects inside the bag reduce oxygen levels from 21% to 5 %. This prevents damage and proliferation by storage insect pests and helps reduce grain losses without using any insecticides. Additionally, it greatly helps preserve the quality, germination and vigor of the seeds. It can be used to store a wide range of commodities (maize, paddy, milled rice, wheat, millet, beans, coffee, soybeans etc.

Advantages

- Easy to use
- Reduces storage loss by reducing damage caused by insects (without using a chemical)
- Extend the germination life of seed for planting from 6 to 12 months
- Preserves quality, taste, aroma and color of the stored commodity
- Ensure safe storage of seeds
- No need to use chemicals
- Strong plastic materials
- Applicable to wide variety of agricultural commodities (Paddy, maize, milled rice, millet, soya beans, all types of seeds, wheat, beans, peas, lentils, sorghum, coffee)

Precautions

- Make sure that the grains or seeds are properly dried
- Don't overfill
- Remove excess air
- Don't puncture or damage.
- Never carry the grain by holding on to the super grain bag; always use the outer bag for carrying.
- Seal properly
- Do not use hooks to hang the bags
- After use, clean, dry and fold the SGB for future use

Farmers feedbacks and recommendations on the use of Super Grain Bag (SGB) to store maize

With support from the ongoing FAO Maize TCP project coordinated by the National Plant Protection Centre, super grain bags were distributed to farmers in the nine pilot Gewogs in Chukha, Dagana and Mongar Dzongkhags. The main objective of supplying super grain bags to the farmers was to store maize to prevent maize storage pests' infestation and as a whole to reduce postharvest losses in nine pilot Gewogs.

Chukha Dzongkhag

1. No of bags supplied to farmers: 700
2. Use of SGB: storing maize for seed and other cereals

3. Approximate reduction of postharvest losses by using SGB: 90% in Bongo, 99% in Darla and 30-40% in Sampelling
4. Issues with SGB:
   a. 100 kg capacity not feasible for storing maize at household level.
   b. Proper drying of maize prior to storage in SGB is difficult
   c. SGB not feasible to store cobs (instead of shelling)
5. Recommendations for SGB
   a. 50 kgs capacity is feasible for storing maize at household level

Dagana Dzongkhag

1. No of bags supplied to farmers: 533
2. Use of SGB: Storing maize for seed and other cereals
3. Approximate reduction of postharvest losses by using SGB: 70% in Tsangkha, >50% in Karmalling, and 70% in Kana
4. Issues with SGB:
   a. SGB easily damaged by rodents
   b. Some farmers not using SGB despite being trained and distributed with SGB
   c. Not easily available in markets
5. Recommendations for SGB
   a. SGB should be made readily available in Sanam Tsongkhang.

Mongar Dzongkhag

1. No of bags supplied to farmers: 600
2. Use of SGB: Storing maize for seed and other cereals
3. Approximate reduction of postharvest losses by using SGB: 90-95% in Narang, 70-80% in Thangrong, 70% in Silambi
4. Issues with SGB:
   a. 100 kgs capacity SGB not feasible at household level
   b. Ineffective if maize grains are not properly dried
   c. Not effective against rodents
   d. Not easily available in markets
   e. Few farmers using SGB without outer protective jute bag
5. Recommendations for SGB
   a. More farmers awareness program on use of SGB required

Use of super grain bags to store maize for seeds

Super grain bags being used without outer protective jute bags

Grain stored in super grain bag (Left) and grain stored in jute bag (Right)

NATIONAL PLANT PROTECTION CENTRE
Department of Agriculture
Ministry of Agriculture and Forests
Post Box: 670
Tel. No. : +975-2-351016/351665
Fax No. +975-2-351656
Email: nppcsemtokha@gmail.com
www.nppc.gov.bt

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