

## Assessment of Community-Based Maize Seed Production in Eastern Bhutan

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### ABSTRACT

*Community-Based Seed Production (CBSP) in Bhutan was first initiated in 2006 to overcome and address maize seed degeneration and rapid multiplication of Grey Leaf Spot tolerant varieties. With the success stories of the CBSP model in the first initiated groups, the CBSP concept has been replicated in various other maize growing areas. This study was carried out in one CBSP group each from four eastern districts namely Mongar, Lhuentse, Tashiyangtse and Tashigang. A total of 121 CBSP members were interviewed using semi-structured questionnaires. The main aim of this study was to assess and document the impacts of CBSPs and evaluate seed production trend within the community. The introduction of CBSP in the community saw an increasing trend of seed production in the last six years (2011-2016). The study found that the total production of maize in the four study sites increased by 45.4% from 37.4 ton in 2011 to 139.3 ton in 2016. The initiation of CBSP helped in improving food self-sufficiency within the community through increased productivity. The result from this study showed that more than 96.7% of the respondents became food self-sufficient. The study also found that mobilization of CBSP group brought unity within the community. Besides, the introduction of CBSP also helped in increasing income; the income increased by 54% in the last five years (2012-2016). The study also reported that the initiation of CBSP has benefited in ensuring seed security and quality seed production at farm level. This study also noted some negative impact such as loss of traditional varieties and increasing wage rate with the establishment of the CBSP model.*

**Keywords:** *Community-Based Seed Production; seed quality; seed security; household Income; Food self- sufficiency*

### 1. Introduction

Maize is one of the most widely cultivated food crops in Bhutan. More than 69% of the rural households across the 20 districts grow maize on 61,403 ac land (DoA 2015). It is a major food crop cultivated widely in the six eastern districts accounting for up to 46% of the total maize area and over 54% of the total production (DoA 2015). The total production and the national average yield are 74,370 ton and 1.224 ton/ac (DoA 2015). Being ranked as first in the extent of area cultivated, it plays a vital role in ensuring the household food security. According to Katwal et al (2007), about 80% of the total production is consumed at the household level by the farmer which is valued at Nu. 353 million annually. Only 6% of the total production is sold, which is an important source of household income (Katwal et al 2015).

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Bhutanese farmers grow different maize varieties in same field or in close proximity due to limited size of land holding which had lead to the production of undesirable seeds. Most of the farmers meet their seed requirement from informal traditional seed system managed by themselves from their farm saved seed which has lead to poor quality seed. Maize seed degeneration was underpinned to the lack of poor seed source and production practice. Moreover, in 2007, a major fungal disease called Gray Leaf Spot (GLS) which was never reported before in the country seriously affected 12 major maize growing districts which prompted seed replacement initiative (Katwal et al 2015). The introduction of CBSP in maize seed system had played a vital role in producing improved quality seed and fulfilling the demand of the increasing populace besides being replacing degenerated poor seed. CBSP was initiated to overcome and address seed degeneration and rapid production of GLS tolerant varieties (Katwal et al 2009). In order to rapidly produce GLS tolerant seeds and to address the seed degeneration problem, the National Maize Program (NMP) based at Agriculture Research and Development Centre (ARDC) Wengkhar initiated an approach called Community-Based Seed Production (CBSP) in 2006, which was emulated from the hills of Nepal. With the success stories of the CBSP models in the first initiated CBSP groups in Waichur and Shaphangma in Mongar, the CBSP model had been replicated in various maize growing areas. Currently there are 11 CBSPs spread in seven districts, including, Mongar, Lhuentse, Tashigang and Tashiyangtse in the east. Across the nation, about 80% of the seed replacement after the GLS outbreak has been accomplished through CBSP groups (Katwal et al 2015).

As per Katwal et al (2015) CBSP has several other advantages such as access to quality seeds, income generation through the sale of maize, adoption of improved technologies and free input supplies. CBSP initiation in the country has been more than a decade old; however there have been no studies to determine and document the impacts of the CBSP seed production model in maize. Thus, this study will quantify the impacts and study the maize seed production trend after the initiation of CBSP. The results from this study will therefore determine the scope for replication of such model in other major maize growing area. The primary objectives of the study are to document and assess maize seed production trends through the adoption of Community-Based Seed Production model and to document the economic and social impacts of CBSPs on Community.

## **2. Materials and methods**

### **2.1. Description of the study area**

The study was conducted in four eastern districts of Bhutan namely Mongar, Tashigang, Lhuentse and Tashiyangtse where CBSP groups in maize promoted or adopted. In each of these districts one CBSP group was randomly selected. The sample CBSP groups of Mongar and Tashigang districts represent older groups which are more than five years old and those of Lhuentse and Tashiyangtse represent new groups which are less than five years old. The four group selected in are Waichur in Mongar, Budur-Kupeneysa in Lhuentse, Changmey in Tashigang and Sharli in Tashiyangtse. The sites share a similar type of climatic condition; hot and wet summer to dry and cold winter. The annual average temperature for all the four sites

ranges from 16° to 23° C and annual rainfall ranges from 1,000 to 1,500 mm (NSB 2012). The study sites lie at an elevation ranging within 500 to 2000 masl.

## 2.2. Sample size

From a total of 173 households (Table 1) of four randomly selected CBSPs in the four eastern districts, 121 respondents were determined using the Yamane formula:  $n = \frac{N}{1+Ne^2}$ . The formula has 95% confidence interval and 5% error level. A simple random sampling technique was used to carry out the sampling. The 121 CBSP members were further distributed into their respective groups (Table 1). The sample size from each CBSP group was calculated and simplicity non-probability sampling was used to select the respondent from each group with the help of geog extension, ARDC researchers and geog administration. Sample size was calculated as:

$$\text{Sample size from each CBSP group} = \frac{\text{Household of each group} \times \text{Total sample size (n)}}{\text{Sampling frame (population)}}$$

Table 1. Maize cultivation and production in the four CBSP sites

| Dzongkhag    | CBSP group      | No. of household | Sample size |
|--------------|-----------------|------------------|-------------|
| Mongar       | Waichur         | 20               | 14          |
| Lhuentse     | Budur-Kupeneysa | 57               | 40          |
| Tarshigang   | Changmey        | 53               | 37          |
| Tashiyangtse | Sharli          | 43               | 30          |
| Total        |                 | 173              | 121         |

## 2.3. Data Collection and analysis

The data was collected through individual interview using a semi-structured questionnaire and informal group discussions. The primary data was supplemented with secondary data from relevant journals, online resources, RNR statistical records and other relevant documents. Some of the important interview questions included social and economic impacts of CBSP, benefits of CBSP in the community, annual production of maize, food self-sufficiency. The data collected was analyzed through Microsoft Excel and Statistical Package for the Social Sciences (SPSS Version 20). The data were checked for normality and homogeneity of variance using Shapiro-Wilk's and Levene's test. The data were analyzed using both descriptive and inferential statistics; mean frequencies, percentages, minimum and maximum value, mean, standard deviation and standard error of different numerical and categorical data. A paired sample *t*-test was carried out for comparison between two variables.

### 3. Result and discussion

#### 3.1. Land Utilization in the CBSP study sites

Most members of the CBSPs are small-scale farmers who are dependent upon agriculture. Every member in the four sites utilizes about an average of  $1(\pm 0.6)$  acre of dry land and  $0.6(\pm 0.8)$  ac of wet land (Table 2). From 193 ac of total dry land only 112 ac is under cultivation and similarly from the total 49.9 ac of wet land only 37.9 ac is cultivated, the remaining lands being fallow. The CBSP group in Lhuentse had the highest maize cultivation area with 37.08 ac, which is mainly due to more number of CBSP household in the community. The group in Mongar had the least with 18.14 ac since the group had fewer members. The main reasons cited for keeping the land fallow are labor shortage and wild animal damage.

Table 2. Land utilization in the study sites

|                     | Total (ac) | Average (SD)  |
|---------------------|------------|---------------|
| Dry land            | 193        | $1.6 \pm 2.0$ |
| Cultivated dry land | 112        | $1.0 \pm 0.6$ |
| Wet land            | 49.9       | $0.7 \pm 0.9$ |
| Cultivated wet land | 37.9       | $0.6 \pm 0.8$ |

#### 3.2. Maize Production Before and After CBSP

The production in terms of output per area under cultivation was low when compared to current situation. The average maize yield before the establishment of CBSP was 1 ton/ac and it has increased to 1.2 ton/ac (Figure 2). A paired sample *t*-test was carried out to compare the yield before and after the initiation of CBSP. There was a significant difference ( $p < .05$ ) in the yield before ( $1.0 \pm 0.48$  ton) and after ( $1.2 \pm 0.55$  ton) condition at;  $t(120) = -10.9$ ,  $p = 0.001$ . It indicated that with the assured quality seed, the yield had increased after the CBSP establishment.

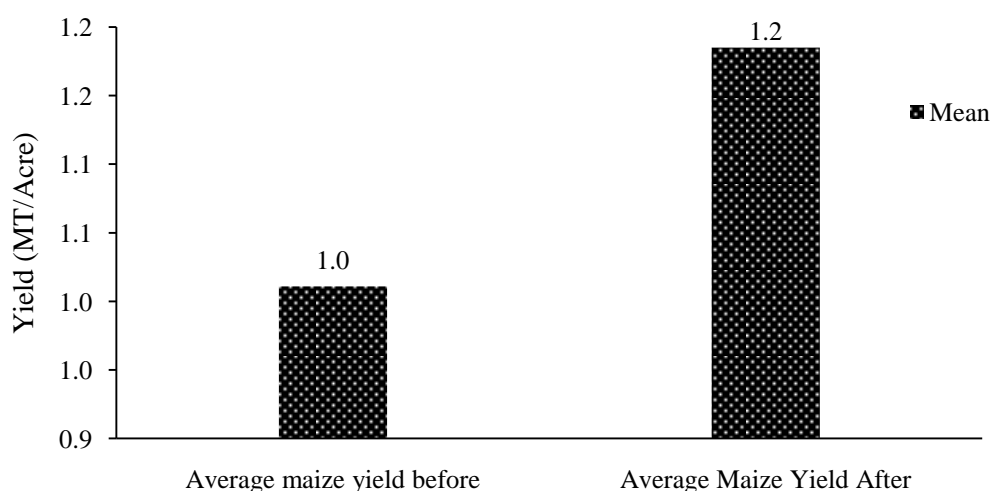


Figure 2. Maize yield before and after CBSP initiation

The reduced performance in the past was mostly attributed by factors such as crop losses to wild animals, maize disease such as GLS, growing of different maize varieties on a same patch of land and non-use of high yielding improved varieties. People were not aware of seed degeneration problem, nor did they receive any training related to maize cultivation. However, with the initiation of CBSP, the farmers are exposed to quality maize production through capacity development such as field day, training on seed production and selection, out-country study visit etc. which has helped in production of maize. The supply of high quality source seed has also contributed in high productivity after the initiation of CBSP. Moreover, with the installation of electric fencing in some of the study sites, the problem of crop depredation by wildlife has declined resulting in higher productivity.

Upadhyaya et al (2014) compared the production capacity of CBSP farmers and non-CBSP farmers in the hills of Nepal. The study reported that the production of CBSP farmers was 0.8 ton/ac and 0.62 ton/ac for non-CBSP farmers. The difference of 13.3% was found between the CBSP and non-CBSP in terms of maize production.

### 3.3. Seed Production Trend

The area, production and productivity of maize are slowly increasing. Today with the increase in numbers of CBSP group, the area for maize cultivation is expanding and the production is increasing. Figure 3 shows the seed production trend and cultivation area for six years. The study found that the production of maize has increased from 37.4 ton in 2011 to 139.2 ton in 2016. The area for cultivation of maize remained constant till 2014 at 39 ac and in 2015 with the establishment of two new groups, the area has increased to 112 ac. Maize productivity has increased due to adoption of quality seed production concept. The community grows the most preferred variety with higher production.

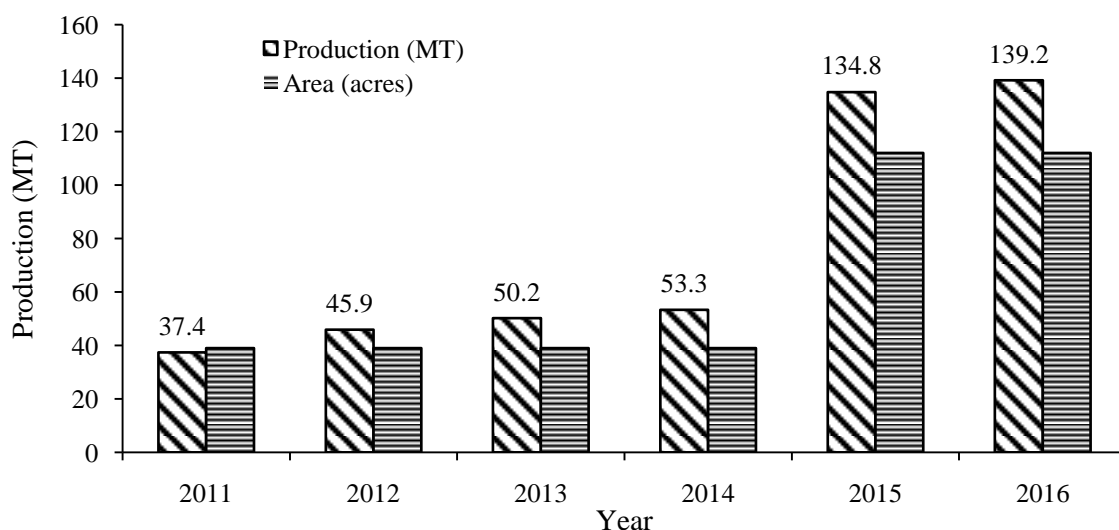


Figure 3. Annual seed production trend

A similar result was observed from an evaluation study in the CBSP sites of Nepal. Upadhyaya et al (2014) reported that the rate of improved seed production through CBSP had

increased by several folds from 14 ton in year 2000 to 830 ton in 2010. The study showed that CBSP brought a considerable increase in the production of maize seed over the years.

### **3.4. Social Impacts of Community-Based Seed Production**

#### **3.4.1. Unity within the Community**

According to the findings from this study, the initiation of CBSP has played a role in building and enhancing unity within the community. Out of 121 respondents, more than 14% of the respondents agreed that the initiation of CBSP has brought unity in the community, while 28% of the respondents hardly agreed with it. CBSP requires a willing community and without unity in the community, those CBSP would not have been established, thus the respondents felt that unity had been there before the initiation of the group. However, majority (38.7%) of the respondents slightly agreed on unity being created by CBSP initiation. Those respondents felt that after the initiation of the group, the communities started helping each other especially in terms of labor. A study by Mathema and Gurung (2006) reported that the group formation and mobilization as one of the most successful steps to bring in unity among the community. Renuka et al (2015) described the initiation of community seed bank as one tool which had brought unity in terms of decision making within the community in Mahabubnagar village of Telangana State in India. The approach of group formation and mobilization has added the value for sustainability of the CBSP (CIMMYT 2015).

#### **3.4.2. Free Input supply and Technical Support**

Table 3 shows the relevancy of free input supplies and technical support brought in by CBSP. The number of the respondent saying the free input supply as a relevant positive change brought in by CBSP was 41.1%. Not a single respondent said that it was not relevant. Only 12.2% of respondents felt technical support as the most relevant impact that came with the initiation of the CBSP.

Table 3. Percentage (%) of the respondents on impacts on free input supplies and technical support

| Relevancy of the Impact | Free Input supplies | Technical Support |
|-------------------------|---------------------|-------------------|
| Less                    | 6.5                 | 23                |
| Slightly                | 27.2                | 43.2              |
| Relevant                | 41.1                | 21.6              |
| Most                    | 25.2                | 12.2              |
| Total                   | 100                 | 100               |

Today, CBSP groups are provided with free input supply such as foundation seed at the initial year of establishment and after every two years. The CBSP groups are also provided with cornflake machine, Tengma frying pan, portable corn sheller, hoe and sickle and chemical fertilizers. The technical support such as training on quality seed production, seed selection, and pest and disease management are frequently provided. A regular monitoring on seed

production is done by both researchers and extension. Wangdi and Wangchuk (2015) reported that CBSP farmers are provided with three types of training at various intervals of maize growing stages which have contributed in quality seed production. The introduction of CBSP in the hills of Nepal has benefited the farmers with various training related to quality seed production and free input supplies as reported by Mathema and Gurung (2009).

### 3.5. Impact on Seed Security and Quality Maize Seed production

More than 30% of the respondents (Table 4) reported seed security and quality production as the most important positive impact that came with the establishment of CBSP. In the past, the community used to grow different maize varieties in same field or in close proximity due to limited size of land holding which had lead to the production of undesirable seeds. However, after the start of CBSP, farmers now grow the same variety of maize to avoid crossing. The farmers are also provided with many other inputs in the form of technical support by which the quality of seed production and seed security has improved significantly. Katwal et al (2009) reported that unlike other cereals, maize being cross-pollinated causes seed degeneration and the entire members of the group are encouraged to grow the same variety to avoid out-crossing, thus resulting in good quality seeds. The researchers in collaboration with the extension staff train all the CBSP members on production of quality seed, thus promoting seed security (Katwal et al 2009). Mathema and Gurung (2006) reported that the initiation of CBSP had enhanced quality and increase in maize seed production.

Table 4. Percentage (%) of respondents on impact on seed production and security

| Degree of Impact | Quality Seed Production | Seed Security |
|------------------|-------------------------|---------------|
| Not Important    | 1                       | 6             |
| Less Important   | 26                      | 24            |
| Important        | 38.5                    | 37            |
| Most Important   | 34.5                    | 33            |
| Total            | 100                     | 100           |

### 3.6. Change in Food consumption pattern in the CBSP Community

The food consumption pattern has also changed with the establishment of CBSP group. The percentage of respondent consuming maize before the initiation of CBSP was 95.9%, rice was 2.5% and millet was 1.7% (Figure 4). After the initiation of CBSP the percentage of maize consumption has decreased to 16.5% and the consumption of rice has increased to 83.5%. A paired sample t-test was carried out to see the differences. The study shows a significant ( $p < 0.05$ ) difference in food consumption pattern before ( $1.05 \pm 0.29$ ) and after ( $31.83 \pm 0.37$ ) condition at  $t(120) = -18.7$   $p = 0.001$ .

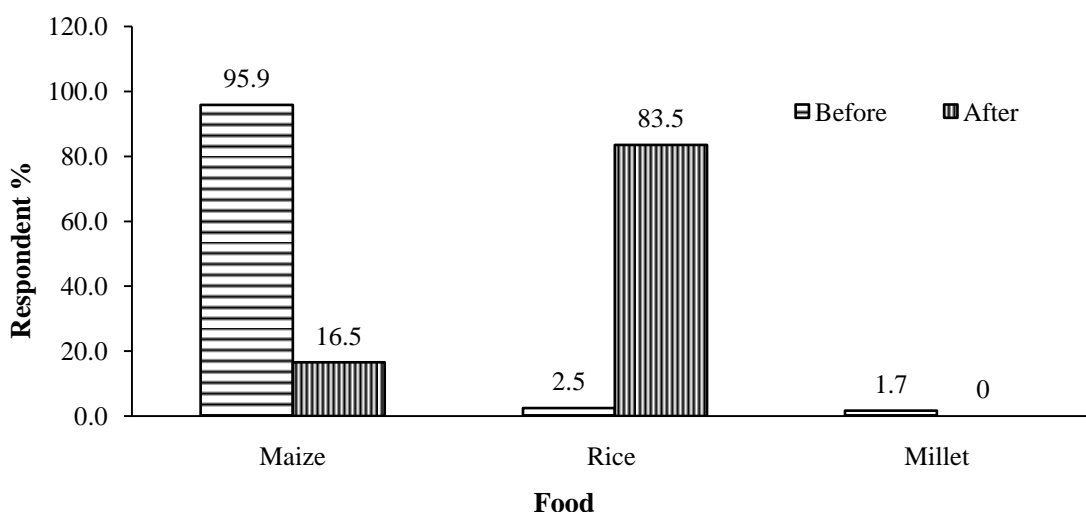


Figure 4. Change in food consumption pattern before and after the CBSP

Most of the respondents shared their views on the change of food consumption pattern. Maize always had a connotation of being a poor man's food. Maize is consumed as a staple food in the form of *Kharang* (grits) and hardly any cash is earned from the sale of maize, thus people are left with no option than to consume maize. However, today with the group formation, the marketing of maize is easy and the cash they earn from the maize has helped them to purchase and consume rice. Citing a report based on the Maize Assessment Survey 2005, Katwal et al (2015) state that the maize farmers consume 80% of the maize they produce, however, with the initiation of CBSP groups, the sale of maize has increased and the cash earned from the maize is used for buying rice, other food and animal feeds. The initiation of CBSP has brought change in the food consumption pattern within the community.

### 3.7. Negative Social Impacts of Community-Based Seed Production

The respondents were interviewed to identify and rank the negative impacts on the basis of importance (Table 5). About 27.3% agreed the increase in wage rate as the most important negative impact that came with the introduction of CBSP. There were 18.6% of respondents who felt the loss in diversity of maize varieties as another most important drawback of CBSP. More than 16% of the respondents viewed 'labor intensive' as one of the most important negative impacts.

Table 5. Relevancy of negative social impacts of CBSP (%)

| Impacts                             | Not at all | Not  | Neutral | Important | Most |
|-------------------------------------|------------|------|---------|-----------|------|
| Loss in Traditional Maize Varieties | 3.5        | 10.5 | 45.3    | 22.1      | 18.6 |
| Low Yield                           | 5.1        | 35.6 | 42.4    | 8.5       | 8.5  |
| Increase in wage rate               |            | 9.1  | 14.0    | 49.6      | 27.3 |
| Labor Intensive                     |            | 1.0  | 39.2    | 43.1      | 16.7 |

Likert Scale where 1 = Not at Important, 2 = Not Important, 3=Neutral, 4 = Important, 5 = Most Important

The production of quality maize seed requires intensive labour right from sowing till the marketing. Unlike before, the current practice of growing maize for seed is different. There



are various activities such as roguing, tagging of selected seed and other management practices involved, thus requiring more labour. Bhutanese CBSPs are small compared to the CBSPs of Nepal where the entire district is converted into seed group and every village grows different varieties of maize. However, in Bhutan the CBSP groups are small with small landholdings, thus the groups are encouraged to practice growing only one variety of maize to avoid out crossing. In the past farmers used to grow different varieties of maize in all the four sites. Today only two varieties of maize are grown. With the outbreak of GLS in 2007, CBSPs were initiated and farmers never had the chance to grow their traditional seeds leading to loss in diversity of the maize. A study by Shrestha et al (2012) found the loss in diversity of maize continues to be alarming in the CBSP sites of Nepal since farmers go for improved variety of maize. Bhatta et al (2007) reported the loss of traditional varieties was mostly due to the replacement by new improved varieties. A study by FAO (2011) found that 74% of crops grown in South Korea in 1985 have been replaced by improved varieties in 1993. The daily wage rate has increased significantly. CBSP involves intensive labor and the non-availability of the labourers within the community has increased the demand for labour. The wage rate of the male labour has increased from Nu 215 to Nu 500; similarly for female the rate has increased from Nu 150 to Nu 300. A study by Upadhyaya et al (2014) reported similar results. The study found that the price of maize seed in the market and the prevailing wage rate have direct relationship. The increased wage rates in the entire CBSP sites are due to increase in the price of maize over time.

### **3.8. Economic Impacts of Community-Based Seed Production**

#### ***3.8.1. Impact on household income***

Maize is considered as a major food crop for the farmers involved in Community Based Seed Production. It is one of the main field crops sold by the group and is considered as a major source of income (64.5%) followed by livestock product and off-farm activities such as weaving and carpentry at 12.4% respectively. Figure 5 shows the income trend from the sale of maize seed from 2012-2016. The study found that in the last five years the total income of the CBSPs from the sale of maize was Nu 40 million (M). The income trend has increased by 54% from Nu 4 M in 2012 to Nu 14.8 M in 2016. However, it showed a decrease from Nu 5.3 M to Nu 3.2 M in 2014. This was due to severe drought condition in CBSP site of Waichur in Mongar, which led to poor seed quality and low production. The average minimum income at household level was Nu 200 and the maximum was Nu 66,000 from the sale of maize. The income earned from the sale of maize was utilized in education of children, household expenses, ritual purposes etc.

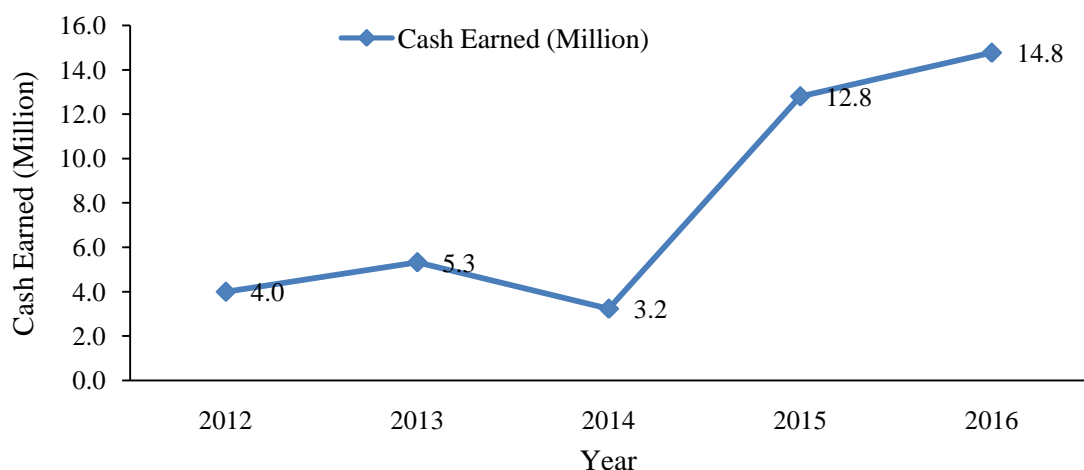


Figure 5. Income trend for six years

A study on *Maize Commodity Chain Analysis* by Katwal et al (2007) reported the sale of maize seed as a recent trend in Bhutan. Before, there were only insignificant transactions among the farmers within and outside the communities either for payment of labor or for seed. However, the CBSP has changed that trend and today all the members of the CBSP market their seeds. Upadhyaya et al (2014) reported that 86% of the CBSP members of Nepal reported an increase in maize income over the years.

### 3.8.2. Impact on Food Self-Sufficiency

This study looked at the household food security only from the production of maize. Since maize is the main crop grown within the community, the availability of the food is sufficient to feed the household members. About 96.7% responded that the production of maize is enough for them, however, only 3.3% of respondents felt the production of maize is not enough for their household (Table 6). These respondents had less land and labour. With the establishment of CBSP, the community grows high yielding varieties resistant to GLS, thus the food produced is sufficient.

Table 6. Respondent of maize self sufficiency

| Maize Production | Respondents' (%) |
|------------------|------------------|
| Enough           | 96.7%            |
| Not Enough       | 3.3%             |
| Total            | 100%             |

This study also found changes in the food self-sufficiency status before and after the initiation of CBSP. The percentage in the food self-sufficiency category of less than three months and 3 to 5 months has decreased from 2.5% to 0% and 57.9% to 13.2% respectively (Figure 6). However, the percentage in the food self-sufficiency category from 6-9 months and 9-11 months increased by 12.4% and 29.8% respectively. It indicates that the initiation of CBSP has brought changes in the food self-sufficiency status within the community. The study also showed that 5% of the respondents have become self-sufficient for the entire year with the initiation of CBSP.

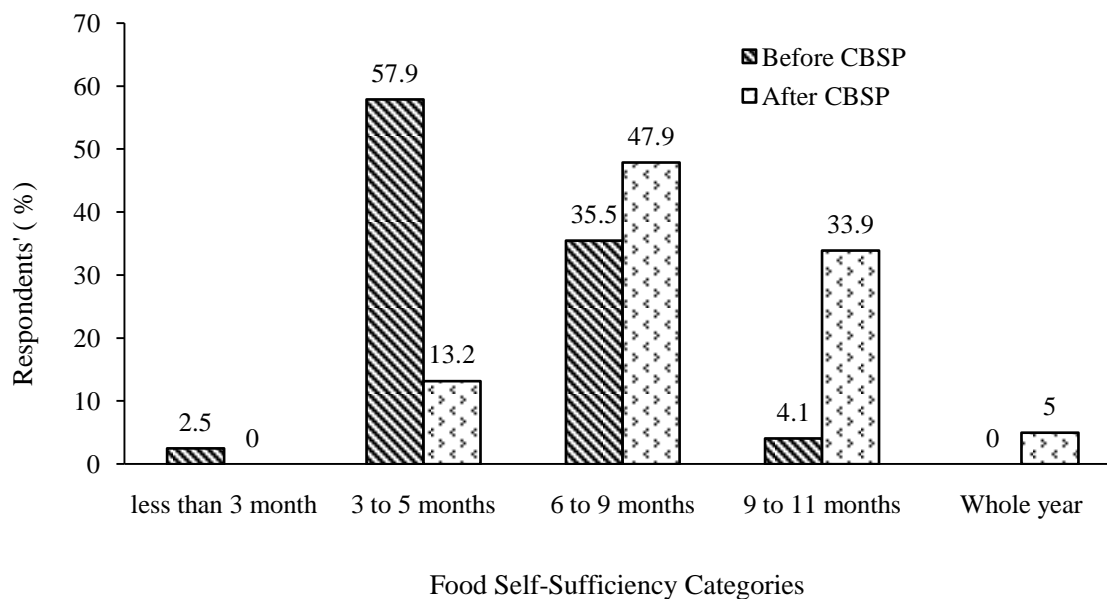


Figure 6. Household food self-sufficiency

Before, with low production, food insufficiency has been a major issue. The undesirable or poor quality of seed, depredation by wild animals and lack of farmers' capacity development had caused this issue. A similar study on assessing impacts of maize research through a livelihoods lens by Rovere et al (2009) found the initiation of CBSP in the community and growing improved varieties of maize have played an increasingly important role in improving livelihoods. The food self-sufficiency of participants in CBSP areas in Nepal improved from 11% in 2002 to 24% in 2006. The findings of Mathema and Gurung (2006) were similar to the cases in this study sites. The comparison in 2002 and 2006 showed that food self-sufficient households at each site increased. The number of farmers who were food self-sufficient for one year or more doubled due to adoption of maize technologies at CBSP sites. It clearly implies the direct positive impact of CBSP on food self-sufficiency.

### 3.8.3. Impact on price changes

The price of maize seed increased slightly compared to the past or at the initial establishment of CBSP. Since the National Seed Centre (NSC) is the major market for CBSP groups, the price of maize seeds is fixed by them. The average price of maize seed was Nu 18 per kg in 2011 which increased to Nu 20 in 2012. Every year the price was increased by Nu 1 and it was Nu 23 in 2016. The pricing fixed by NSC is higher than what they normally get (Nu 19-20 per kg). The pricing trend in CBSPs of Nepal for the five years was found to be increasing at all the sites. The average price of maize seed in 2003 was Nepali Rupee 14 per kg and NR 24 per Kg in 2007 (Upadhyaya et al 2014).

### 3.8.4. Impact on Marketing

All the respondents felt the changes in terms of marketing maize seed after the establishment of CBSP. Seed marketing is a recent trend in the community. After the establishment of CBSP, farmers experienced ease in marketing their seeds. The rate of seed marketing has

increased by 56.4% (21.3 ton in 2012 to 81.4 ton 2016) within the last five years (Figure 7). The increase in the sale of maize was mainly due to higher production of maize. Until 2014, only two older groups (Waichur and Changmey) were involved in the production of seeds. The seed marketing trend has increased within a short span of time. With the establishment of two new groups, the marketing of seed has increased. The decrease in rate of seed marketing trend in 2014 by 35.2% (18.4 ton in 2014 from 28.4 ton in 2013) was due to drought condition in the production sites which has hampered the quality of seed.

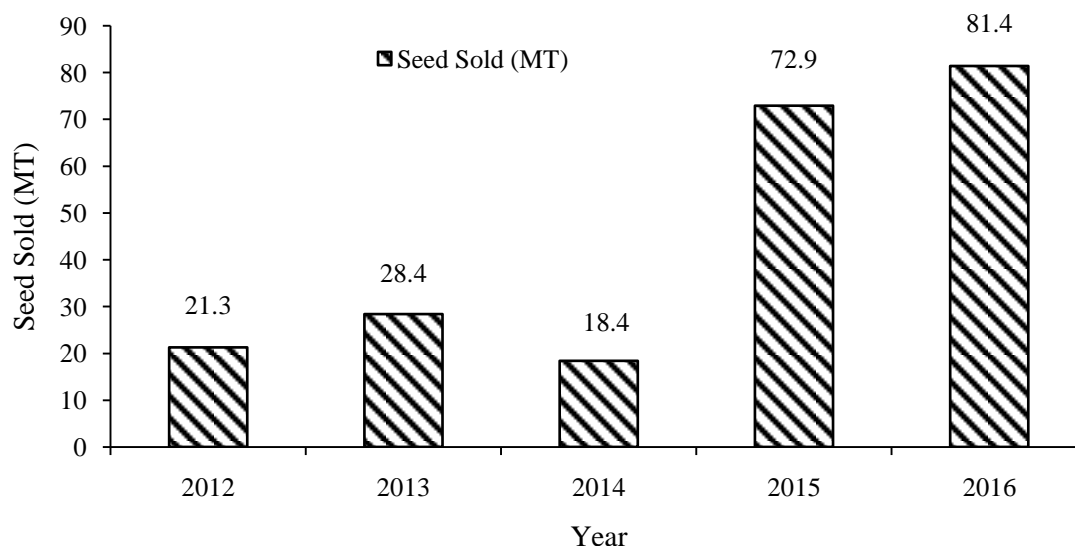


Figure 7. Seed marketing trend

Table 7 shows the major and frequently used market by CBSP members. The NSC based at Tashiyangtse is the major or main market for the CBSP groups since the groups are registered and linked with NSC. They also market their maize seed to other customers (10.9%) in the western part of the country as an animal feed and act as a seed source for their neighboring community who are not members of CBSP. Difficulty in the marketing of the produce in the past has encouraged the community in establishing CBSP. Today with the initiation of CBSP, the customers come at farmer's doorstep to buy the seed.

Table 7. Major markets

| Major Market         | Respondents' (%) |
|----------------------|------------------|
| National Seed Center | 88.1             |
| Neighbors            | 1.0              |
| Others               | 10.9             |
| Total                | 100              |

Katwal et al (2007) reported that one main problem in marketing maize has been the absence of the critical mass of surplus. The surpluses are scattered and are quite small at the household level. It also reported that organizing the farmers into groups had facilitated in marketing and enhancing the bargaining power of the farmers. A study by Upadhyaya et al (2014) in the hills of Nepal reported an increase in the marketing trend of maize seed from

75% of the production sold in 2011 to 90% of the production being sold in 2013. A similar study on CBSP in the hills of Nepal by Hamal et al (2010) observed an increase in the marketing trend of maize seed sold by 33%; the seed sold has increased from 60% in 2003 to 80% in 2007.

#### **4. Conclusion and Recommendations**

The study showed that the initiation of CBSP had benefited the group members in various ways. CBSP concept has played an important role in increasing quality maize seed production and ensuring seed security, enhancing the socio-economic condition and food security. The annual maize production of the CBSP within the last six years (2011-2016) has increased by 45.4% (37.4 ton in 2011 to 139.2 ton in 2016). The increase in production is related to use of improved varieties and adoption of quality seed production. The study found that growing a single variety of maize in a community has resulted in quality seed production and has increased the seed security. It was noted that the technical support and free input supplies were received more often than before. Farmers are provided with training on quality seed production, seed selection and pest and disease management. The mobilization of the community into group has brought unity within the community as said by 13.3% of the respondents. The unity was mostly in terms of decision making. Some drawbacks of CBSP were on the loss of traditional varieties, increasing wage rate and labor shortage.

The field survey data clearly reflects the direct positive impacts of CBSP on food self-sufficiency. Most of the members have significantly improved their food self-sufficiency status. For example, the category of the farmers with food self-sufficiency of 6-9 months has increased by 34.9%. With the increasing productivity, the income trend has also increased by 54%. The mobilization of community into group has seen a change in marketing. Unlike before, today the buyer come to farmers' door-step to buy the seed and the price has also increased annually. The CBSP model should be mainstreamed into seed production groups and must be introduced in all the maize growing areas. However, CSBP may risk loss of traditional varieties. To address this, conservation of local germplasm should also be implemented side by side through both *in-situ* and *ex-situ* conservation approaches.

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