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Households' Seed Security Level In The Aftermath of Earthquake: A Case Study From The Village Pawati-8 One Year After Earthquake, 25th April 2015

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Nawaraj Bhujel , August 2016

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**HOUSEHOLDS' SEED SECURITY LEVEL IN THE
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AFTER THE EARTHQUAKE, 25th APRIL 2015**

MASTER THESIS

NAWARAJ BHUJEL

Declaration

I, (Nawaraj Bhujel), declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Signature.....

Date.....

Dedication

Dedicated to all farmers in Nepal who were victim of the last earthquake in 25th April 2015.

Acknowledgement

I would like to express the deepest gratitude to my supervisor Ola Westegen for his excellent guidance, support, encouragement and care, and providing me friendly and comfortable environment during my thesis writing. I would like to also thank Norwegian University of Life Sciences (NMBU) for providing me opportunities to acquire diverse knowledge.

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I would also like to thank the households living at Pawati-8 for their time, patience, cooperation and response during interview.

Finally I would like to thank my mother Dil Maya Bhujel for her love and encouragement in every steps of my life.

Ås August 2016

Nawaraj Bhujel

Abstract

Despite the report of wide spread damage of seed system by the earthquake in after 25th April 2015, the seed security studies in pro-earthquake context (aftermath of earthquake) has been missed in several rural villages of Nepal. With aim identifying seed (maize and paddy) insecure households of one particular village, this study has examined the seed security level of randomly selected households living at Pawati-8 in Nepal. The match pair-mean comparison test was used to compare seed security level in the pro-disaster seasons (2015 and 2016) with seed security level in normal season. The findings suggest that the higher proportion of households (nearly double) were paddy insecure than maize seed in the season 2015. However the maize insecure households have sowed lower proportion of seed (by 6%) than the paddy insecure households in the same season. The findings also suggest that the proportion of seed insecure households (maize) have shrunk to 20% in the season 2016. The seed insecure households have been recovering their seed security level.

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CHAPTER ONE: INTRODUCTION

1.1 Introduction

Sustaining the agro activities in Nepal keeps direct association with the sustaining the national economy, rural livelihood and employment of thousands of people. However the widespread damage in agricultural sectors after the earthquake in 25th April 2015 has affected all sectors of life -posing thousands of the rural households to the risk of acute food insecurity. Seed is fundamental input of agricultural production and accessibility, availability and quality of seed not only determines the sustainability of production but also determines the corresponding availability, accessibility and quality of food as well. In this regard, seed security study should receive priority in Nepal (Paudel et al., 2009; Poudel and Shaw, 2016; Sperling, 2004; FAO, 2015b).

1.2 Background of Study/Rationale

The earthquake in 25th April 2015 and thousands of aftershocks have devastated agro production system in Nepal - resulting the loss of life, house, labor, farming equipment, land, crop store house, standing crops in the field, crops saved in home, seed, livestock, livestock house, income, infrastructure and access to credit. These losses extend to 31 districts (out of 75 districts) - resulting the loss of USD 385 million (in agriculture sector alone) and posing the rural farmers to risk of hunger and food insecurity (Government of Nepal: National Planning Commission, 2015; Rasul et al., 2015 ; FLASH NEPAL 2015; WFP, 2015; Nepal Food Security Cluster, 2015).

Together with these damages, several studies and the newspaper report the wide spread damage of seed system in the affected regions. This includes the report by Rasul et al. (2015) which admit that the seed loss remains substantial (more than 50%) over six districts: Dolakha, Sindupalanckowk, Rasuwa, Nuwakot, Dhading, Gorkha; includes findings of Food Security Cluster (2015) which claims that 50% of households lost their paddy, millet, wheat and maize seed immediate after earthquake; includes a article in Himalaya times (2015) which writes that these households lost their seed and stored crops under the rumble of collapse house and there were no seed in the market as well; includes the report by Government of Nepal: National Planning Commission (2015) which admits that the most of the farmer living in the affected region do not have seed storage facility, depite the possibility to access seed from standing crops; includes the finding of Food Security Cluster (2015) which reports the wide spread damage of agricultural infrastructure including chilling centers, processing plants and seed stores; and

includes the findings from same source which admits that the summer and spring planting (especially for rice and maize since the window for those crops are near) would be significantly affected with the crisis of seed.

Together with the crisis, several recovery policies and interventions have been also forwarded. The national planning commission of Nepal has come with the list –presenting the essential elements for reconstruction and recovery of agriculture system- including seed based recovery as key need. Similarly Rasul et al. (2015) has presented the key elements for the sustainable livelihood strategy, which include the supply of seed, tools and credit to the farmer and enterprises. Likewise FAO begun its assistance within few weeks after earthquake with the aim of supporting the long term recovery and reconstruction work in agriculture and livelihood sectors-targeting 1.5 millions people. During the span of 13 months, FAO distributed paddy, maize, wheat and vegetables seeds, seed bags and seed bins and facilitated the temporary collection centers for vegetables (FAO 2016b). Likewise, Lutheran World Relief (2016) has begun its seed intervention three months after earthquake with the aim of supporting early recovery of agriculture livelihood and food security. The intervention begun with distribution of soybean seed together with agriculture tool and cash to one district (Lampung, later followed to another district, Gorkha, as well), which has been followed monthly basis then after. Similarly Save the Children (2016) has also distributed food, seed and cash to support immediate need and early recovery of farmer livelihood while OXFAM (2015) has distributed paddy seed and cash voucher to replenish the destroyed supply.

Despite these reports of crisis and intervention, the study of seed security level in pro-disaster context has been missed in several disaster-affected regions-particularly in the village level. In Dolakha only, it has been reported “no information” of 43 villages including Pawati as well (OSOCC 2015). Also the seed intervention in several places has been either coupled with food intervention (which is particularly based on food security assessment) or modeled on the basis of the advice from District Agricultural Development Office (DADO) or District Disaster Relief Committee (DDRC). For example, in Juabari VDC located in Gorkha district, local citizen committee has recommended the name of receptionist to FAO for aid seed distribution(FAO, 2015a). In this regard, this paper will present current seed security status of the households living at Pawati -8 in Dolakha district.

1.3 Statement of Problem

Paddy and maize rank the first and second foremost staples crops in Nepal. These crops together represent the half grain-production of Nepal and are commonly grown above 70 meter above (from sea level) in plane and 2830 meter above in hill and mountain of Nepal (Paudel, Matsuoka, & others, 2009; Poudel and Shaw 2016). Maize is spring crop. When Nepal hit by the first big earthquake in April, the farmer were close to season of maize. When Nepal again received another big after shock in May 2015, they were close to paddy season. In this regard, this study chooses paddy seed and maize seed to access the seed security level in pro-disaster context (emergency context).

Comparing the seed security level before disaster with the seed security level after disaster is the fundamental process of accessing the seed security level in pro-disaster context (FAO 2016a). In Haiti earthquake case in 2010, seed security levels of two consecutive seasons after earthquake has been compared with the seed security level before earthquake (CRS et al. 2010). This study will also use two consecutive seasons (2015 and 2016) for maize seed and the first season (2015) for paddy seed to access the seed security level in pro-disaster context.

Several authors and reports link the households' seed insecurity level with the level of their home stock seed loss and purchasing power (Sperling, 2004; Sperling et. Al, 2008; CRS, nd; Sperling & Cooper, 2004). In case of Haiti, the household substantially lost their purchasing power together with the loss of assets and other properties and could not afford the seed available in the market (CRS et al. 2010). Similar case has been also registered in case of Malawi flood case in 2015, where the households lost their seed stock in home to flood and could not purchase seed from the local market (Walters and Ashman 2015). In Nepal as well, seed crisis in households level has been linked with the level of home stock loss. With this regard, this study will examine the seed security level based on the following indicators.

1. Total Amount of Seed Accessed
2. Amount of Seed Accessed from Home and Other Sources
3. Amount of Seed Purchased

For this, the study will use quantitative method.

1.4 Objective of Study

Board Objectives: To identify whether the households living at Pawati-8 were seed secured or not after the earthquake in 25th April 2015

Objective 1: To examine whether the households living at Pawati-8 have been obtaining sufficient seed or not since last earthquake

Research Question 1.1: Did the households living at Pawati-8 source lesser maize and paddy seed for the first season after earthquake than normally required before earthquake?

Sub-Research question 1.2: Did the households living at Pawati-8 source lesser maize seed for the second season after earthquake than normally required before earthquake?

Objective 2: To identify whether the households have been obtaining enough seed from home stock or not

Research Question 2.1: Did the households living at Pawati-8 source lesser maize and paddy seed from home stock for the first season after earthquake than normally required before earthquake?

Research Question 2.1 Did the households living at Pawati-8 source lesser maize seed from home stock for the second season after earthquake than normally required before earthquake?

Objective 3: To identify whether they have been accessing higher amount of seed from cash purchase or not

Sub-Research Question 3.1: Did the households living at Pawati-8 purchase lesser maize and paddy seed for the first season after earthquake than normally required before earthquake?

Sub-Research Question 3.2: Did the households living at Pawati-8 purchase lesser maize seed for the second season after earthquake than normally required before earthquake?

1.5 Significance of Study

The finding of this study would offer the information that can be used to guide the potential seed intervention at Pawat-8. NGOs, INGOs and Governmental Bodies, currently involving in the recovery activities of agriculture system in rural sectors of Nepal (in post-disaster context), could also benefit from the finding as it provides the viable information of seed system in pro-disaster context. The study would also provide large set of data across three seasons, which can be reused for further studies and research in seed and agriculture sectors.

1.6 Delimitation of Study

The delimitation of study is process of defining the boundary of study which delimitates the choice of objective, research questions, variables of interest, theoretical prospective and the population under investigation (Simon 2011). In regard to this research, this study was confined to the households living at Pawati-8 in Dolakha District of Nepal. It belongs to the district, which was devastated by the earthquake in 25 April 2015 and is dominated by the households whose livelihood is based on the farming activities. Apart from this, there exist five fundamental elements: availability, access, varietal suitability, resilience and quality to access seed security level in emergency context or pro disaster context. This study particularly focuses on availability (in home) and accessibility (from home, other and purchase) of seed regardless of variety.

1.7 Limitations of Study

The households of Pawati-8 have been sourcing their seed from home stock, social network, local market and government. This study does not use each of these sources separately. However these sources are divided into home stock and other (social network + local market + government) to represent them in this study.

Few variables used in this study have registered very few entries to perform statistical test. Those variables are not used for inferential purpose but used for specific context.

1.8 Definition of Term Used

Disaster: refers to the earthquake in 25th April 2015 and hundred of after shocks extended to end of May 2015

Normal Season: refers one season just before the earthquake. This implies to seasons of maize and paddy only where maize is basically grown from April to August while paddy is grown from July to September

Pro-Disaster Season: refers to two consecutive seasons (2015 and 2016) after earthquake in 2015. This only implies to season of maize and paddy

Home Stock Seed: refers to the seed saved in home for up coming season.

Social Network: refers to the network among the neighbor, relatives and friends living at Pawati

Local Market: refers the local grain market at Pawati

Government: refers to the district agriculture office at Dolakha district in Nepal

Other: represents local market, government and social network.

Purchased seed: refers to seed purchased by paying money

Income: refers to the income generated by selling the harvest.

House: refers to the condition of house after May 2015. It is categorized into three levels: fully damage, partially damage and no damage. Fully damage refers to collapse of house into rubble; partial damage ranges from crack in wall to collapse of top floor; and no damage indicates that the house is in same condition as it was before earthquake.

CHAPTER TWO: LITERATURE REVIEW

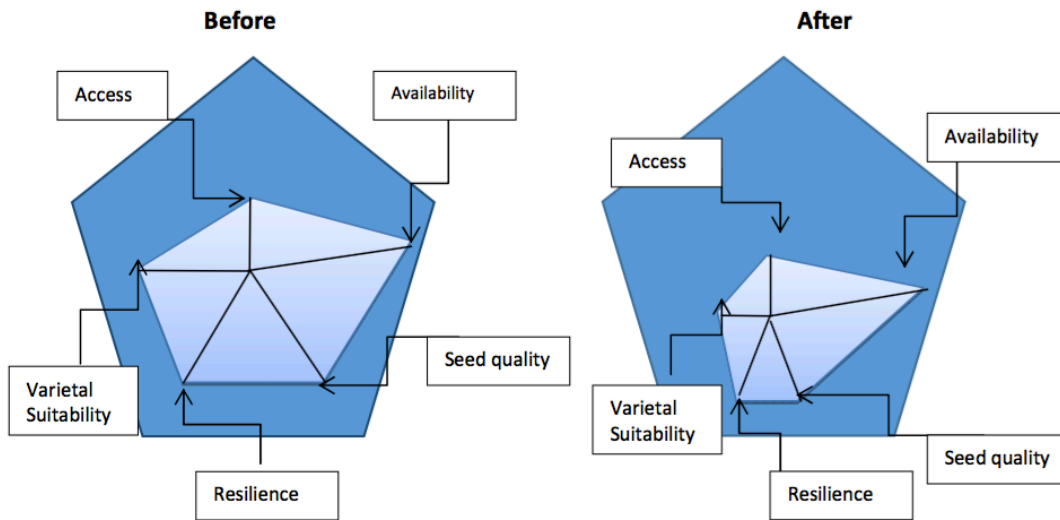
2.1 Concept Review

Seed Security: The most of definitions on whether a farmer living in a region is seed secured or not grounds on whether seed has available or not; whether the farmer has ability to access it or not; and whether seed possesses desired quality and variety or not. Among them, the definition presented by FAO (2016a) associates the farmers' seed security level with their ability to access adequate seed of desired variety and planting material of adopted crops during both good and bad season. Likewise, Scowcroft and Polak Scowcroft (as cited in Sperling and Cooper, 2004) corresponds it with the farmers' ability to access adequate amount of desired variety at right time. While (Louwaars and Tripp 1999) believe on sustained access of desired variety rather than only access. Similarly, Van Der Burg (1998) and (Sperling and Cooper 2004) admit that the farmers need to access year after year rather than for imminent season of planting in order to remain seed secured. Likewise Remington et al. (2002) believe that the adequate availability of seed of adopted variety within the reasonable proximities at time of critical sowing period defines the part of households' seed security.

Conceptualization of Seed Security Level In Disaster Context

Despite these several works in seed security concepts, how to measure seed security is still remaining fundamental issue in seed security assessment, as there are no universally recognized methods for measuring seed insecurity. However FAO (2015b) presents seed security pentagon, which presents the way of conceptualizing and visualizing seed security level at households level.

Figure 1: Seed security pentagon before and after a severe localized drought



Each pentagon consists five elements: Access, Availability, Seed Quality, Varietal Suitability, and Resilience for measuring seed security level before and after disaster. The larger area (dark blue) of each seed pentagon represents the theoretical maximum of seed security; the smaller area (light blue) represents the actual seed security level; and length of each side of light blue pentagon (corresponded to each above elements) represents the level of seed security based on those elements. The change in the area of pentagon (light blue) indicates the change in seed security level while change in the length of side indicates the change in the seed security based on the elements. The above figure shows the smaller pentagon (light blue) in the right side than the pentagon (light blue) in the left side with one equal side (availability). This change indicates that the households are seed secured from seed availability element but not from other.

Seed Availability: The concept of seed availability is basically grounded on physical quantity, time and space. Sperling and Cooper (2004) define that availability is geographical based parameter and exists independent of socio-economical factors. They further extend that the presence of target crop in a region defines the corresponding availability of seed in the region. Remington et al. (2002) also agree on the spatial availability of seed, but extends that the available seed should be the seed of adopted crops and should be available at time for critical sowing period as well.

Apart from these definitions, FAO (2015b) presents the indicators of seed availability in households' level, which includes the following.

- Quantity of seed stock in home

- Quantity of seed stock known to exist in social network, local market and formal seed sectors
- Quantity of seed available through seed aid organization at time of planting
- Proximities of seed source like distance to local market

Seed Accessibility: The concept of seed access is basically associated with the financial and social ability of individual. Sperling & Cooper (2004) argues that the level of financial and social capital of individual determines their corresponding seed access. They further extend that income, land, house and other physical properties represent their financial capital while social relation, power and status represents their social capital. Likewise Sperling, Cooper, and Remington (2008) present different methods of access with respects to financial capital and social capital. These include access from one saved seed, barter, exchange, cash purchase, loan, and gift. They further appropriate these methods of access with the seed sources. For example, the farmer often accesses seed by purchase from local market but also from social network. Likewise social network often facilitates exchange, barter, gift or loan while the formal seed sectors can offer all modes of access.

In addition, FAO (2015b) presents the indicators of accessibility which includes the following.

- Amount of seed accessible by households through social network (social access)
- Level of households' income obtained by different sources
- Level of physical assets
- Purchasing power of households

Acute and Chronic Seed Insecurity: The idea of acute and chronic seed insecurity is basically grounded on the duration of insecurity and factors triggering that insecurity. Sperling (2003) believes that the short-lived events (disaster like flood and drought) trigger the seed shortage (acute seed insecurity) for short while poverty or resource deprivation can sustain seed insecurity (chronic seed insecurity) year after year. Sperling (2004) extends that crop failure in the single season, or one-time loss of seed stocks often pose the households to acute seed insecurity while in the normal scenarios, they are either seed secured or semi-seed secured or not seed secured (chronic seed insecurity). She further adds that those households who recover their seed security shortly immediately after acute events (flood, earthquake or civil disturbance) falls into the households suffering acute seed problem while rest falls into the category of chronic seed stress.

She also admits that the population marginalized economically (poverty, land, labor), ecologically (repeated drought, degraded land) and politically (war zone) often pose to higher risk of chronic seed security.

Seed Availability and Accessibility (Assumptions, Findings and Cases)

The cases of seed availability includes the assumptions, findings, and cases –arguing on the whether seed remains available or not during the stress or at least during the first season after disaster. These include assumption (often by seed relief agency to guide their seed intervention in emergency context) which states “seed remains unavailable locally during acute stress”; and include the case of southern Somalia (1992-93) where widespread displacement of community detached them from the farming activities and posed them to risk of absolute unavailability of seed Sperling (2004). In contrary to these, these include findings from Sperling & Cooper (2004) which states that the absolute unavailability of seed is very rare case since at least one source of seed keeps potential to serve in the crisis (either in local market or agro dealer); and include the findings of Haiti Earthquake (2010) and Southern Malawi Flood Case (2015), where seed remains available in the local seed system despite significant loss in home stock.

The cases of seed availability and accessibility include studies comprising the relative strength of each sources during the stress. These includes the study of Sperling & Cooper (2004) which believes that the local seed system meets higher proportion of seed demand than the formal seed system during crisis, includes the findings (based on the several case studies in Africa) by Sperling, Cooper, and Remington (2008) which admit the role of local grain market always remains influential during the crisis; include the case of Haiti, where more than 75% need of seed came from the local market; and include the case of Malawi where the local agro dealer and local market have enough seed to meet the seed crisis generated by flood.

The issue of availability also includes the cases –reporting general misconception on defining the problem of availability and problem of utilization (variety and quality). This includes the clarification by CRS (nd) in the context of seed intervention, which states that if seed is available and not of desired quality and variety, then it is problem of seed utilization, not the problem of seed availability.

The issue of availability and accessibility also include a case -explaining the complexities on defining the scale of availability. This include a study from Sperling (2004) which indicates that the availability can be relatively defined depending upon the social and financial ability of

individual. For example, for the individual possesses enough money and transport, the seed existed outside his/her community/region is also available (Sperling, 2004).

The issue of availability also includes the cases –comparing the availability based on the seed multiplication rate. This includes the study from Sperling, Cooper, and Remington (2008) which argues that it is more likely to have problem of seed availability to those crops which has lower seed multiplication rate. For example, small grain crops like millet retains higher multiplication rate (only 1% of harvest is enough for next planting). In this situation, only total harvest failure can deplete home stock seed.

Similarly the issue of accessibility includes the literatures explaining the reasons of reduced access. These include the remark of Sperling & Cooper (2004) which, in general, states that the reduced access in crisis period is often triggered with the financial constraint; include the case of Haiti where the reduced access came significantly from hike in seed price, the lower purchasing power, poor land tenure, repeated health issue and destruction of infrastructure; include the case of Malawi, where it was associated with the harvest loss and reduced income; and include the list of (CRS n.d.) which enlists the collapse of local market and poor social network for the reduced access; and includes the findings from Poudel et al. (as cited in Coomes et al., 2015) which admits that the community with weak social connection have always constrained access to locally adopted crops –posing them risk during the adverse condition.

The issue of accessibility includes studies - reporting condition of secure access. These include the study by Sperling, Cooper, and Remington (2008) which presents that the households owning secure land and labor can find way to access the seeds of key crops during the stress, include the study from (Sperling 2004) which admits that the access to variety can be only problem when pest and diseases leads total varietal breakdown.

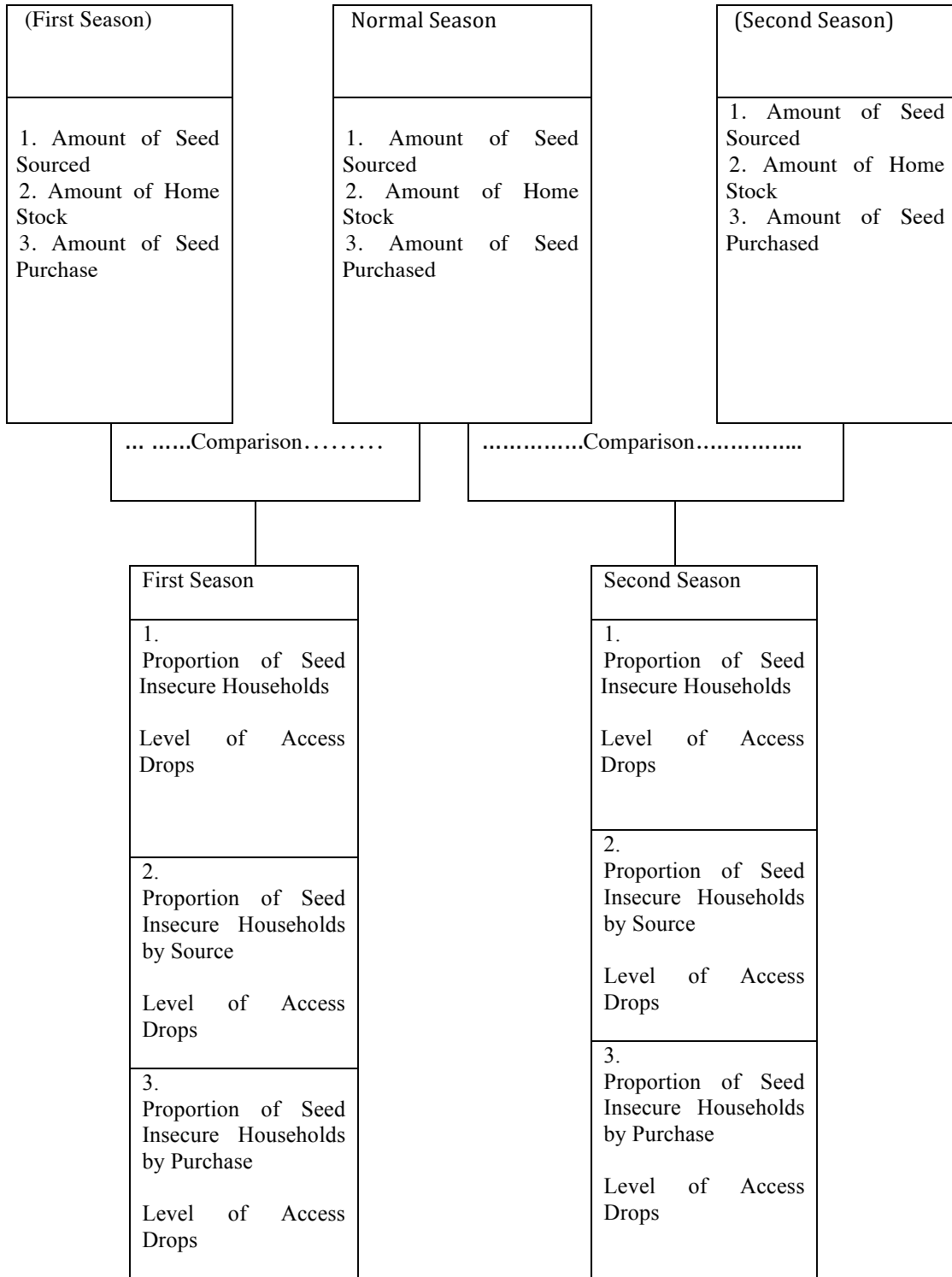
Seed Security Assessment (SSA): The seed security assessment basically offers four fundamental tools: availability, access, varietal suitability and quality to access the seed security level during three board situations: protracted situation, non-emergency and post-disaster/emergency. In protracted crisis, the seed security may rise or fall together with periodic worsening and improvements of situation. When there appears “sudden change” in seed security level within the overall context, then it may be viable to use the assessment based on before and after technique with respect to “sudden change”. In non-emergency context, it uses current seed security situation without comparing it with any other situation. In contrary to this, the seed

security assessment in pro-disaster context uses at least two situations: situation before disaster and situation after disaster for comparison. The situation after disaster often includes two seasons (FAO 2016a).

2.2 Conceptual Framework

Conceptual framework refers to the construct or structure of interlinked concepts that provides the comprehensive understanding of phenomena. It includes the layout of variables and presumes the relation among them (Teoh and Pan 2004). With regard to this study as well, the layout of variables has been presented to provide visual description of phenomena.

Figure 1: Conceptual Framework



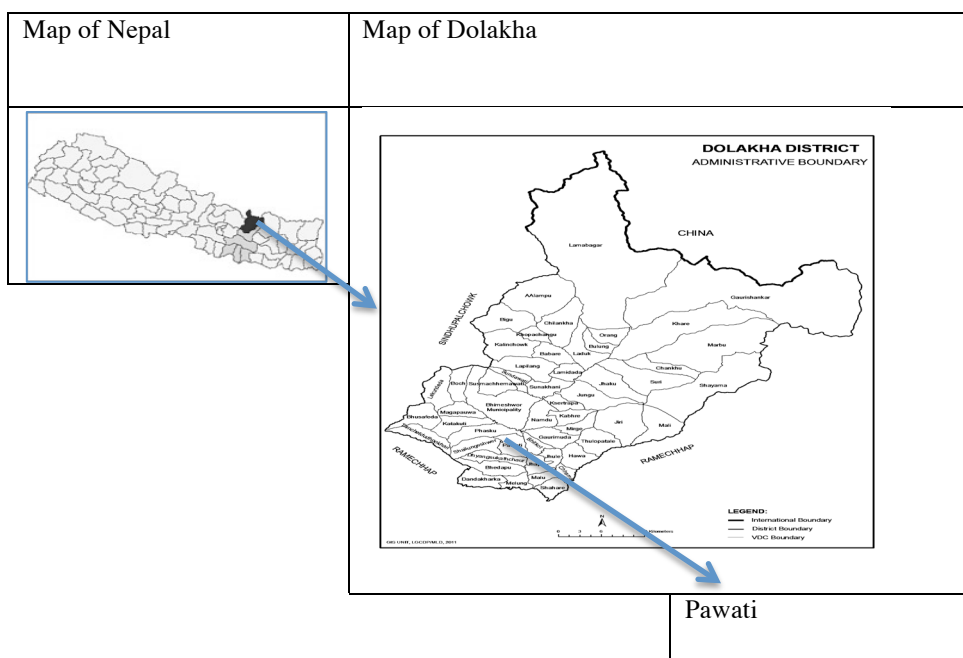
CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Research Design

Any research needs general plan or framework that guides whole data collection and analysis process as need of research questions and objectives (Bryman 2012). In regard to this research, the framework of explanatory survey research was followed to guide data collection and analysis. This design facilitates both comparative study and study of causal relation among the variables (Teoh & Pan, 2004; Bhattacharjee 2012) which is a key part of this research

3.2 Target Population

Figure 2: Map of Nepal



Target population represents a large population on which a researcher wish to conduct his/her study and from which sample is withdrawn (Brink, 1998). In regard this study, the target population includes 110 households currently living at Pawati VDC-8 in Dolakha. Similarly the target population should possess some fundamental characteristics that hints researcher whether the given population fulfills research requirement or not. In regard to this study, the population must belong to zone affected from recent earthquake. Apart from that, at least one member from each population unit (in this case households) should actively involve in farming from last three years. The 110 households hold both characteristics.

3.3 Sample Size

How precisely the given fraction of population or sample infers population depends on sample size (Ott and Longnecker 2001). Neither large sample nor small sample can provide precise inference about population. Apart from precision, resources and time constraints can also influence the decision of sample size (Bryman 2012). In regard to this research, it was expected that the precision on inference could be achieved by collecting data from 52 samples. This sample size was determined by using Yamane's formula (Yamane, 1967). The cost and time of handling larger sample size were managed by working on 10% error rather than smaller error level (1% or 5%), which can increase sample size dramatically (nearly equal to population size). In 10% error level, sample size was calculated as given below.

Here

$$n = N / (1 + Ne^2)$$

Where

Sample size = n

Error level = e = (10%/100 = 0.1)

Population size = N = 110

$$\begin{aligned} n &= 110 / (1 + 110 * 0.1^2) \\ &= 110 / (1 + 110 * 0.01) \\ &= 110 / (1 + 1.1) \\ &= 110 / 2.1 \\ &= 52.39 \end{aligned}$$

Approximately 52

3.4 Sampling Procedure

Simple random sampling method was chosen as sampling method in this research. This sampling method provides equal chance of selecting each sample unit (household) independently from given population- avoiding chance of over-represent or under-represent of any part of population (Ott and Longnecker 2001). In order to select the sample randomly, each household were first assigned to number from 1 to 110 and then tabulated. Then 52 numbers were selected randomly from the table without replication. This process provides equal likelihood for each household to be selected as sample (Ott and Longnecker 2001).

3.5 Research Instrument

This research employed structure interview as research instrument. This comprised both close-ended and open-ended questionnaire. The instrument was divided into two sections. The first section focused on the general details of respondents and the second section focused on the research objectives.

This instrument was selected because of three reasons. The interview survey with close and open-ended questions can serve data appropriate for quantitative analysis. The response aggregation, data recording and data processing can be easily handled since each respondent faces the same set of question in structure interview (Bryman 2012). The selected sample for this study belongs to rural community that probably has limited access to education and communication. In this constraint as well, the individual interview is possible whereas other instruments, for instance questionnaire, is limited by these factors (Wilkinson and Birmingham 2003).

3.6 Piloting of the Study

One-way of testing how efficient our research instrument is: to conduct a small study in the study site prior to final study. This process is called piloting of study (Wilkinson and Birmingham 2003). In regard to this study as well, the piloting of study was used to test whether interview questionnaire was logically designed, clear and understandable or not; included unnecessary themes or not; missed important themes or not; was lengthy and exhausted to answer or not; and needed edition in research questions correspond with change of instruments or not. Likewise selection of sample and sample size is also important part of pilot study. Mugenda and Mugenda (as cited in Tongi, 2015) suggest that sample size for study should represent 10% of sample size for main study and should be chosen randomly but should not be included as sample when conducting main study. In regard to this study, 5 samples were chosen randomly from 52 samples and not approached as sample for further study.

3.7 Validity of the Research Instrument

The validity of research instrument refers to the quality of measurement made by the research instrument. The quality of measurement is determined by whether the research instrument can measure what we are supposed to measure or not. Bryan (2012) defines validity as the issue of whether set of indicators derived to measure concept really measure that concept or not.

Bhattacharjee (2012) further extends validity to face validity. The face validity refers the strength of indicators to measure underlying constructs of concept (for example, frequency of visit in church to measure religiosity). Bryan (2012) argues that the measure of face validity apparently reflects content of concept in question. He further adds that the judgment from expert and experience facilitates to establish content validity of concept. In regard to this research, major concepts (seed availability and accessibility) and research instrument were adopted from the framework of seed security assessment (McGuire and Sperling 2016). In addition, the research supervisor reviewed the research instrument to ensure content validity of research, which basically measures whether the instrument covers what is supposed to cover or not.

3.8 Reliability of the Research Instrument

The reliability of research instruments refers to consistency in measurement. In other word, it tells about whether the research instrument measures what is intended to measurer or not. One-way of measuring reliability of instrument is: to measure the degree at which the respondents give consistent answer for same construct (Bryan, 2012). With regard to this study, researcher has conducted piloting of study on small samples to test the efficiency of instrument. Sampled respondents show consistency in their answers.

3.9 Data Collection Procedure

Data were collected using the interview questionnaire adopted from the questionnaire template used by McGuire and Sperling(2016). The interview questionnaires were edited – based on the response from pilot sample-before using them for final data collection. A person was hired to guide the location and identify the respondent during the study. The respondents were visited either in home or field and the household head was preferred for each interview. In absent of the first head, the second head was approached. The responses were recorded in the questionnaire templates available in computer. The interview and recording process were done simultaneously.

3.10 Data Analysis Procedure

Data were cleaned, coded, entered and analyzed by using STATA (Version 12.1 for Mac). This statistical package eases data import from excel file, offers wide range of statistical tools and operations and eases export of result to other file (Baum, Schaffer, and Stillman 2011). In addition, figures (Box Plot, Bar Graph and Venn Diagram) were produced by using STATA, excel (Version 14.0.0) and word (Version 14.0.0). For analysis of each individual variable, the descriptive statistics was used. The descriptive analysis is often used to describe general

properties of single variable (Bhattacharjee 2012). With regard to this research, it was used to describe central tendency (mean), dispersion and frequency distribution of each individual variable. Likewise, General Linear Model (GLM) and Two Group Comparison Test (TGCT) were used for inferential analysis. The inferential analysis is often used to reach the conclusions about association among the variables (Bhattacharjee 2012). In regard to this study, the measure of association and mean comparison among the different variables constitutes large portion of analysis. So GLM model was adopted for the measure of association and Match Pair Mean T test for comparison.

3.11 Ethical Considerations

The researcher should respect the respondents' right to participate or not participate in interview. The research should also ensure the confidentiality of information (provided by the respondent), no physical and psychological harm (to the respondent) and the right of leaving interview in any stages of interview (Bryman 2012). In regard to this research, the inform consent was obtained from each of the respondents before taking interview. Before that, the researcher explained the objectives of study to facilitate the information, based on which they could decide whether to participate or not. Apart from this, the choices of escaping any questions (sensible and personal) and leaving the interview in anytime were given to the respondents. During interview, none of the respondent was physically harmed and the details provided by them were maintained confidential.

3.12 Operationalization of Variables

The table below presents the list of operationalized variables. Since maize and paddy both share these variables over three seasons, the table only refers seed instead of maize seed or paddy seed.

Table 1: Operationalization of Variables

s.no.	Variables (For three seasons)	Definition	Unit	Level	Tools of Analysis	Specific Tool
1.	Amount of Seed Sourced	Total sum of seed sourced from home, social network, market and government	Kg	Numerical	-Descriptive Statistics -Comparative	-Mean, Standard Deviation, frequency count -Match Pair Mean

					Statistics	Comparison test
2.	Amount of Seed Sourced From Home	Amount of Seed Sourced from home stock	Kg	Numerical	- Descriptive Statistics -Comparative Statistics	-Mean, Standard Deviation, frequency count -Match Pair Mean Comparison test
3	Amount of Seed Purchase	Amount of seed purchasing by cash	Kg	Numerical	-Descriptive Statistics -Comparative Statistics	-Mean, Standard Deviation, frequency count -Match Pair Mean Comparison test
4	Proportion of Seed Insecure Households	The percentage of households accessing lower amount seed than normally required	%	Count	Descriptive	Bar Graph
5	Proportion of Seed Insecure Households by Source	The percentage of households accessing lower amount seed (from home or other or both) than normally required	%	Count	Descriptive	Bar Graph Venn Diagram Table
6	Proportion of Seed Insecure Households by Source	The percentage of households accessing lower amount seed (from home or other or both) than normally required	%	Count	Descriptive	Bar Graph
7	Level of Access Drops	The percentage of reduced access in compared to the access level in normal season	%	Count Numeric	Comparatives Statistics	Match Pair Mean Comparison Test

CHAPTER FOUR: DATA ANALYSIS PRESENTATION AND INTERPRETATION

4.1 Summary Statistics

The table below presents the descriptive statistics containing the number of observations (obs.), mean, standard deviation (Std.d), maximum value (Max) and minimum value (Min) for paddy and maize seed. It presents mean seed accessed from home, other sources and by purchase over three seasons (Normal, First and Second Season) for maize and two seasons (Normal and First season) for paddy.

Table 2: Summary Statistics

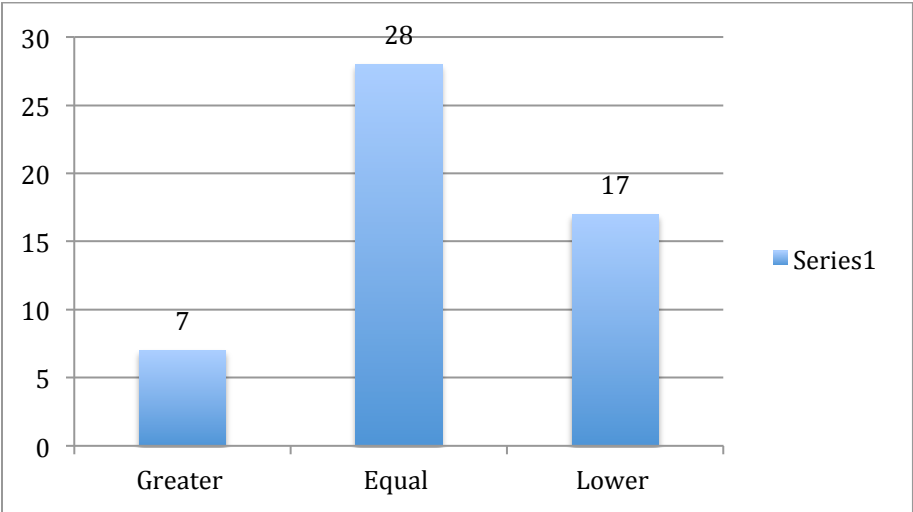
Maize						
Variables	Season	Obs.	Mean	Std. D.	Min	Max
Total	Normal	52	7.9	7.53	1	54
Total	First	52	7.7	7.6	1	53
Total	Second	52	8.09	7.6	1	53
Home	Normal	34	7.1	6.1	1	36
Home	First	28	6.8	6.7	1	38
Home	Second	29	6.6	2.9	2	12
Other	Normal	27	6.3	4.7	1	18
Other	First	40	5.4	4.2	1	17
Other	Second	33	5.8	4.9	1	20
Purchase	Normal	13	5.1	4.9	1	15
Purchase	First	19	4.8	4.5	1	17
Purchase	Second	16	4.6	5.2	1	20
Paddy						
Total	Normal	48	44.18	19.67	18	125
Total	First	48	41.9	17.4	18	100
Home	Normal	37	37.43	17.89	10	100
Home	First	34	30.32	12.69	10	60
Other	Normal	34	21.64	15.77	5	60
Other	First	42	23.67	15.24	3	55
Purchase	Normal	5	28.2	20.88	10	60
Purchase	First	18	22.06	15.73	5	55

4.2 Proportion of Households Accessing Lower Amount of Seed

This section presents the proportion of households who have accessed lower amount of seed during pro-disaster season (first and second season after earthquake). For that, it uses the bar graph consisting three categories: greater, equal and lower. The category “greater” includes those households who have accessed higher amount of seed in the first season than they normally require. The category “equal” includes those households whose amount of access is indifferent. The category “lower” includes those households who have accessed lower amount of seed.

4.2a. First Season (Maize)

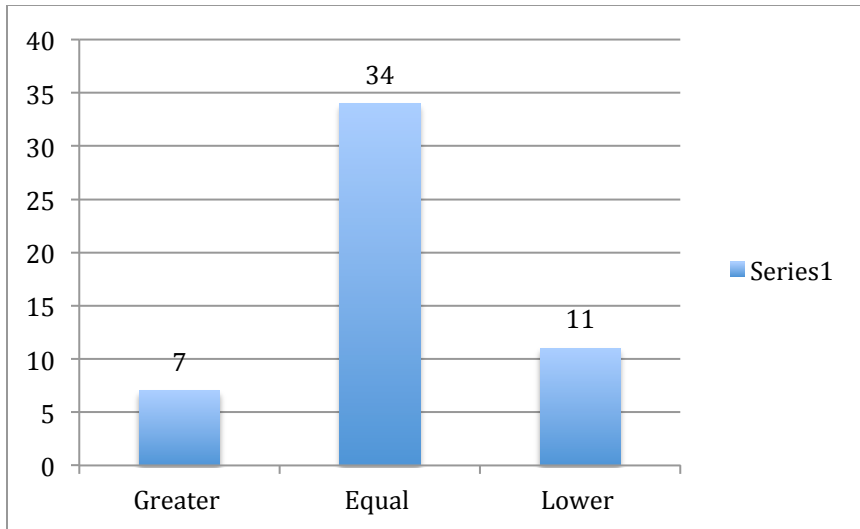
A Bar Graph 1: The proportion of Households Accessing Lower Amount of Maize Seed in The First Season



The bar graph shows that one- third (=17) of households has registered the fall (seed shortage) in the first season. They have only managed 83% of seed (p-value = 0.000).

4.2b. Second Season (Maize)

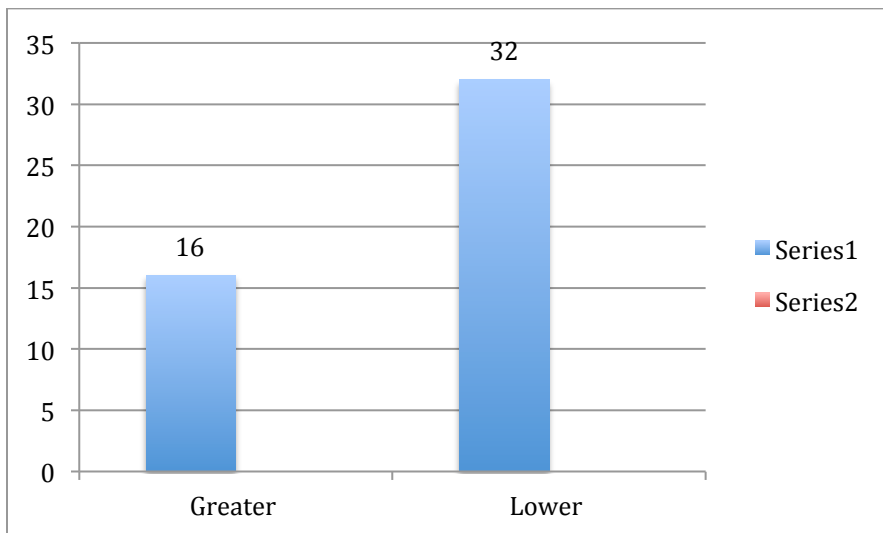
A Bar Graph 2: The proportion of Households Accessing Lower Amount of Maize Seed in The Second Season



The figure shows that 80% of households have managed their regular amount of seed in the second season. Those (11) who failed to manage their regular need have accessed 12% lower amount of seed than normally required (p-value = 0.000).

4.2c. First Season (Paddy)

A Bar Graph 3: The proportion of Households Accessing Lower Amount of Maize Seed in The First Season



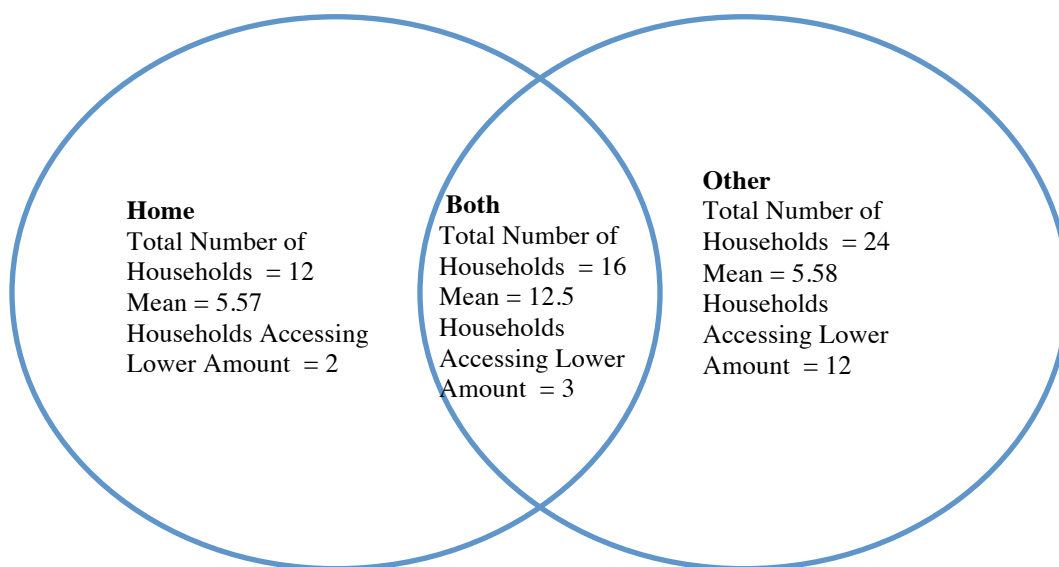
The bar graph shows that two third of households have accessed the lower amount of paddy seed than they normally required. They have shortly failed to meet their usual amount (by 11%, p-value = 0.000)

4.3 Proportion of Households Accessing Lower Amount of Seed From Different Sources

The households living at Pawati-8 have reported four seed sources: home stock, social network, local market and government. This section divides them into two sources: “Home Stock” and “Other”. “Other” includes all those households who have sourced seed from at least one of these three sources: social network, government and local market. The proportion of households who fall into each these sources is presented in the Venn diagram below. The details in the intersection “both” represents the details of those households who have used both home stock and other to access seed.

4.3a. First Season (Maize)

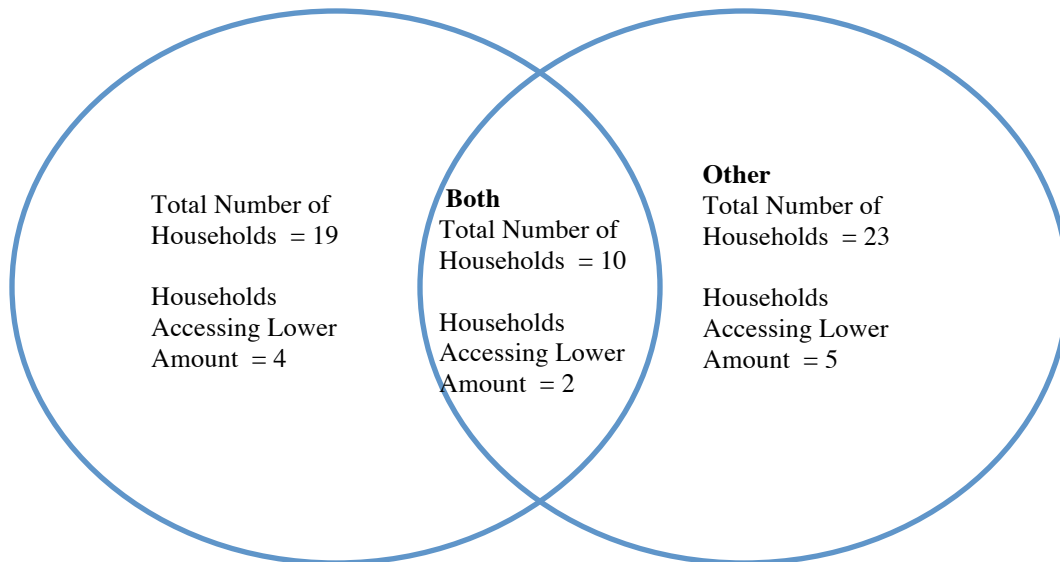
Venn Diagram 1: The proportion of Households Accessing Lower Amount of Maize Seed From Different Sources in The First Season



The diagram shows that the highest proportion of households has sourced their seed from other. However 50% of them have only managed 48% of seed for the first season (p value = 0.014). In contrary to this, majority of households (75%) sourcing seed either from home stock or both sources have managed their need.

4.3b. Second Season (Maize)

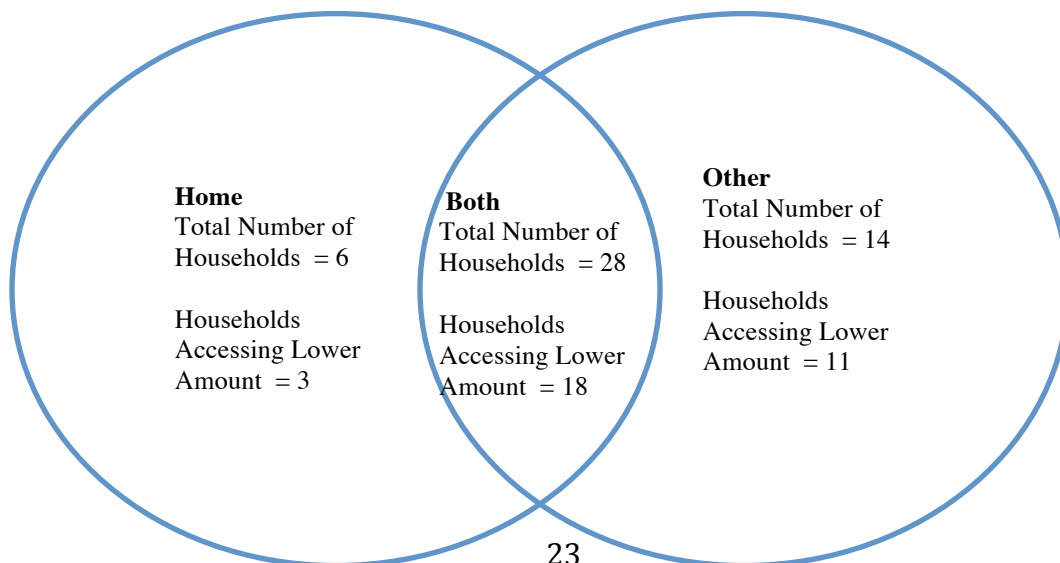
Venn Diagram 2: The proportion of Households Accessing Lower Amount of Maize Seed From Different Sources in The Second Season



The diagram shows that seed shortage have been extended to all three sources. The largest proportion ($5/11 = 0.45$) has been again registered by the households sourcing seed from other sources than home. These households have shortly failed to meet their amount (by 9%, p value = 0.0001). Contrary to this, the households accessing lower amount of the seed from home stock has only bigger drop (14%, p value = 0.015).

4.3c. First Season (Paddy)

Venn Diagram 3: The proportion of Households Accessing Lower Amount of Paddy Seed From Different Sources in The First Season



The diagram shows that the largest proportion of households (58%) have sourced their seed from both sources (home and other). They have also represented the highest proportion (56%) of seed shortage households. In average, these seed shortage households have only managed 88% of seed (p value = 0.0001). While the seed shortage households belonged to other have managed 92% of seed (0.000).

4.4 Proportion of Households Accessing Lower Amount of Seed From Home Stock

In pro-disaster season, the households have accessed higher, lower or equal amount of seed (repeat) than the normal season, or lost their home access (Drops). The households have also begun to access the seed from home (Entry). This section presents the number of the households who belongs to each of the above categories. It also presents the proportion of households who have lower access of seed from each of these categories.

4.4a. First Season (Maize)

Table 3: The proportion of Households Accessing Lower Amount of Maize Seed From Home Stock in The First Season

Category	Number of households	Number of Households accessing lower amount of Seed	Shared Drops
Drops	8	17	7 (41%)
Lower	12	17	4 (24%)
Higher	2	17	1 (5%)
Equal	12	17	0
Entry	2	17	0
			12

The table shows households who lost their access from home have represented highest proportion (41%) of seed shortage households. These households have also accessed significantly lower amount (32%) of seed (0.0018). Those households accessing equal amount of seed each season have sustained their seed need.

4.4b. Second Season (Maize)

Table 4: The proportion of Households Accessing Lower Amount of Maize Seed From Home Stock in The Second Season

Category	Number of households	Number of Households Accessing Lower Amount	Drops Shared
Drops	11	11	3 (27%)
Repeat	23	11	5 (45%)
Entry	6	11	1 (9%)
			9

The table shows that the households who repeatedly used home source have registered the largest proportion of seed shortage households (45%) in the second season. These households have only managed 83% of seed this season (p-value = 0.004).

4.4c. First Season (Paddy)

Table 5: The proportion of Households Accessing Lower Amount of Paddy Seed From Home Stock in The First Season

Category	Number of households	Number of Households Accessing Lower	Drops Shared
Drops	6	32	0
Lower	24	32	18 (56%)
Higher	1	32	0
Equal	6	32	3
Entry	3	32	0
			19

The table shows that the households who accessed lower amount from home stock have registered the largest proportion of seed shortage households (56%). These households have

managed 89% of seed (p value = .002). Contrary to this, those households who have failed to access any amount from home have managed their need.

4.5 Purchase

This section examines whether the households involved in purchase have accessed adequate amount of seed or not. For that, it compares the amount of seed purchase in the first season and second seasons to amount of seed purchased in the normal season.

4.5.1 Seasonal Status of Purchase

This section examines whether the level of purchase have been changed seasonally or not. The bar graphs below presents the mean purchased amount in the normal and the stress season (either first or second season).

4.5.1a. First Season (Maize)

A Box Plot 4: Seasonal Status of Maize Seed Purchase in The First Season



The bar graph does not show any observable difference in the seasonal purchase.

4.5.1b. Second Season (Maize)

A Box Plot 5: Seasonal Status of Maize Seed Purchase in The Second Season



The bar graph does not show any observable difference in the seasonal purchase.

4.5.1c. First Season (Paddy)

A Box Plot 6: Seasonal Status of Paddy Seed Purchase in The First Season



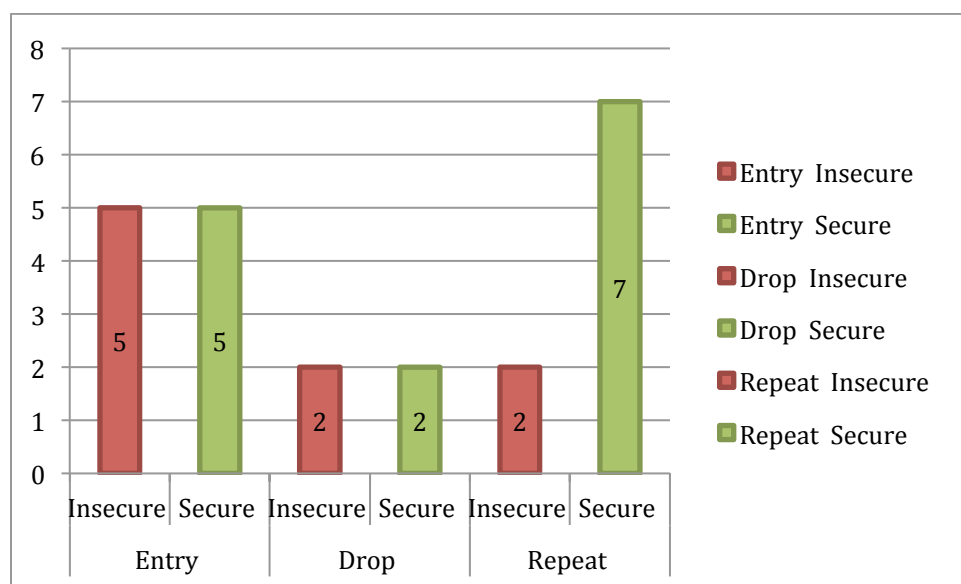
The plot shows that amount of seed purchased dropped significantly in the first season (p value = .06)

4.5.2 Proportion of Households Accessing Lower Amount of Seed by Purchase

This section presents the proportion of seed shortage households who have purchased seed. The households are divided into three categories: Entry, Drop and Repeat. “Entry” refers those households who have just begun to purchase; “Drop” refers to those households who have failed to continue purchase; and “Repeat” refers to those households who have continued their purchase. The bar graph below presents the proportion of seed shortage (Insecure) households in each of the above categories.

4.5.2a. First Season (Maize)

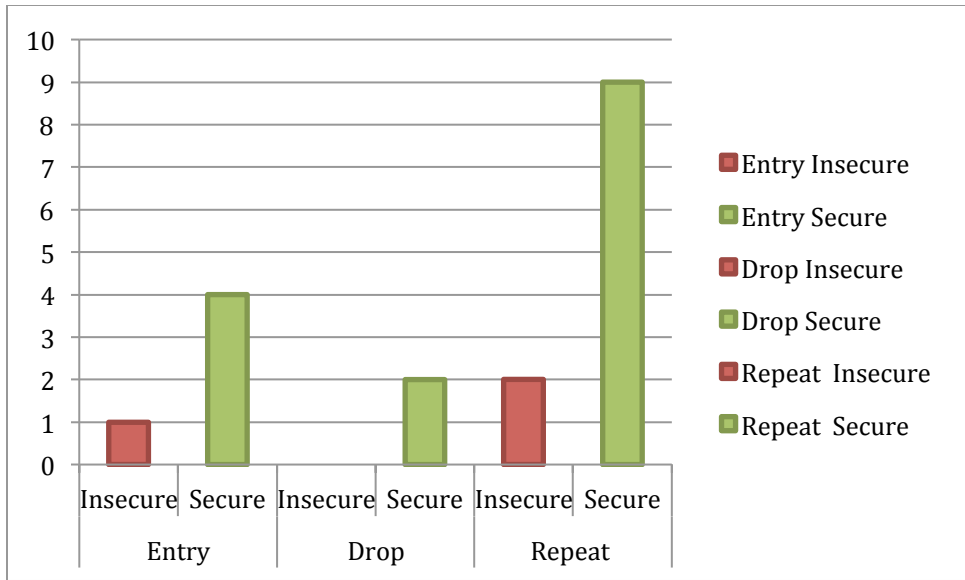
A Bar Graph 7: Proportion of Households Accessing Lower Amount of Maize Seed by Purchase In The First Season



The bar graph shows that 19 households have involved in purchase in the first season, which is 46% more than the normal season. 37% (7/19) of households involving in purchase have failed to secure their need. Those who have begun to purchase from the first season suffered significant drops (45%, p value = .05).

4.5.2b. Second Season (Maize)

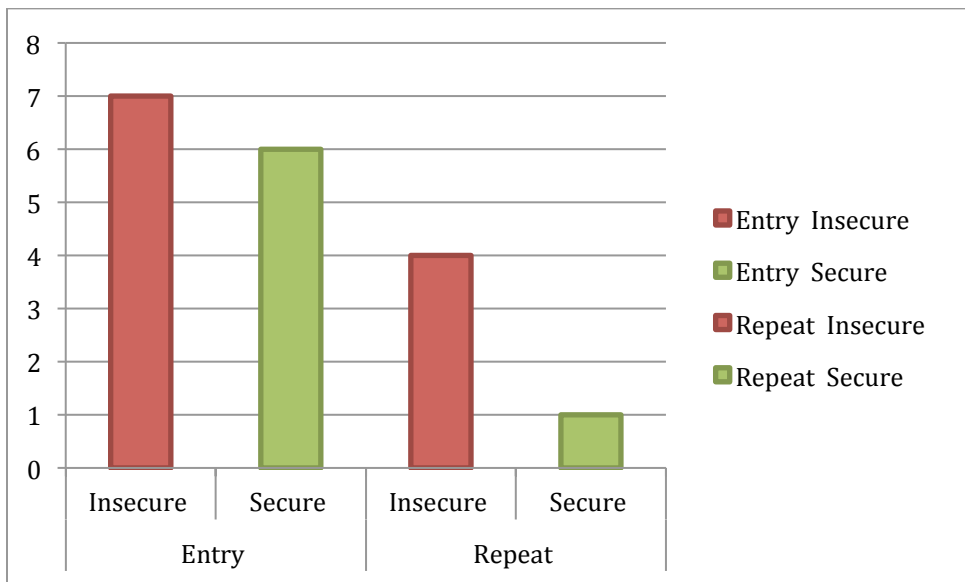
A Bar Graph 8: Proportion of Households Accessing Lower Amount of Maize Seed by Purchase In The Second Season



The bar graph shows that 16 households have purchased seed in the second season while only one of them has failed to manage their need.

4.5.2c. First Season (Paddy)

A Bar Graph 9: Proportion of Households Accessing Lower Amount of paddy Seed by Purchase In The First Season



The bar graph shows that the households who began to purchase from the first season have registered the largest proportion (7/18) of seed shortage households. These households have shortly failed to manage their need (by 10%, p value = 0.0014)

4.5.3 Proportion of Households Accessing Lower Amount of Paddy Seed (Purchase + Home)

This section presents the proportion of seed shortage households who have accessed seed by purchase and from home stock (Both). “Purchase only” refers to those households accessing seed from purchase but not from home stock.

Table 6: Proportion of Households Accessing Lower Amount of Paddy Seed (Purchase + Home) in The First Season

	Total	Number Accessing Reduced Amount	Reduction In Access	P value
Purchase Only	6	4	9%	0.01
Home Only	22	14	11.5%	0.000
Both	12	7	14%	0.035

Chapter Five: Summary of Findings and Discussion

5.1 Summary of Findings

The findings suggest that one third of households living at Pawati-8 were seed insecure during the first season after earthquake. These households have sowed 11% lower amount of seed than normally required. The level of insecurity has extended differently across crops. Two third of households who have been growing paddy have dropped their access level by 11% while one third of maize grower have dropped their access by 17%.

The households have been sourcing their maize seed from home stock, local market, social network and government. More households (23% out of 52) have been depending on the others sources (local market, government and social network) than home. However the amount of seed accessed from home have been higher than the amount of seed accessed from other. Also the majority of households accessing seed from home stock were more seed secured than those accessing from other sources (14% insecure in home out of 12 and 50% insecure in other out of 24). In contrary to this, the majority of households (58%) have accessed paddy seed from multiple sources than single source. Majority of seed insecure households (64% out of 28 multiple user) have also come from same category.

The households who have been accessing seed from home have either accessed lower amount of seed or higher amount of seed or failed to access the seed in the first season. Particularly the households (15% out of 52) who lost their maize access from home have suffered seed shortage during the first season. In contrary to this, those households (13% out of 52) who lost their paddy access from home stock have managed enough seed for the first season. Those households who repeated home source in the first season have shared the largest proportion of seed insecure households (56% out of 32).

The proportion of households purchasing maize seed has increased by 9% (normal season-25%, first season-37% out of 52). However one third of households (out of 19 purchasers) have suffered maize seed crisis despite purchase. Likewise, the proportion of households purchasing paddy seed has also risen from 10% to 38% (out of 48). However 44% households (out of 18 purchasers) have suffered paddy seed crisis during the first season.

In the second season, the seed insecure households (maize) have shrunk from 33% to 20% (out of 52). Like in the first season, this season has also received the highest number of insecure households (9% out of 52) from other source users. The proportion of seed insecure households who have sourced maize seed from home has remained equal. The majority of households (81% out of 16 purchasers) involving in purchase have managed their seed need for the second season.

5.2 Discussion

Disaster often results the reduced availability and reliance on own saved seed (Sperling 2004). In post disaster season, the households often fail to source adequate amount of seed from home stock. In case of Haiti earthquake 2010, the households have accessed lower than 20% seed from home stock. In case of Malawi flood case as well, the households have lost their home stock seed and standing crops to flood, and depended on aid seed to continue their first season. In northern Ghana flood case in 2007 as well, the flood jeopardized the seed system loop by damaging stored seed (Armah et al. 2010). In case of Nepal earthquake 2015 as well, several early studies have reported the substantial loss of home stock (more than 50%) in six earthquake-affected districts. With Regard to Pawati-8 as well, the findings suggest that 60% of households who have been using home source have failed to access adequate amount of maize seed in the first season. 24% have lost their home stock completely and rest of the households has dropped their access by 30% (p-value = .001). The figure further spreads to paddy users. 81% of households have failed to access adequate amount of seed from home. This accounts 16% of households who have

completely lost their home access and 65% of households who have dropped their access by 30% (p value = 0.000).

The level of seed stock in home often determines households' seed security level-particularly for those households who use this source. With Regard to Pawati-8, the households accessing higher or equal amount of seed from home have higher seed security level than those having lower access (p value = 0.003, R2 = 27%). 28 households have sourced their maize seed from home and 8 old users have failed to source from it again. Out of 28, only 5 have failed to meet their seed need for the first season while 7 out of 8 have dropped their access by 30%. These individual situations also supports that the households who access more seed from home stock are more likely to be seed secured. However the individual findings from paddy contradict this situation. 6 households have lost their access from home and all of them have ultimately managed their paddy seed for the first season. However if these 6 households are excluded and only accounted those households (34) who have used their source in the season, then above relation holds for paddy as well (p value = .03, R2 = .28%). Also if they are included, the relation still holds (p value = .001, R2 = 26%).

The access from other sources often compensates the households' home stock loss. It is often examined that the households find at least one way to manage their seasonal need of seed (Sperling, Cooper, and Remington 2008). With regard to Pawati-8, 16 households have used home stock and other sources and 13 have managed to meet their seasonal need. Out of 13, 10 belong to those households who have accessed lower amount from home stock. Out of 10, 8 households have recovered their seed gap (47%)by accessing from other sources (p value = 0.006). This situation supports the finding of Sperling et Al. (2008). However the 7 households (out of 8) who have lost their maize access from home contradict it since they failed to manage their seasonal need despite accessing seed from other sources. The paddy presents bias findings. The bias in this aspect is: the households who lost their part of their home seed (by 30%) have lower seed security level (seed insecure) than those who lost whole home stock (seed secure). Out of 28 households who have been using both home and other, 23 belong to the households who have lost their part of their home stock. Out of 23, 17 belong to seed insecure households. These households have only managed 55% from home stock (p value = 0.000). Other sources have only compensated 34% (p value = 0.062). As a result these households have failed to meet their overall seed need for the season by 12%.

Apart from these, the findings also show the proportion households who involved in purchase of maize have been increased in the first season. This finding looks quite unlikely in this regard that purchaser often shrank to lower number because of reduced purchasing power. However the households may involve in purchase when they have no viable option of seed access. With regards to this study, the main focus has been on whether the households have purchased enough seed or not. The findings suggest that the 9 households who have involved in purchase in both normal and the first season have increased their purchased amount by 10%, which clearly contradicts several cases where the households lost their purchasing power. Despite the increased purchase, 2 households have still failed to manage their need. If we see individual case, the contribution of purchase and seed insecurity level varies from households to households. 19 households have purchased maize seed in the first season. Two third of them belongs to seed secured households. The purchase has contributed 71% of their need (p value = 0.031). In contrary to this, 7 seed insecure households have purchased only 50% of their need (p value = 0.0037). It means these households have only accessed 33% of seed from other method of access. Similarly 4 households have failed to continue their purchase. However 2 of them have still managed their need. These findings indicate that the contribution of purchase remained significant –particularly for those households who have continued purchase over season.

However the findings of paddy differ from above. First, the paddy registers the significant rise in the amount of seed purchased in the first season. Second the proportion of households involved in purchase has also increased by huge margin (from 5 to 18). Third the households who used to purchase have not left purchase seasonally. Fourth the households who have purchased seed over season have increased their purchased amount by 50% (p value = 0.03). Fifth despite the higher purchase, 4 insecure households have only purchased only 60% of their need (p value = 0.09). Contrary to this, the 6 seed secured households who begun to purchase have meet their seasonal need by just purchasing 28% of their need (p value = 0.025) while same level of purchase have put rest of the beginners into seed insecure households (p value = 0.007). These findings indicate that level of purchase (needed to manage their seasonal amount of paddy seed) varies from households to households. 32 paddy insecure households have dropped their access by 17% and 11 insecure households' purchase range from 25% to 60%. This gap indicates the both lower purchase and lower access from other methods (barter, gift and own saved stock) has remained reasons for seed insecurity. Also 7 households who have accessed seed from home stock and by

purchase have dropped their total amount of seed by 14% (p value = 0.035). This finding also supports the above finding.

However the second season has reduced both the proportion of seed secured households and amount of seed drops. Maize insecure households have shrunk from 17 to 11 and the seed drop reduced to 12% from 17%. Also the seed insecure households shared by each source (except home stock which has one more seed insecure household than in the first season) have dropped and the households (19 out of 23) who have purchased their seed have also managed their seasonal need. These improvements indicate that the households have been recovering their seed security level, which looks quite appealing since in several cases, the households have recovered their seed within two or three seasons after disaster.

5.3 Conclusion, Recommendations and Suggestions

Shortage of maize seed in spring season and paddy seed in summer season after earthquake in 2015 has significantly affected the planting activities of the part of households (1/3) living at Pawati-8. One third of households have sowed 17% less maize seed and two third of households have sowed 11% less paddy seed in the season 2015. Majority of households accessing their maize seed from local market or friends, relatives and neighbors or district agriculture office have failed to manage adequate amount of seed for their spring planting while the large proportion of paddy insecure households have surprisingly come from those who have used both home source and other (local market or friends, relatives and neighbors or district agriculture office). The households saving higher proportion of seeds in home stock have ultimately sowed adequate amount of seed. However few exception households (6) have sowed adequate amount of paddy seed despite 100% loss of home stock. The proportion of households purchasing their seeds has dramatically increased in the first season. However, the majority of households still failed shortly to manage their need despite purchase.

The households have begun to recover the seed shortage from the spring season 2016. The majority of households (80%) have resumed their sowing need (maize) from this season while the rest of the households have also met their need by 88%. In overall, the households have improved their seed security level this season than last season.

Recommendations

- The seed loss at Pawati-8 is not as substantial as it was reported in early studies in disaster-affected districts. Two third of households have enough maize seed to plant while the rest of the households have met their need by 83%. In this regard, prior to forward any seed or agriculture recovery action in the village like Pawati-8, damage in the agriculture sectors (including seed) should be individually assessed from village to village.
- The proportion of seed insecure households could vary from crops to crops. In Pawati-8, two third of households were paddy seed insecure while only one third were maize insecure. Also the amount of seed needed to fill the seed gap of the seed insecure could vary from crop to crop. In Pawati-8, the maize insecure households have needed 17% of extra seed to fill the gap while it was 11% for paddy. In this regard, any further seed intervention and agriculture recovery action in acute context should examine these variations and forward their intervention accordingly.

Suggestions for Future Research

Researcher suggests the following topics for further research in future.

- Impact of Improved Seed in Soil Biology of Pawati
- Chronic Seed Insecurity Based on Caste in Pawati

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