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For Small Farmers Future

Caritas Nepal

Nawalparasi
District Assessment Report

This publication contains the results of a village level assessment carried out by Caritas Nepal in 10 SAF-BIN project villages in Nawalparasi district, Nepal.
The base for this report was literature review conducted by the Caritas Nepal team. Additionally interactions with the involved communities were used to conduct Participatory Rural Appraisal, household surveys, focus group discussions and in depth interviews.

Front matter: Farmers of Nawalparasi District, Nepal during a participatory rural appraisal exercise conducted by the SAF-BIN team © SAF-BIN/Caritas Nepal

For more information on SAF-BIN project contact:
Sunil Simon
South Asia Programme Manager – SAF-BIN, South Asia Coordination Unit (SACU)
Caritas India
Web: www.safbin.org
email: sacu@safbin.org, sunilsimon@caritasindia.org

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Building Resilience to Climate Change through Strengthening Adaptive Small Scale Farming System in Rain-Fed Areas in Bangladesh, India and Nepal (SAF-BIN)

A summary report of ten SAF-BIN clusters from Nawalparasi district of Nepal

Prepared for:

Caritas Nepal,

Dhobighat, Lalitpur

Prepared by:

Kanchan Joshi,

Consultant,

Caritas Nepal

Table of Contents

List of Tables

List of Figures

List of Map

List of Annexes

ACRONYMS

BLM	Broad Leaf Mustard
E	East
EU	European Union
Ha	Hectares
HH	Households
IPM	Integrated Pest Management
masl	meters above sea level
N	North
NWP	Nawalparasi
PRA	Participatory Rural Appraisal
VDC	Village Development Committee

1 BACKGROUND

1.1 CLIMATE CHANGE AND AGRICULTURAL LIVELIHOOD

Nepalese farmers rely upon natural weather conditions for agriculture and traditional farming practices. Hence, changing climate observed as change in timings of monsoon rain and increasing temperature negatively affect crop yields. The long spell of drought due to shift or delay in monsoon rain or lack of rainfall during winter season owing to climate change has decreased the yield of the agriculture commodities such as rice, wheat, maize and millet. This has profound negative effect in the food security situation of Nepal especially the small farm holders. The impact of climate change is worse in countries like Nepal, where still majority of agricultural land are rain-fed. Many reported increase in pest and disease infestation due to lack of rainfall during monsoon period for crops like paddy. In many areas, wheat has been replaced by other crops that require less water due to lack of winter rainfall during critical root initiation stage of wheat plant.

The woes of small farmers are added by the fact they have inadequate understanding of climate change issue. In addition, they are ill equipped to adapt and cope climate change through technological innovation. For example, in eastern terai during 2005/2006, rainfall deficit led to decline in yield of crops by 12.5% on national basis (Malla, 2008; cited in Karki and Gurung, 2012, p. 22) whereas due to incessant rainfall in Midwestern region in the year 2005/06, crop production slumped by 30% (Malla, 2008, Regmi, 2007; cited in Karki and Gurung, 2012, p. 20). Extreme climatic situations observed frequently have affected agricultural sector decreasing productivity and increasing vulnerability of poor which in turn stimulate out-migration misbalancing the local economy as economically active population migrates (Khanal, 2009; cited in Karki and Gurung, 2012, p. 20).

Changing climate induced natural disasters in the form of flash floods, drought, hailstorm, late/early precipitation, mass movement, soil erosion, glacial lake outburst floods (GLOFs) caused physical damage. Likewise, climate change increased the pest or disease infestation in the crops, reducing the crop yield by 30% to 70% in far western regions of Nepal (World Food Programme, 2010**).** Around 60% farm households are food insecure in hilly and mountainous

areas, due to effect of disasters, lack of productive land and lack of technological advancement such as irrigation facility, good quality seed etc.

1.2 CLIMATE CHANGE AND ADAPTATION MEASURES IN AGRICULTURE

In Nepal, temperature has increased more significantly (Shrestha et al., 1999, cited in Chaulagain, 2006) owing to the changing climate. The temperature increased at higher rates in mountainous areas than in plain areas. The uncertainty in weather patterns especially due to late onset of monsoon rain, intense rainfall during harvesting time and lack of rainfall during winter due to rapid climate change has induced lots of natural disasters. This has increased the incidence of crop failure, flash floods, and drought. Besides changing climate, unique geophysical situation triggered natural disasters such as flash floods, drought, and landslides and intensity of their damages. These turn of events are especially disastrous to small farm families. Especially crop failure due to change in weather pattern have profound negative impacts – from food security situation to health and livelihoods situation especially in case of subsistence farmers. In future also, potential change in climates will have dire consequences on livelihood of locals, natural resources situation and ecological situation as Nepal has very low adaptive capacities.

It is important to reduce the harmful impacts of climate change in agriculture especially to poor vulnerable farm households by developing adaptive measures. Adaptive measures should be introduced at strategic level and local level involving farmers. At local level, adaptive measures can be introduced with the help of developmental agencies in co-ordination with local communities. Adaption at local level will help to lessen the probability of households to move into poverty but will certainly not help the households to be non-poor (Joshi, 2011). The adaptive measures for reducing the vulnerability situation of farmers from crop failure can be done by incorporating climate change with technical intervention with good extension activities that interlinks research, extension and capacity building of the small farm holders. These adaptive measures such as choosing suitable drought tolerant or stress tolerant variety, integrated pest management activities, crop diversification and diversifying the source of incomes through off-farm or on-farm activities can build resilience and adaptive capacity against climate change.

1.3 ON-FARM ACTION RESEARCH AS AN ADAPTATION MEASURE

In Nepal and its South Asian counterparts, the activities involving active participation of farmers to adapt against climate change is very few. Realizing this, Caritas with the help of European

Union is launching action research based project activities on major crops of particular project location for selecting suitable seed variety and cultivation practices to help small holder farm families to mitigate and adapt against climate change in Nepal, Bangladesh and India under SAF-BIN project. As a part of that program, Caritas Nepal, through EU funded SAF-BIN project intervened in 30 farm clusters of Nawalparasi, Bardiya, Kaski and Surkhet districts of Nepal for building resilience of small farm households to climate change issues.

2 METHODOLOGY

2.1 SITE AND BENEFICIARY SELECTION

The project locations of Nawalparasi district were selected after interactions with District Development Committee and District Agriculture Development Officers. The suitability of location was evaluated by performing exploratory visits to the sites. The project team held interactions with District Agriculture Development Officers, District Development Officers, other local stakeholders including agricultural scientists and locals while selecting the potential project sites. 10 clusters from Nawalparasi were chosen as a site of project intervention. While choosing the sites, agro-ecological diversity was considered. Hence, sites belonging to plains as well as hills were chosen. Within each cluster, three hamlets were formed. Each of the hamlets consists of 15 farmers following rain-fed agriculture with small farm holdings. In general, following aspects have been considered during the selection of Small Household Farmers (SHF) collectives:

- Diversity in climatic zones: Tropical & Sub tropical
- Geographical setting which includes: Inner terai, mid-hill and high hill and also the type of land such as flat land and sloping land
- Diversity in Rainfall Patterns: High, moderate and low rainfall area
- Cropping diversities which include: Maize, millet, rice etc with other crops
- Existence of rain-fed situation
- Ethnic diversity of target groups
- Socio-economic set up – inclusion of marginalized groups

2.2 SOURCES OF DATA

For the preparation of this report, both qualitative and quantitative data were collected using tools such as Participatory Rural Appraisal, Household survey for baseline data collection and village screening workshop to identify and find past and present trends of farming practices of key crops, and rate the most important problem, helping research team choose proper theme of research. Before conducting these activities, orientation about SAF-BIN project and its activities were given to local stakeholders including potential beneficiaries, research scientists and government officers.

PRA tools used for collecting baseline information included Village Landscape Transect Map, Resource Map, Social Map, Agro-ecology & Foodscape Map, Venn Diagram, Time Trend, Technology Adoption Map, Food In and Food Out (FIFO), Agro & Food Seasonality, Bio Resource Flow Diagram, Wealth Ranking and Problem Matrix, tree & Analysis) and a structured village level data collection questionnaires, mainly around food security of small holder farmers in the context of climate change.

2.3 DATA COMPILATION AND ANALYSIS

The data collected through different tools and techniques were fed in Excel spread sheet and a general statistical tool such as frequency tabulation was used whenever needed. Separate thematic worksheets were prepared for in-depth analysis such as for preparing information derived from screening workshop in presentable form, Food in and food out information etc. Detailed information of these is presented in the village level reports. In this report, we will focus on whole Nawalparasi district.

2.4 PREPARATION OF REPORTS

Based upon the information collected, reviewing secondary literatures about climate change issues in Nepal and triangulating the field information repeatedly when needed, reports were prepared. We have tried to maintain uniformity in all the report formats. However, there are differences in the format of the report or table of contents as data for each project cluster has more or less some variability.

2.5 CONTENT OF THE REPORT

This report is the compilation of information generated from 10 clusters belonging to Nawalparasi district. The collective insights of Nawalparasi district based upon data collected

from the 10 clusters are given in this report, and wherever possible comparative insights will also be given. The collective insights will be based upon -

1. Information on demographic, socio-economic and educational situation, asset situation (natural, physical, social, human & financial) in general and in the context of food security of small holder farmers with respect to climate change issues.
2. Food insecurity situation of the locality and practices of food handling and management
3. Agriculture and livestock situation in terms of production system, production, consumption and productivity patterns
4. Key problems while following traditional cropping practices

Nevertheless, the detailed information of particular cluster are discussed and presented in village level reports.

3 RESULTS

3.1 BRIEF COMPARATIVE OVERVIEW OF THE PROJECT CLUSTERS

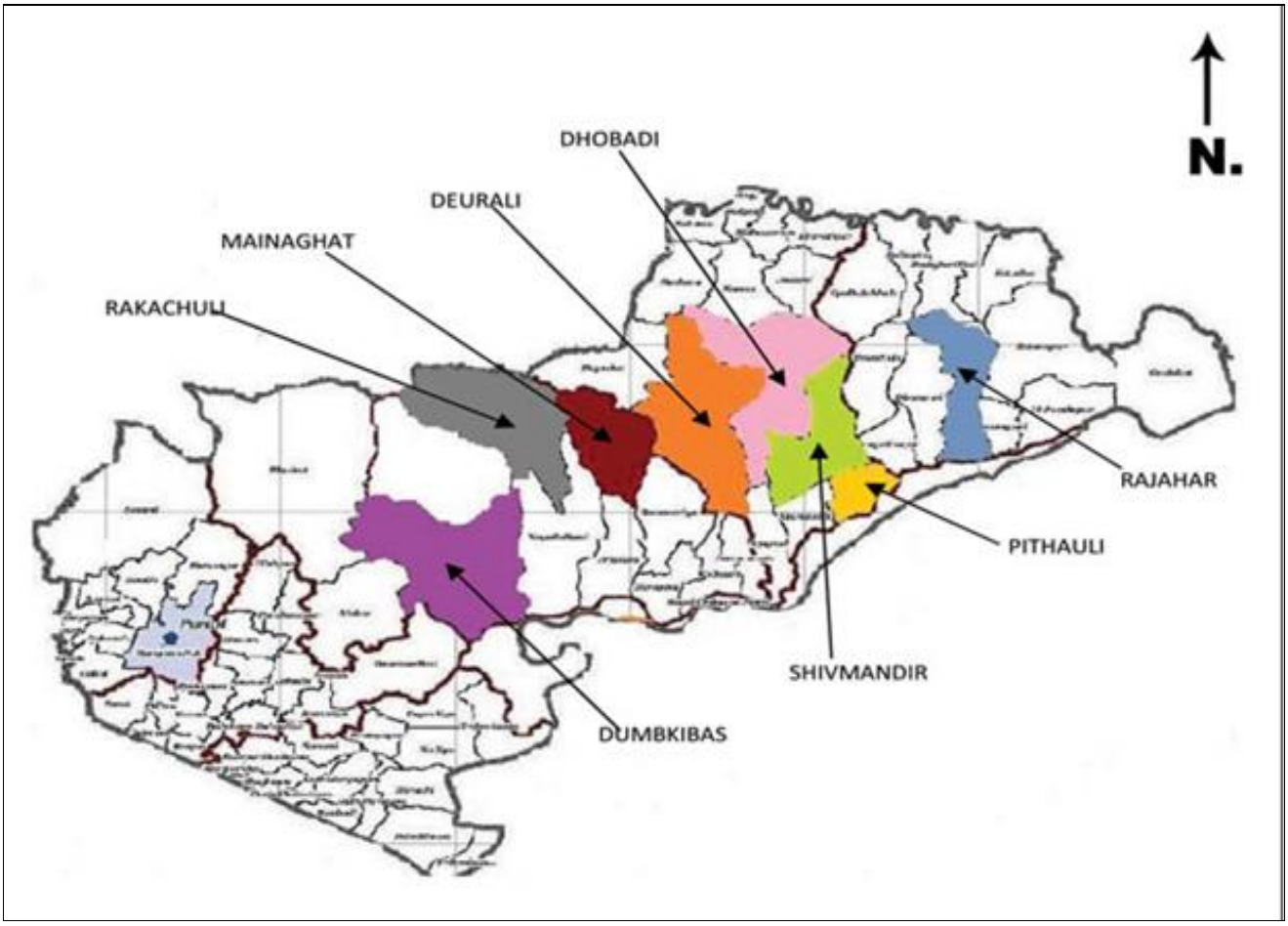
Nawalparasi (NWP) district lies in mid western region of Nepal under Lumbini zone. In N district, SAF-BIN has been intervened in 10 project clusters. Of 10 clusters in Nawalparasi district, Shivamandir, Dumkibas, Rajahar, Pithauli and Dhobadi are relatively in plain belts with tropical climate where as Mainaghat lower, Mainaghat upper, Rakachuli upper, Rakachuli lower, and Deurali belongs to hilly or slopy region with humid sub-tropical climate. The details of project clusters in the Nawalparasi district are given in Table 1.

Table 1: Details on project intervention clusters of Nawalparasi

Project clusters VDC	**Latitude**	**Longitude**	**Belt**	**Total cluster area in ha**	**Agri-land and horticultural in ha (% of total land occupied for agriculture)**
Shivamandir	No data (ND)	ND	Plain	175.41	72.11 (41.10%)
Dumkibas	27.59N	83.88E	Plain	835	206.5 (24.73%)
Rajahar	27 40.823N	84 13.367E	Plain 157 masl	48.70	26.7 (54.83%)
Pithauli	27.65N	84.16E	Plain	322.7	134 (41.52%)
Dhobadi	ND	ND	Plain	690	169.63 (24.58%)
Rakachuli upper	27.70N	83.90E	Hills	341	20 (5.87%)
Deurali	ND	ND	Hills	361	178 (49.30%)
Rakachuli lower	27.70N	83.90E	Hills	386.5	48.5 (12.54%)
Mainaghat lower	27.68N	83.99E	Hills	88	42 (47.73%)

Mainaghat upper	27.68N	83.99E	Hills	386.5	71.5 (18.5%)
Total of Nawalparasi cluster				***3634.81***	***968.94 (26.66%)***

SAF-BIN clusters of Nawalparasi occupy 4503ha area of which 26.66% is used for agriculture. Map 1 provides the geographic position of the project VDCs within the Nawalparasi district.



MAP 1: Location of SAF-BIN cluster VDCs in Nawalparasi District

3.2 DEMOGRAPHIC INFORMATION

Socio-demographic characteristics such as educational, household characteristics (gender and caste wise) of the clusters of Nawalparasi district are presented in the demographic information.

3.2.1 Population and household characteristics

The Table 2 below shows the general overview on population. The total population size is **7699** within 1329 HHs of 10 NWP clusters. The average household size is 5.96. Of the 10 clusters,

Dhobadi, Shivamandir, Rajahar and Pithauli have higher population. Since, these clusters lie in plain region, the population pressure seems to be more in these regions.

Table 2: Population and household characteristics of the Nawalparasi cluster

SAF-BIN clusters	**Population characteristics**			**Household (HH) characteristics**			
	Male	Female	**Total**	Total HH size	Average HH size	Women headed HH	HH with differently able
Shivamandir	502	530	***1032***	189	5.46	8	7
Dumkibas	370	390	***760***	148	5.14	31	5
Rajahar	475	467	***942***	166	5.67	13	8
Pithauli	498	402	***900***	168	5.35	0	10
Dhobadi	746	694	***1440***	241	5.97	40	5
Rakachuli upper	230	243	***473***	59	8.01	5	-
Deurali	231	232	***463***	70	6.61	2	3
Rakachuli lower	191	213	***404***	73	5.53	40	5
Mainaghat lower	277	274	***551***	96	5.73	2	1
Mainaghat upper	364	370	***734***	119	6.16	4	2
Summary of NWP cluster	3884 (50.45%)	3815 (49.55%)	***7699 (100%)***	1329	5.963	145	46

Figures in parentheses are in percentage

Source: Village data sheet 2011/2012 and PRA 2012, SAF-BIN

3.2.2 Ethnic characteristics of the NWP cluster

The ethnic diversity of the Nawalparasi cluster is presented in table 3. The data reveals that the cluster chosen for SAF-BIN contained majority of janajati (ethnic groups) households.

Table 3: Ethnic diversity in Nawalparasi clusters

SAF-BIN clusters	**Ethnic characteristics of the HHs**			
	Ethnic groups/ Janajati	Advantaged caste groups	Dalits/ Disadvantaged groups	Total HH
Shivamandir	133 (70%)	48 (26%)	8 (4%)	189 (100%)
Dumkibas	107 (72.3%)	19 (12.84%)	22 (14.86%)	148 (100%)
Rajahar	134 (80.72%)	25 (15.06%)	7 (4.22%)	166 (100%)
Pithauli	119 (70.83%)	46 (27.38%)	3 (1.79%)	168 (100%)
Dhobadi	188 (78.01%)	9 (3.73%)	44 (18.26%)	241 (100%)
Rakachuli upper	50 (84.75%)	2 (3.39%)	7 (11.86%)	59 (100%)
Deurali	66 (94.29%)	2 (2.86%)	2 (2.86%)	70 (100%)
Rakachuli lower	69 (94.52%)	2 (2.74%)	2 (2.74%)	73 (100%)
Mainaghat lower	71 (73.96%)	2 (2.08%)	23 (23.96%)	96 (100%)
Mainaghat upper	108 (90.75%)	-	11 (9.25%)	119 (100%)
Summary of NWP cluster	1045 (78.63%)	155 (11.66%)	129 (9.71%)	1329 (100%)

Figures in parentheses are in percentage

Source: Village data sheet 2011/2012 and PRA 2012, SAF-BIN

In Nepal, Hill Brahmin and Chhetris belonging to advantageous caste groups are put into advantageous group. They are termed as advantageous groups as they occupy dominant position in power structure of the country (K. Hachhethu, 2003). Meanwhile, rest of the groups – *Janajati (ethnic and indigenous groups), and disadvantaged caste groups/Dalit*, who occupy marginalized space in country's social, economic and political are termed as minority or disadvantaged groups.

Advantaged caste groups – includes Brahmin and Chhetri communities, having Nepali as mother tongue and Hinduism as a main religion

Janajati/Ethnic or Indigenous communities - includes people originally following different religion than Hinduism and speaking different language than Nepali e.g. Newars, Gurung, Tharu, Magar, Tamang, Bote, Chepang etc.

Disadvantaged caste groups - includes people having Nepali as mother tongue and Hinduism as a main religion, but belonging to lower caste groups.

Source: K. Hachhethu, 2003

As per social justice point of view, Caritas Nepal advocates the right of marginalized people of Nepal and other South Asian countries for international support to adapt to climate change. Hence, while choosing the group members, Caritas has been inclusive to marginalized groups to adapt against climate change.

3.2.3 Gender wise educational status

The frequency tabulation of the educational status of the clusters' population showed that number of literates in Pithauli and Shivamandir clusters is reasonably higher as compared to other regions. When literacy trend is scrutinized, it is observed that clusters in plains such as Pithauli, Shivamandir, and Dumkias seem to have more number of literates, whereas hilly regions which have difficult terrains such as Rakachuli upper and lower and Deurali seems to have less number of literates as compared to other clusters. The details are given on table 4.

Table 4: Educational status of the locals of ten SAF-BIN clusters from Nawalparasi

SAF-BIN clusters	Literacy of the cluster population in %

	Male	Female	Average
Shivamandir	77.83	79.93	75.93
Dumkibas	62.56	44.60	53.81
Rajahar	40.63	47.54	44.06
Pithauli	91.58	63.55	89.88
Dhobadi	43.23	40.21	41.66
Rakachuli upper	33.48	50.61	42.05
Deurali	53.88	54.54	54.21
Rakachuli lower	3.66	15.02	9.65
Mainaghat lower	No data (ND)	ND	55
Mainaghat upper	63.46	59.46	61.44
Summary of NWP cluster (*excluding Mainaghat lower)	**52.26***	**50.61***	**52.52**

Source: Village data sheet 2011/2012, SAF-BIN

3.3 LAND HOLDING PATTERN

In Nepal, farmers having land holding size of 0.5 ha and less are considered as small and marginal farmers. Considering the village level report data, it is revealed that majority of the farm households are small with 0.5 ha and less lands. Table 5 shows the land holding pattern of NWP cluster.

Table 5: Land holding pattern of Nawalparasi SAF-BIN clusters

Nawalparasi SAF-BIN clusters	% of landless agriculture (absolute landless)	% with 0-0.25ha	% with 0.26-0.5 ha	% with 0.51- 1 ha	% with 1.1-2 ha	% with > 2ha	Total in %
Shivamandir	0.52	54.4	38.34	6.22	0.52	0	100
Dumkibas	0	33.78	42.57	22.3	1.35	0	100
Rajahar	11.49	48.28	22.41	11.49	2.87	3.45	100
Pithauli	23.81	35.71	11.9	25.6	2.38	0.6	100
Dhobadi	0	33.78	42.57	22.3	1.35	0	100
Rakachuli upper	3.39	10.17	69.49	15.25	1.69	0	100
Deurali	2.86	97.14	0	0	0	0	100
Rakachuli lower	0	41.1	26.03	23.29	9.59	0	100
Mainaghat lower	6.25	25	58.33	8.33	2.08	0	100
Mainaghat upper	0	7.91	15.83	33.81	25.9	16.55	100

Source: Village data sheet 2011/2012, SAF-BIN

3.4 LAND USE PATTERN

The area occupied by 10 clusters of Nawalparasi district is 3634.81 ha of which 938.11 ha (40.03%) of land is used for agricultural purposes. The details of land use pattern of the cluster are shown in the Table 6 below.

Table 6: Land use pattern in clusters of Nawalparasi district in hectares (ha)

SAF-BIN clusters of NWP	Agricultural land	Horticultural land	Pasture land	Dense forest	Area under open forest	Shrub land	Cultivable waste fallow land	Uncultivable waste fallow land	Area under water	Others	Total in ha
Shivamandir	72.11 (41.10%)	*0*	0	103.3 (58.89%)	0	0	0	0	0	0	*175.41 (100%)*
Dumkibas	206 (24.67%)	*0.5 (0.06%)*	0	600 (71.86%)	22 (2.60%)	5 (0.6%)	0	0	0	1.5 (0.18%)	*835 (100%)*
Rajahar	26.7 (54.83%)	*0*	0	9 (18.5%)	9 (18.5%)	0	1.3 (2.67%)	2.7 (5.54%)	0	0	*48.7 (100%)*
Pithauli	134 (41.52%)	*0*	0	35 (10.85%)	35 (10.85%)	0	0	0	1.7 (0.53%)	0	*322.7 (100%)*
Dhobadi	166.3 (54.83%)	*3.33*	5	490 (18.5%)	12 (18.5%)	0	13.33 (2.67%)	5	490 (18.5%)	0	*690 (100%)*
Rakachuli upper	19 (5.57%)	*1(0.3%)*	2 (0.59%)	200 (58.65%)	50 (14.66%)	50 (14.66%)	12 (3.52%)	7 (2.05%)	0	0	*341 (100%)*
Deurali	178 (54.83%)	*0*	0	0	0	0	0	0	0	0	*361 (100%)*
Rakachuli lower	24 (6.21%)	*24.5 (6.34%)*	33 (8.54%)	267 (69.08%)	38 (9.84%)	0	0	0	0	0	*386.5 (100%)*
Mainaghat lower	42 (47.72%)	*0*	0	23 (26.14%)	0	0	0	0	0	0	*88 (100%)*
Mainaghat upper	70 (18.11%)	*1.5 (0.39%)*	150 (38.81%)	0	0	0	0	0	*15 (3.88%)*	0	*386.5 (100%)*
Total	**938.11**	**30.83**	**346**	**1727.3**	**366**	**55**	**26.63**	**131.7**	**506.7**	**1.5**	**3634.81**

Figures in parentheses are in percentage

Source: Village data sheet 2011/2012, SAF-BIN

3.5 SOIL AND LAND TYPE

3.5.1 Soil Characteristics

The soil types vary depending upon the land characteristics within the NWP cluster. The area consists of different kinds of soil that includes black, red, sandy loan, sandy, clayey and loamy soils. The soil characteristics presented here consider only registered land. The details of soil and land type are given in Table 7.

Table 7: Soil characteristics in clusters of Nawalparasi district

SAF-BIN clusters of NWP	**Types of soil and their characteristics**					
	Sandy loam	***Loamy***	***Sandy***	***Clayey***	***Red***	***Black***
Shivamandir	-	-	Pebble mixed red colored soil	Difficult to dig or plough in dry season - yellow colored	-	-
Dumkibas	-	-	Fertile and useful for maize and mustard	Good for paddy production	-	-
Rajahar	Good for vegetable farming	Good for vegetable farming	-	Mixed with black soil and good for cultivation	-	-
Pithauli	Good for vegetable farming and potato	-	Good for vegetable farming including potato	Not good soil for cultivation	-	-
Dhobadi	-	-	Mixed with pebbles and require more water	Good for vegetable farming especially for potato	Useful for ginger and other root crops	-
Rakachuli upper	-	-	Fertile and good for mustard and maize	-	-	Good for ginger, potato, maize
Deurali	-	-	Mixed with pebbles and require more water	Difficult to plough or dig	Red colored sandy soil	-
Rakachuli lower	-	-	-	-	Soil useful for potato, ginger, paddy, lentil	-
Mainaghat lower	-	-	-	-	Need more manure and water	Productive soil

Mainaghat upper	-	-	Red colored with low water holding capacity	-	-	-
Summary of NWP cluster according to soil type	*Rajahar, Pithauli*	*Rajahar*	*Shivamandir, Dumkibas, Pithauli, Dhobadi, Rakachuli upper, Deurali, Mainaghat upper*	*Shivamandir, Dumkibas, Rajahar, Pithauli, Dhobadi, Deurali,*	*Dhobadi, Deurali, Rakachuli lower, Mainaghat lower*	*Rakachuli upper, Mainaghat lower*

Source: Village data sheet 2011/2012, SAF-BIN

3.5.2 Land Characteristics

The land characteristics vary depending upon topography, elevation, soil properties and even weather conditions. The land characteristics presented here consider only registered land. The plain areas are more fertile as compared to the slopy land. Likewise, the area with perennial source of irrigation yields more than dry areas. The details of land type are given in table 8.

Table 8: Land characteristics in clusters of Nawalparasi district

SAF-BIN clusters of Nawalparasi	***Land type***				
	Type I (Abbal)[1]	*Type II (Doyam)*[2]	*Type III (Sim)*[3]	*Type IV (Chahar)*[4]	*Total agricultural land in ha*
Shivamandir	135.45 (77.22%)	39.96 (22.78%)	-	-	175.41 (100%)
Dumkibas	16 (14.55%)	87 (79.09%)	7 (6.36%)		110 (100%)
Rajahar	39.86 (80%)	9.74 (20%)	-	-	48.7 (100%)
Pithauli	5%	71.43%	23.57%	-	
Dhobadi	0.00%	165 (81.28%)	32 (16.26%)	5 (2.46%)	202
Rakachuli upper	No data				
Deurali	0	177 (49.03%)	0	184 (50.97%)	361(100%)
Rakachuli lower	0	24 (49.48%)	17.5 (36.08%)	7 (14.44%)	48.5 (100%)
Mainaghat lower	0	0	13 (30.95%)	29 (69.04%)	42 (100%)
Mainaghat upper	2 (2.38%)	40 (47.62%)	40 (47.62%)	2 (2.38%)	85 (100%)

Figures in parentheses are in percentage

Source: Village data sheet 2011/2012, SAF-BIN

In NWP, lands from hilly areas are less fertile as major portion of their land belong to type III and type IV. These types of lands have less fertility as compared to Type I and Type II.

3.6 METEOROLOGICAL INFORMATION

[1] Best quality soil for agricultural purposes
[2] Good soil for agricultural purposes
[3] Not good for agricultural purposes
[4] Unsuitable for agricultural purposes

Since, the weather trends data for particular cluster is not available, we chose nearby weather station of Dumkauli from Nawalparasi district as a representation of meteorological information of many of the clusters from Nawalparasi. Based upon the data provided by Department of Hydrology and Meteorology, average maximum temperature, average minimum temperature and average monthly rainfall are calculated (Table 9). In addition, the weather attributes are subjected to trend analysis (figure 1, 2 and 3).

Table 9: Meteorological information of Dumkauli Meteorological Station, Nawalparasi district

	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Average monthly rainfall measured in mm (1976-2011)	18.4	15.2	21.4	62.8	191.9	402.2	653.1	531.5	361.7	84.2	10.5	18.4
Average maximum temperature in °C over the last 30 years (1980-2011)	22.1	25.7	31.1	35.4	35.3	34.6	32.9	33.2	32.5	31.4	28.0	24.0
Minimum temperature in °C over the last 30 years (1980-2011)	9.2	11.0	14.9	19.4	23.1	25.3	25.8	25.7	24.6	20.5	14.8	10.6

Source: Dumkauli Meteorological Station, Nawalparasi under Department of Hydrology and Meteorology

The trend analyses showed that the minimum temperature in the area increased by 0.4°C approximately since past 35 years, whereas maximum temperature has not shown much change (Figure 1 and Figure 2). Figure 3 showed that total rainfall has been increasing. The precipitation trend data also showed increase in overall monsoon precipitation. However, it has been perceived that since past decade monsoon had been late in certain periods or years affecting the crop growth, where as in other times, timely monsoon was observed. The intensity of rainfall has been more in July than in June while precipitation trends of past few years was observed (Annex 2) due to late triggering of monsoon. Winter rainfall trend has been more or less constant (Figure 3). Nevertheless, locals perceived that lack of timely winter rainfall makes them difficult to predict the rainfall and carry on with their cropping activities; same is the case for monsoon rainfall (details in Annex 2).

[Note: Weather trends of NWP cluster has been interpreted using the data from Dumkauli Meteorological Station, which lies in inner terai region (154 masl). Hence, results from trend analysis of weather data can be aligned with the plain areas of NWP clusters only.]

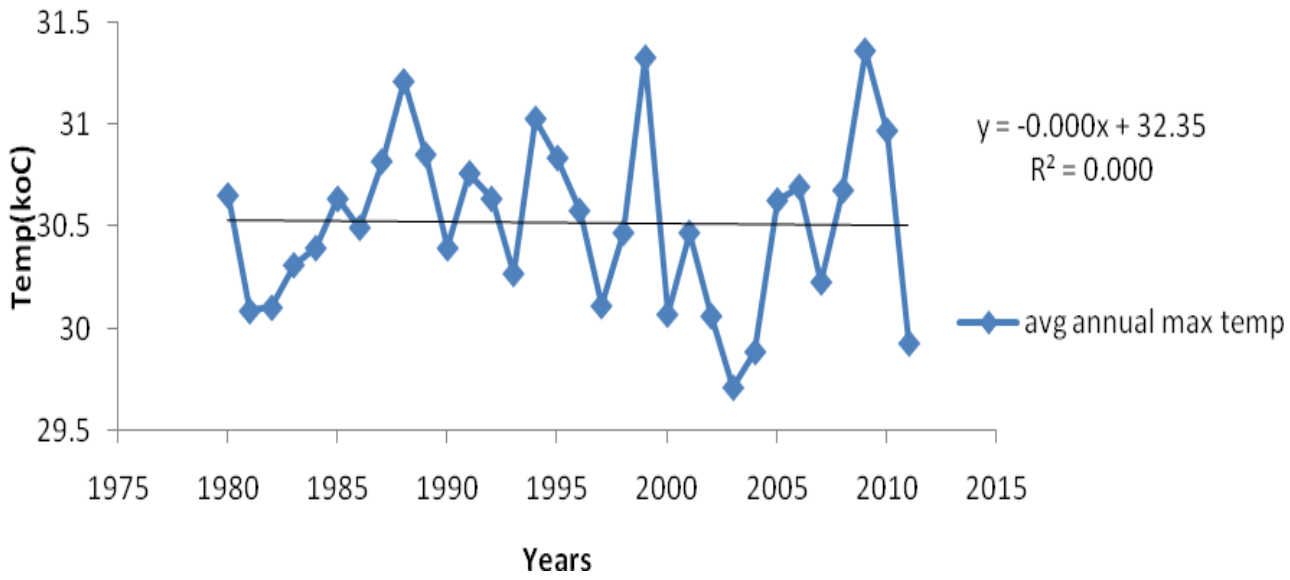


Figure 1: Trend analysis of the maximum temperature in Nawalparasi District

(Source: Department of Hydrology and Meteorology data, analysed by Jeevan Lamichhane)

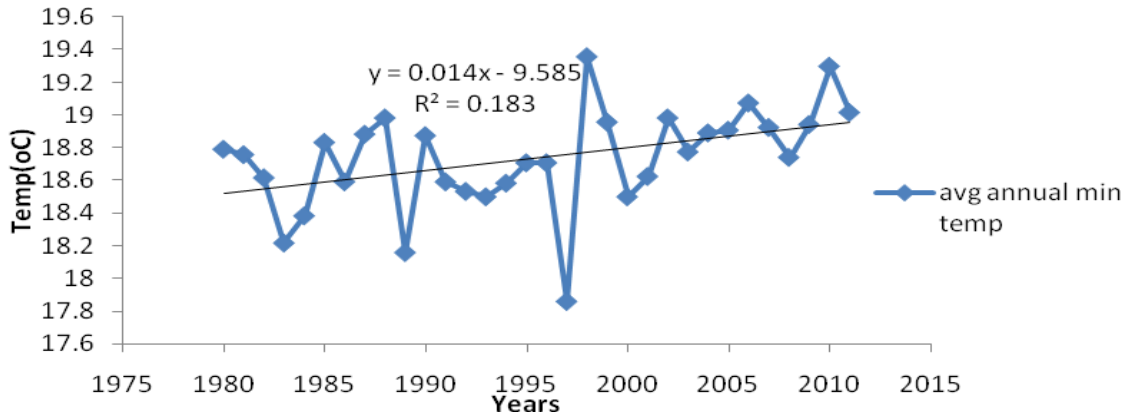


Figure 2: Analysis of the change in minimum temperature in Nawalparasi District

(Source: Department of Hydrology and Meteorology data, analysed by Jeevan Lamichhane)

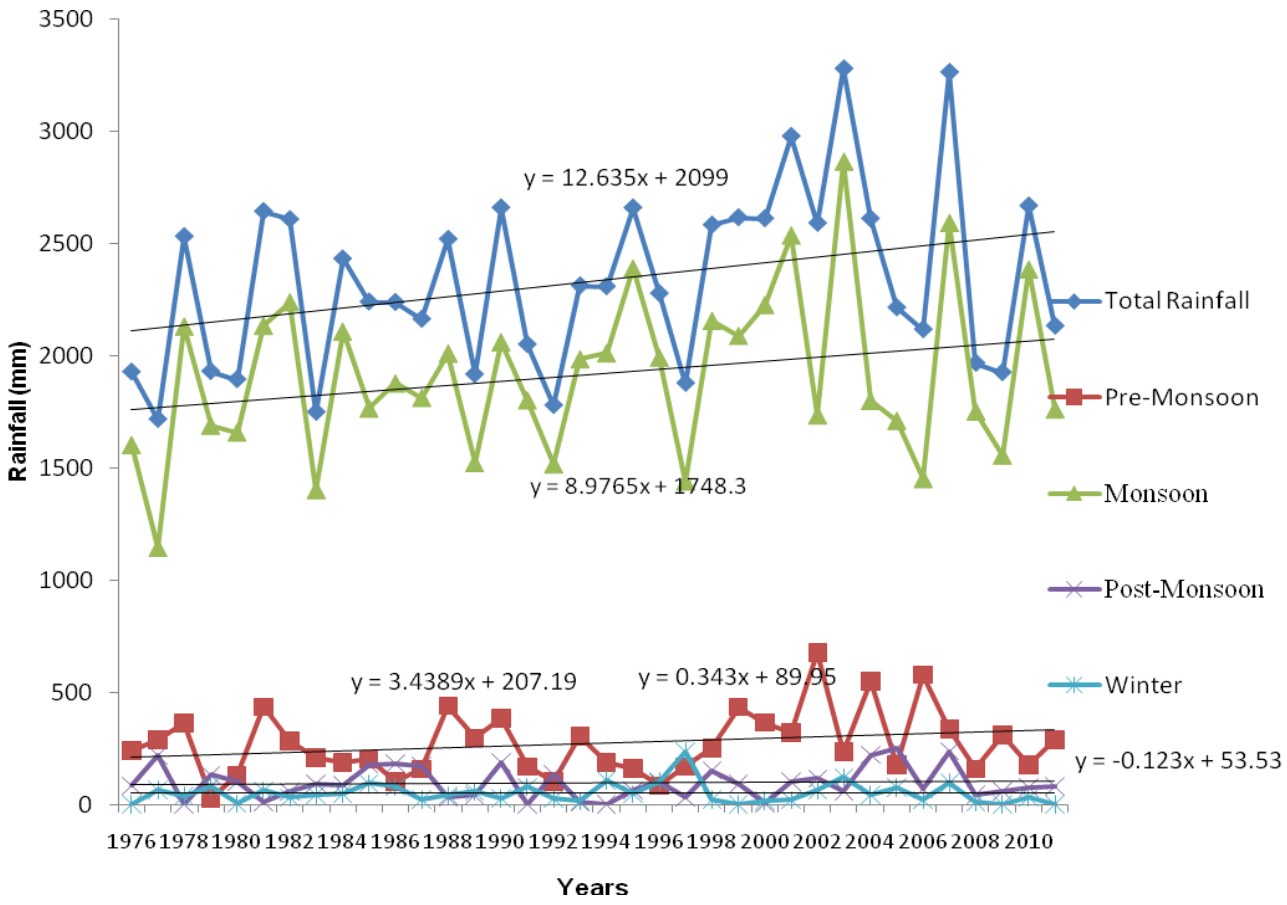


Figure 3: Analysis of the change in the rainfall in Nawalparasi District

(Source: Department of Hydrology and Meteorology data, analysed by Jeevan Lamichhane)

3.7 CAPITAL ASSETS SITUATION

The local people's ability to deal and cope with shocks and vulnerable situation depends on their assets situation (physical, financial, social, human and natural capital). The population who are rich in these assets can develop survival strategy and have higher resilience capacity if exposed with riskier situation than their asset poor counterparts. In this section, focus is on the presentation of the assets situation of the clusters.

3.7.1 Physical assets

This section will give an overview of the situation of physical infrastructure such as road connectivity, electricity services, telecom facilities, schools, health centers, veterinary service centres, VDC office, market, etc. Surely, availability of these assets can have good impact on the local people such as road connectivity can increase access to market. Table 10 shows the availability and types of physical assets in various clusters of NWP.

Table 10: Physical assets in the clusters of NWP

Physical assets	**Nawalparasi clusters**									
	Shivamandir	Dumkibas	Rajahar	Pithauli	Dhobadi	Rakachuli upper	Deurali	Rakachuli lower	Mainaghat lower	Mainaghat upper
All weathered road connectivity	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
Electricity facility	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Mobile network coverage	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Access to internet	Yes	Yes	Yes	No	Yes	No	No	No	No	No
Primary school	No	No	Yes	No	No	Yes	Yes	No	No	Yes
Secondary school	Yes	No	No	No	Yes	No	No	No	No	No
Community meeting place	Yes	No	Yes	No	Yes	Yes	No	Yes	No	No
Health centre	Yes	No	No	No	No	Yes	No	No	No	Yes

Veterinary service centre	No	No	No	No	No	No	Yes	No	No	No
Cottage industries/Agro-enterprises	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes
VDC/GP/Union Office	No	No	Yes	No	No	Yes	Yes	No	No	Yes
Concrete drains	No	No	No	No	No	No	No	No	No	No
Markets for farm produce	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Grocery and other shops	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Remarks	Distance 3-4km, Health post 1km away	Services 3-4km away	Services 1km away	Facilities 4km away	Services 6km away, except VDC 13km away	Health post, VDC 1-2 km far, Market 7km far, Veterinary service centre - 17km far	All services 6km away except VDC office which is 13km far	Facilities 3-5km away	Facilities 8-9km away	Facilities 12km, except Health post &VDC-0km

Source: Village data sheet 2011/2012, SAF-BIN

All weathered roads are not available in hilly clusters of NWP – Rakachuli upper, Rakachuli lower, Mainaghat lower, Mainaghat upper and Deurali making it difficult for villagers to access market and other facilities. Other clusters are well connected with all weathered roads, which give them privilege to access various services offered in the city centre of Chitwan and NWP districts. Hence, though they might not have facilities within the area, the people of clusters from plains of NWP have better access to these services due to availability of the road.

[Being connected with power grid through electric poles do not ensure availability of electricity in Nepal, as in the winter time due to low production and ever increasing demand of electricity, load shedding can go up to 16 hours per day.]

3.7.2 Social, human and financial assets

Besides physical assets that provide services, social, human and financial capitals are equally important to reduce vulnerability against any disasters. In table 11, we note on these assets – social, human and financial assets present in the NWP clusters.

Table 11: Status of social, human and financial assets in NWP clusters

Assets situation in ten NWP clusters	*Shivamandir*	*Dumkibas*	*Rajahar*	*Pithauli*	*Dhobadi*	*Rakachuli upper*	*Deurali*	*Rakachuli lower*	*Mainaghat lower*	*Mainaghat upper*
Financial Assets										
Self-help groups Microfinance	Yes	Yes	Yes	Yes - 1group	Yes	Yes	Yes	Yes	No	Yes
Cooperative (credit/marketing)	No	No	No	No	Yes	Yes	No	No	No	No
Branch of Rural/Cooperative Bank	Yes	No	No	No	No	Yes	No	No	Yes	No
Branch of Commercial Bank	Yes	No	No	No	No	No	No	No	No	No
Money lender	Yes	No	No	No	Yes	No	No	No	No	No
Social Assets										
Local self governance units/VDC	Yes	No	No	No	No	Yes	No	No	No	Yes
Farmers' organizations	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Community Forest User Groups	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Water users' group	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Communal/Ethnic institution	Yes	No	No	No	No	No	No	No	No	No
Community based organization	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	No
Youth club	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Religious/festival committee	Yes	No	No	No	Yes	Yes	Yes	Yes	No	Yes
Grain/food bank	No	No	No	No	Yes	No	Yes	No	No	No
Emergency response	No	No	No	No	Yes	No	Yes	No	Yes	No
Human Assets										
Organic farming	No	No	No	Yes	No	No	No	No	No	No
Resource/leader farmer	Yes	No	Yes	No	Yes	No	Yes	No	No	Yes
Gardner/nursery raiser	No	No	No	No	Yes	No	No	Yes	No	No
Agricultural degree	-	-	-	-	-	Yes-5	-	-	-	-

Source: Village data sheet 2011/2012, SAF-BIN

In all the clusters, farmers or local communities are in one or other way aligned with particular groups or organizations. This is surely important as being in a group can make their voices heard in public and social domain. However, in-depth analyses of group dynamics are necessary to find whether the groups are functioning well or not.

3.8 MAJOR CROPS AND CROPPING PATTERNS

In plains of NWP, rice is a major crop whereas in hills, millet, maize and yam or colocasia are widely grown. In hills, upland rice or paddy is also grown in limited area, where water resources are nearby. Table12 shows some key crops and their yield in tonnes/hectares (t/ha), major cropping system and food scape. Rice and paddy are dominant food in NWP food scape, though not grown in sufficient amount especially in the hill clusters of NWP. Demand of rice is fulfilled by importing.

Table 12: Major crops, cropping system and food scape of the NWP cluster

NWP SAF-BIN clusters	*1st crop*	*2nd crop*		*3rd crop*		*4th crop*		*Cropping pattern*		*Food scape in order of priority*	*Important vegetables with yield in t/ha*
	Rice yield (t/ha)	*Crops*	*yield (t/ha)*	*Name*	*yield (t/ha)*	*Crops*	*yield (t/ha)*	*Past*	*Present*		
Shivamandir	2.2	wheat		maize	1.4			Rice-millet-maize	Rice-Wheat-Maize	Rice>Maize>Wheat	potato, colocasia, radish, banana, cauli, potato
Dumkibas	2.5	wheat		maize	1.2			Rice-wheat-mustard	Rice-Wheat-Maize	Rice>Maize>Wheat/ vegetables	cauli-11, banana-13, tomato-5
Rajahar	2	wheat	1.8	maize	1.2			Rice-wheat-maize	Rice-Wheat-Maize	Rice>Wheat>Maize	cauli & radish - 20
Pithauli	2	wheat	ND	maize	ND	Lentil	1.3	Rice-wheat/ mustard	Rice-Wheat-Maize	Rice>Wheat>Maize	tomato
Dhobadi	2* & 4**	maize	4	millet	0.5			Maize – Millet – Colocasia	Rice-Maize-Millet; Rice-Vegetables-Millet in irrigated area	Rice>Maize>Millet/ vegetables	potato-6, colocasia-8, banana-10, BLM-3

Rakachuli upper	1.7	maize	1.5	millet	0.5-1.2	Mustard	0.9	Buckwheat - Millet	Upland: Maize-Millet/Ginger - Mustard; Maize -Millet; Maize-Sesame; Lowland: Rice – Maize; Rice - Mustard; Rice – Sesame; Rice - Nigerseed	Rice>Maize>Millet	mango, BLM, banana
Deurali	1.2	maize	1.6	millet	0.7			Rice-sorghum-maize/millet In rainfed condition: Rice - Wheat/ Mustard - Maize, Rice - Maize -Wheat, Maize-Mustard	Rice-wheat-maize/millet	Rice>Maize>Millet/ vegetables	potato-8, colocasia-20, jackfruit-18
Rakachuli lower	1.2* in 9ha, 3.5** in 13.5ha	maize	2.5	millet	1.5 or 0.5			Rice-Sorghum-Maize/Millet	Rice, maize- millet, rice-maize/millet	maize>rice>millet/wheat	colocasia-15, potato-6, litchi-5
Mainaghat lower	1.8	maize	1.3	millet	0.5			Maize/ Sorghum - colocasia (Sorghum cultivated in Khoria system)	Maize/millet - mustard	Rice>Maize>Wheat	Radish, ginger, colocasia, yam, banana, turmeric, mango
Mainaghat upper	1.8	wheat		maize	1.5	millet	0.5	rice-junelo-(great millet)-maize/millet	Rice-wheat-maize/millet	Rice>Maize>Millet	potato-7, jackfruits-12

** = Irrigated ; *= Unirrigated, BLM = Broad leaf mustard

Source: Village data sheet 2011/2012, SAF-BIN

3.9 FOOD SECURITY SITUATION

Due to changing climate, farmers face problems such as drought, lack of timely rainfall during monsoon and critical plant growth stages leading to crop failure and increasing food insecurity. Table 13 presents the information about food availability situation, adverse conditions contributing to crop failure and food sufficiency situation of the NWP clusters. It is observed that majority of households have food security for less than a year. Only in Shivamandir and Pithauli clusters, 50% and more farm households have all year round food security. In Deurali, majority of households (68.97%) have food security for less than 6 months.

Table 13: Adversities and food availability and deficiency situation in NWP clusters

SAF-BIN clusters - NWP	*Shivamandir*	*Dumkibas*	*Rajahar*	*Pithauli*	*Dhobadi*	*Rakachuli upper*	*Deurali*	*Rakachuli lower*	*Mainaghat lower*	*Mainaghat upper*
No. of times key food crops failed in last 5 years							Rice failed once in past 5 years			
Occurrence of drought over past 5 years	3	1	4	2	3	2	1	3	4	2
Disadvantaged caste group (Dalit and Janajati)										
12 months secure	47 (49.47%)	24 (18.6%)	20 (14.18%)	70 (57.38%)	34(34.34%)	No data (ND)	13 (15.66%)	0	ND	38 (31.93%)
>6 months insecure	48 (50.53%)	10 (7.75%)	7 (4.96%)	25 (20.49%)	0		60 (72.29%)	0		54 (45.38%)
4-6 months	0	45	4 (2.84%)	27 (16.13%)	30 (30.30%)		0	2 (2.82%)		24

insecure		(34.88%)								(20.17%)
2-4 months insecure	0	35 (27.13%)	50 (35.46%)	0	21 (21.21%)		4 (4.82%)	24 (33.8%)		3 (2.52%)
0-2 months insecure	0	15 (11.63%)	60 (42.55%)	0	14 (14.14%)		6 (7.23%)	45 (63.38%)		0
Sub-total	***95 (100%)***	***129 (100%)***	***141 (100%)***	***122 (100%)***	***99 (100%)***		***83(100%)***	***71 (100%)***		***119 (100%)***
Others (Advantaged caste group)										
12 months secure	47 (50%)	6 (31.58%)	25 (100%)	35 (76.09%)	0	ND	4 (100%)	0	ND	0
>6 months insecure	9 (9.57%)	13 (68.42%)	0	6 (13.04%)	0		0	2 (100%)		0
4-6months insecure	10 (10.64%)	0	0	5 (10.87%)	0		0	0		0
2-4months insecure	19 (20.22%)	0	0	0	12 (75%)		0	0		0
0-2 months insecure	9 (9.57%)	0	0	0	4 (25%)		0	0		0
Sub-total	***94 (100%)***	***19 (100%)***	***25***	***46 (100%)***	***16 (100%)***		***4 (100%)***	***2 (100%)***		
Total in % excluding Rakachuli upper and Mainaghat lower data										
12 months secure	94 (50%)	30 (20.27%)	45 (27.11%)	105 (62.5%)	34 (29.57%)	10.64%	17 (19.54%)	0	ND	38 (31.93%)
>6 months	57 (30.15%)	23	7 (4.22%)	31 (18.45%)	0	0	60 (68.97%)	2 (2.74%)		54

insecure		(15.54%)								(45.38%)
4-6 months insecure	10 (5.29%)	45 (30.4%)	4 (2.41%)	32 (19.05%)	30 (26.09%)	41.49%	0	2 (2.74%)		24 (20.17%)
2-4 months insecure	19 (10.05%)	35 (23.64%)	50 (30.12%)	0	33 (28.7%)	5.32%	4 (4.6%)	24 (32.88%)		3 (2.52%)
0-2 months insecure	9 (4.76%)	15 (10.13%)	60 (36.14%)	0	18 (15.65%)	42.55%	6 (6.89%)	45 (61.64%)		0
Overall	***189 (100%)***	***148 (100%)***	***166 (100%)***	***168 (100%)***	***115 (100%)***	***100.00%***	***87 (100%)***	***73 (100%)***		***119 (100%)***

Figures in parentheses are in percentage

Source: Village data sheet 2011/2012, SAF-BIN

3.10 FOOD HANDLING AND MANAGEMENT

The food handling and post harvest management of food are important. Good practices undertaken during harvesting, processing, storage ensures food loss is less after production. Hence, more food is available for consumption by the households. Table 14 below presents the post harvest handling and management practices followed by the cluster population. It also notes what is the learning or innovations pursued by the small farmers to reduce food loss during these stages.

Table 14: Food storage and processing technologies used in ten clusters of NWP

Storage techniques	**Clusters using the techniques**
Rice stored in bamboo bins	Pithauli, Dumkibas, Upper Mainaghat
Metal drum or bins	Rajahar, Shivamandir
Plastic drums for wheat	Pithauli, Upper Rakachuli, Rajahar, Shivamandir
Wood bins	Upper Mainaghat
Plastic sacs	Pithauli, Dhobadi, Deurali, Dumkibas, Mainaghat lower, Upper Rakachuli, Upper Mainaghat
Mudbins(Deheri)*	Pithauli, Dhobadi, Deurali, Dumkibas, Mainaghat lower, Upper Rakachuli, Upper Mainaghat, Rajahar, Shivamandir
Bamboo bins	Pithauli, Dhobadi, Deurali, Dumkibas, Mainaghat lower, Upper Rakachuli, Upper Mainaghat
Jute sacs	Dhobadi, Deurali, Dumkibas, Mainaghat lower, Upper Rakachuli, Upper Mainaghat
Suli (raised str. with thatched roof for maize storage)	Dhobadi, Deurali, Dumkibas, Mainaghat lower, Upper Rakachuli, Upper Mainaghat, Shivamandir
Harvesting techniques	
Manual	Dhobadi, Deurali, Dumkibas, Mainaghat lower, Upper Rakachuli, Upper Mainaghat, Rajahar
Thresher (used sp. for rice)	Pithauli, Dhobadi, Dumkibas, Upper Mainaghat, Rajahar
Processing	
In mills	Pithauli, Dhobadi, Deurali, Dumkibas, Mainaghat lower, Upper Rakachuli, Upper Mainaghat, Rajahar
Traditional cereal pounder	Dhobadi, Deurali, Mainaghat lower, Upper Rakachuli, Upper Mainaghat
Mortar and pestle	Dhobadi, Deurali, Mainaghat lower, Upper Rakachuli, Upper Mainaghat

Source: Village data sheet 2011/2012, SAF-BIN

Bamboo bins, mud bins, jute and plastic sacs are commonly used for storage. Though might be expensive, use of closed mouth metal bins are recommended for maintaining better quality during storage of seed. However, metal bins are used in Rajahar and Shivamandir clusters only. Harvesting is done manually in all the clusters. In 5 clusters namely - Pithauli, Dhobadi,

Dumkibas, Upper Mainaghat, Rajahar, threshing of rice has been mechanized. Both traditional and contemporary processing methods are followed to process key cereal crops.

3.11 MAJOR CROP VARIETIES AND SEED SOURCE

Rice is the major crop with farmers followed by maize, wheat and millet. In the hilly clusters of NWP - Deurali, Mainaghat upper, Mainaghat lower, Rakachuli upper and Rakachuli lower, upland rice is cultivated. Farmers used both improved and local varieties of the crops in the clusters expect for Deurali where only local varieties are cultivated. Table 15 below provides varietal information of seed of major crops used in the clusters.

Table 15: Major crops varieties grown in NWP clusters

SAF-BIN clusters Nawalparasi	***Varieties cultivated in the clusters (L=local, I=improved, H=hybrid)***			
	Rice	***Wheat***	***Maize***	***Millet***
Shivamandir	I: OR, Sabitri	I: RR21	L: Local yellow, I: Rampur	
Dumkibas	L: Aath hajare, I: Radha 4, Sarju 52, Gorkhanath, Hardinath	L:Kathhe	L: Local yellow	
Rajahar	L: Kanchi/OR, I: Sabitri, Loknath	No data	L: Local yellow, I: Arun	
Pithauli	L: Marshi, I:Sabitri, Loknath, Mansuli	L:Kathhe	L: Local yellow	
Dhobadi	L:No name, I: Sabitri, Gorakhnath, Radha-4, Radha-17, H: Prithivi		L: Local yellow, white; I: Rampur, Makwanpur	Kabre
Rakachuli upper	L: kanchi; I: Sabitri, Radha-4		L: Yellow/Red/ White, Amrikane, I: Manakamana-2	L: Dalle
Deurali	L: Kanchi	L: Brown wheat	L: Local yellow	L: Dalle
Rakachuli lower	L: Kanchi/Marshi; I: Sabitri, Radha-4		L: Local yellow, white; I: Rampur	Local
Mainaghat lower	L: kanchi, Marshi, pakhe mansuli; I:Sabitri, Radha-4, Makwanpur 1		L: Local yellow	Local
Mainaghat upper	L: Makwanpure 1, Mansuli, Baspate, I: Gorakhnath, mansuli, sabitri	L: Brown wheat, Kathhe,	L: Local yellow, white and red; I: Rampur Composite	L: Lahure/ Okhale, Dalle

Source: Village data sheet 2011/2012, SAF-BIN

3.12 SEED SOURCE

In every cluster, farmers perceived low yield of crops as one of the key problems. Among the causes attributed to low yield, key cause has been termed as lack of quality seed. Table 16 below provides information about the source of seed farmers depends upon.

Table 16: Seed source of major crops grown in NWP clusters

SAF-BIN clusters NWP	***Seed Source (L=local source, E=external source)***				***Major vegetables consumed and produced***
	Rice	**Wheat**	**Maize**	**Millet**	
Shivamandir	L: 20, E: 80	L: 80, E: 20	L: 70, E: 30	-	*Cucumber, pumpkin, cauliflower, garlic, leafy vegetables, chilies*
Dumkibas	L: 85, E: 15	L: 100	L: 80, E: 20	-	
Rajahar	L: 25, E: 75	-	L: 50, E: 50	L: 100	
Pithauli	L: 70, E: 30	L: 75, E: 25	L: 90, E: 10	-	
Dhobadi	L: 40, E: 60	-	L: 100	E: 100	*Potato, Colocasia, Banana, Broad leaf mustard*
Rakachuli upper	L: 100	-	L: 100	L: 100	
Deurali	L: 90, E: 10	-	L: 90, E: 10	L: 0, E: 100	
Rakachuli lower	L:100	-	L:100	L:100	
Mainaghat lower	L: 100	-	L: 100	-	
Mainaghat upper	L: 90, E: 10	L: 90, E: 10	L: 90, E: 10		*Potato, colocasia*

Source: Village data sheet 2011/2012, SAF-BIN

It has been observed that Nepal's seed replacement rate is nominal and not at all, leading to degradation in quality and production of crops. The table above confirms the same that farmers' do not replace their old seeds with fresh ones. Lack of seed replacement can also be the reason for low yield of the crops. Only in Shivamandir, Rajahar and Dhobadi clusters, more than 60% of farmers sought seeds from external sources such as agro-vet, research centers, etc.

3.13 FARMING PRACTICES

A farm's agriculture productivity and sustainability depends on seeds, soil, climate as well as the capacity of farmers to pursue suitable farming practices. Table 17 gives information on farming practices followed in the clusters of NWP.

Table 17: Farming practices followed in the NWP SAF-BIN clusters

Cultivation practices	**Clusters following**	**No. of followers**	**Area in ha**	**Crops/system**
Organic farming	Deurali	all	all	all
Integrated Pest Management	Pithauli, Dhobadi, Dumkibas, Rajahar, Shivamandir	23 +25 +28 +50 +30=156	2.3 +2 +33 +1 +1=39.3	Paddy

Agro-forestry	Dumkibas,	75	1.5	Fodder trees
	Upper Rakachuli (khoriya),	+55	+1	+Khoriya[5]
	Rajahar,	+175	+2	+fodder trees
	Lower Rakachuli,	+65	+4	+fodder trees
	Shivamandir	+92=462	+1.5=10	+fodder trees
In Mainaghat upper and lower, none of the innovative farming practices are followed.				

Source: Village data sheet 2011/2012, SAF-BIN

In NWP organic farming, Integrated Pest Management (IPM) and agro-forestry are three cultivation practices worth mentioning. However, IPM is practiced in paddy in the limited area. Deurali is a hilly cluster without access to motorable roads. Hence, transporting goods are expensive. Because of high costs incurred while transporting, farmers do not import chemical fertilizers and pesticides, keeping the farms and their products organic.

3.14 LIVESTOCK INFORMATION

Livestock are an important part of small integrated farming systems present in Nepal. Small and large livestock are raised for income generation. Milk and milk products, egg and meat are consumed and also sold by the small farmer households to raise much needed cash. At times of household emergency such as illness of family member, small or large livestock may be sold to raise the funds needed for medication. In addition to this, animal waste are used as farm yard manure, compost, and for preparing organic concoctions used in farming such as bio-spray. There are various levels of mechanization in the rural areas; however, significant numbers of the households are still noted to keep large animals for use as draught force. The following table 18 is the status of different types of local and improved livestock per household in the location.

Table 18: Livestock status in ten NWP clusters

Status of the local livestock and birds

SAF-BIN clusters Nawalparasi	Cow	Buffalo	Bullocks	Goat	Sheep	Pig	Poultry/birds	Ducks
Shivamandir	1	100	2	150	0	0	3000	-
Dumkibas	215	105	80	565	60	60	1680	-
Rajahar	5	40	40	120	1	250	450	-
Pithauli	20	70	40	300	100	0	500	-

[5] Shifting cultivation or slash and burn agriculture, is an agro-forestry practice, generally practiced by ethnic groups in steep to gentle steep lands from hills, in which, they clear and burn small patches of forest or shrubland, usually unregistered or open one to cultivate staple crops for a year or two, and desert the place for more than a decade or considerable period till it regains its fertility (Khadka, 2010).

Dhobadi	40	150	200	400	0	40	1500	-
Rakachuli upper	75	90	140	1000	0	120	150	-
Deurali	210	5	130	250	0	75	520	-
Rakachuli lower	29	80	250	300	0	220	107	9
Mainaghat lower	50	65	80	215	0	103	130	-
Mainaghat upper	600	400	500	1500	0	0	0	-
Total	***1244***	***1105***	***1460***	***4650***	***161***	***868***	***8037***	***9***

Status of the improved livestock and birds

SAF-BIN clusters Nawalparasi	**Cow**	**Buffalo**	**Bullocks**	**Goat**	**Sheep**	**Pig**	**Poultry/birds**
Shivamandir	12	100	16	3000	0	100	12
Dumkibas	4	15	0	98	0	100	1100
Rajahar	10	0	0	0	0	0	8
Pithauli	6	5	0	0	0	50	no data
Dhobadi	4	10	0	150	0	1000	1800
Rakachuli upper	0	0	0	0	0	0	no data
Deurali	0	15	0	45	0	35	0
Rakachuli lower	0	0	0	0	0	0	no data
Mainaghat lower	0	0	0	0	0	0	no data
Mainaghat upper	0	0	2	565	0	0	no data
Total	***36***	***145***	***2***	***3858***	***0***	***1285***	***2920***

Status of Local and improved livestock and poultry combined

SAF-BIN clusters Nawalparasi	**Cow**	**Buffalo**	**Bullocks**	**Goat**	**Sheep**	**Pig**	**Poultry/birds**
Shivamandir	13	200	18	3150	0	100	3012
Dumkibas	219	120	80	663	60	160	2780
Rajahar	15	40	40	120	1	250	458
Pithauli	26	75	40	300	100	50	500
Dhobadi	44	160	200	550	0	1040	3300
Rakachuli upper	75	90	140	1000	0	120	150
Deurali	420	20	260	545	0	185	1040
Rakachuli lower	29	80	250	300	0	220	107
Mainaghat lower	50	65	80	215	0	103	130
Mainaghat upper	600	400	502	2065	0	0	0
Total	***1281***	***1250***	***1462***	***8658***	***161***	***2153***	***10957***

Average livestock per HH

SAF-BIN clusters **Nawalparasi**	**Total HH size**	***Cow***	***Buffalo***	***Bullocks***	***Goat***	***Sheep***	***Pig***
Shivamandir	189	0.07	1.06	0.10	16.67	0.00	0.53
Dumkibas	148	1.48	0.81	0.54	4.48	0.41	1.08

Rajahar	166	0.09	0.24	0.24	0.72	0.01	1.51
Pithauli	168	0.15	0.45	0.24	1.79	0.60	0.30
Dhobadi	241	0.18	0.66	0.83	2.28	0.00	4.32
Rakachuli upper	59	1.27	1.53	2.37	16.95	0.00	2.03
Deurali	70	6.00	0.29	3.71	7.79	0.00	2.64
Rakachuli lower	73	0.40	1.10	3.42	4.11	0.00	3.01
Mainaghat lower	96	0.52	0.68	0.83	2.24	0.00	1.07
Mainaghat upper	119	5.04	3.36	4.22	17.35	0.00	0.00
Summary	***1329***	***0.96***	***0.94***	***1.10***	***6.51***	***0.12***	***1.62***

(N.B.: While collecting information on poultry, the poultries reared for commercial purpose was left out from data because of which average poultry per HH has not been calculated.)

Source: Village data sheet 2011/2012, SAF-BIN

Among the large milch breeds, buffalo is preferred more than cow as buffaloes produce more milk with higher fat percentage fetching better price in dairy market. However, numbers of cows still outnumber the buffalo population. The data showed that in hilly areas, improved breeds are uncommon which may be due to the remoteness of the area and lack of financial resources owing to meager production of crops and lack of good income source where as areas near the cities are found to adopt improved breeds as well. In case of small livestock, goats are preferred as they can generate fast cash in case of emergency.

3.15 Climate Change Perception, Impacts, and Adaptation

United Nations Panel on Climate Change has reported how humans are contributing to bringing about significant change in climate with their deposition of green house gases in the atmosphere starting with the onset of the industrial age. The change in climate is noted mostly in terms of change in temperature (of soil, water and air) and rainfall pattern (time and period, intensity, frequency, amount). The small farm holders from South Asia had been highly vulnerable to and affected by adverse changing climate scenario such as drought, no rainfall during critical growth stages especially of winter crops and high rainfall during harvesting and vegetative growth stages. Caritas Nepal undertook research using participatory research tools that includes Participatory Rural Appraisal, Screening workshops, stakeholder meetings to name few in the potential project clusters to find out small farmers' understanding of climate change and its impacts in general, its impact on agriculture, and adaptations pursued in agriculture by them. Following are the findings.

Farmer's perception on climate change trend in NWP clusters

According to the farmers of the cluster,

- *Changes perceived during monsoon:*

  There is a fluctuation in monsoon rainfall pattern in recent years, with more rainfall towards the latter half of the monsoon season. Within monsoon, there are periods of high and low rainfall over the period of time. There are times when onset of monsoon is delayed where as there are periods or years of timely start of monsoon. In some years, there has been high rainfall in latter part of Monsoon. In addition to this, there are periods of no rainfall (or limited) rainfall within the wider Monsoon season. The irregular pattern of rainfall has made it difficult for farmers to predict monsoon and carry on smoothly timely cropping practices. Hence, farmers in the plain areas of NWP have started adopting drought tolerant and short duration rice varieties, mostly improved ones in the majority of locations. Erratic monsoon rainfall has delayed planting season of maize in Rajahar cluster.

- *Changes in precipitation perceived during winter*

  Winter rainfall is important for the major crops including wheat. However, farmers perceived that the amount of rainfall and duration of rainfall has declined negatively affecting the yields of major crops especially of wheat. There are times when there is late rainfall in winter or no rainfall at all. Due to this, wheat could not receive necessary moisture for triggering its growth in its critical growth stages. Hence, wheat could not maintain its smooth growth leading to low yield or crop failure. The low yield due to lack of adequate and timely rainfall as well as lack of innovative agricultural practices in cultivating wheat led to cessation of wheat cultivation in many plain areas of Nawalparasi.

- Local water resource including river are drying up fast. For example in Shivamandir cluster, people used to irrigate their fields using Kerunge Khola (water stream) till 15 years back. Due to availability of perennial water source, farmers were able to harvest paddy twice a year (summer and monsoon). However, since past few years, water in the stream depleted drastically making it a seasonal stream. Now, water from stream is insufficient even for monsoon rice. Due to this, the farmers have replaced their local cultivars requiring high irrigation with the drought tolerant and short duration varieties.

They have adopted hybrid cultivars too. Farmers have completely given up summer rice and the farmers of ward no-2 of that village replaced monsoon rice with the maize (Source- PRA, SAF-BIN, Caritas Nepal 2011).

- Timely plantation of crops next to impossible, so cultivation of monsoon maize has been delayed in Rajahar, Rakachuli upper and other clusters. In Rakachuli upper, due to lack of rainfall, cultivation of ginger which used to be cultivated in May have been shifted to June. Even in rice, farmers shift the transplanting date depending upon the onset of monsoon. Meanwhile, due to sparse rainfall in winter, farmers in Dhobadi find it difficult to continue wheat cultivation as main winter season crop.
- Previously, the food produced from farmers' field used to be adequate for 12 months, but at present, food produced from field is sufficient for 6-7 months owing to lack of adequate rainfall. For example: In some of areas of NWP clusters, especially in plain areas, triple cropping used to be followed in agri-land. Rice used to be cultivated twice in a season. But now, due to lack of adequate water, farmers have stopped cultivating *Chaite* rice (*chaite dhan*). Only double cropping pattern is practiced. This has affected their food security situation.
- Outbreak of diseases and pests on plants have been increased,
- Summer and spring seasons are getting warmer.

(Other details in Annex 3)

Negative impacts or problems due to climate change to small farmers

Various sources observed that climate change has profound negative impacts to the small holder farmers of South Asian region. Even farmers concur that they have experienced the change in terms of change in rainfall time, duration, temperature and change in other weather patterns. This section covers the problems perceived by farmers blaming climate change. According to the yield of crops has decreased where as pest and disease infestation problem has increased. Reservoirs and rivers' water level has decreased in due course of time. Due to out-migration owing to food insecurity, human resources working in agricultural land have decreased.

Besides general problem, crop specific problems (rice and maize) owing to climate change as perceived by farmers will be discussed below, using problem matrix. The result of problem

matrixes done on rice and maize is presented in table 19 and table 20 (details of problem matrix calculation in Annex 1).

Table 19: Problems on rice cultivation

NWP - problems on rice	Weighted score	Score wise problem ranking	Remarks
Diseases and pests	39	1st	no. 1 problem in 1 out of 6 clusters
Lack of technical knowhow/advanced technology	34	2nd	no. 1 problem in 1 out of 6 clusters
Lack of quality seed	34	2nd	
Drought and lack of irrigation	28	3rd	no. 1 problem in 4 out of 6 clusters
Low yield	16	4th	
Spikelets without grain (papata lagnu)	11	5th	
Storage pest problem	6	6th	
Numerous tillers formation but less panicle formation	5	7th	
Thataunda najharne	2	8th	
Disease infestation during nursery bed preparation	1	9th	
Problem matrix of rice based on - Pithauli, Dhobadi, Deurali, Rajahar, Rakachuli lower, Shivamandir clusters			

Source: Village Screening Workshop, 2012

From the problem matrix of rice in NWP cluster when compiled, diseases and pests emerged as biggest problem though being ranked as number one problem in only one cluster. Drought and lack of irrigation ranked third score wise despite being ranked as number one problem in 4 clusters out of 6 clusters of NWP. In the rest two clusters, drought and lack of irrigation is not even mentioned as a problem.

Table 20: Problems on maize cultivation

NWP - problems on maize	Weighted score	Score wise problem ranking	Remarks
Drought	53	1st	no. 1 problem in 6 out of 9 clusters
Lack of technical know-how	47	2nd	no. 1 problem in 2 out of 9 clusters
Lack of quality seed	47	2nd	no. 1 problem in 1 out of 9 clusters
Diseases and pests	28	3rd	

Seedless cob formation	16	4th
Lodging of plant	11	5th
Low yield	11	5th
Pests	9	6th
No cob formation	7	7th
Diseases	6	8th
Delay in ripening due to late sowing	4	9th
Storage pest problem	3	10th
Stem rot and leaf spot	3	10th
Lack of adequate FYM	3	10th
Problem matrix of maize based on - Pithauli, Dhobadi, Deurali, Dumkibas, Rakachuli upper, Mainaghat upper, Rajahar, Rakachuli lower, Shivamandir clusters		

Source: Village Screening Workshop, 2012

Except for Mainaghat lower, data on problem matrix of maize is available for rest of the nine clusters. From the problem matrix of maize in NWP cluster when compiled, drought, lack of technical know-how and lack of quality seed consecutively were ranked as top problems in clusters of Nawalparasi for maize crop. Hence, drought and lack of irrigation has been observed as major problems in rice and maize crops in Nawalparasi clusters.

Drought and lack of irrigation are associated with climate change in a sense that rainfall pattern change has been observed affecting traditional agricultural practices. In addition to the problems pertaining to climate change issues, farmers' management practices, such as use of old seeds and lack of technical knowledge is also responsible for low yield, which in itself is a problem. In conclusion, detailed study is needed to identify the causes of the problems - climate related problems and crop management related negative impacts so as to provide effective solution.

Adaptation and coping strategy for climate change followed (Present and Possible)

- Adjustment in sowing and harvesting time according to availability of rainfall (done by farmers at many places)
- Selection of robust seeds at local level
- Selection of appropriate seed variety such as choosing drought tolerant variety
- In plain clusters of NWP, farmers started cultivating short duration, drought tolerant rice varieties so as to adapt against erratic monsoon pattern

- Crop replacement: wheat replaced with other crops as winter rainfall become sparse in some places of Dhobadi
- Out-migration increased owing to food insecurity because of low productivity.

4 CONCLUSION

Caritas Nepal has used this base line information to form small farmer groups. In Nawalparasi, from 10 clusters, 30 groups are formed. From each clusters, three hamlets are formed. About 15 farmers interested to work on the issue of climate change and agriculture adaptation have been organized to form a group in each hamlet.

Based on this base line information and pursuing workshops held in the villages, Caritas Nepal is identifying areas for further research. The research will be "small farmer group led action research". It will examine agriculture adaptations in farming to improve productivity of food grain crops (rice/wheat/maize) and other nutritious crops. The research will further examine the strengths found in this base line survey and screening outcomes regarding the small farming systems in the face of changing climate.

In this way, this baseline information has been useful to Caritas Nepal to understand the real context of climate change and its impacts in the cluster. We hope this information will be useful to other actors who want to contribute to the sector of climate change research and agriculture adaptation in Nepal and South Asia as a whole.

5 RECOMMENDATION

Local farmers need to follow innovative and alternative strategy rather than following only traditional practices so as to increase the adaptive capacity against climate change. Such as following integrated farming approach, integrated pest and nutrient management approach can increase their ability to fight against the adversities due to climate change. Generally, farmers do not replace old seeds with new ones, affecting yield potential, so awareness and action in this aspect might help them to prevent crop failure. Likewise, farmers should have access to innovative ideas and alternative technologies so that they are able to solve or deal with problems due to climate and pest infestations in effective manner. Meanwhile, innovative ideas used by local farmers should be disseminated to other local farmers.

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ANNEXES

Annex 1: Problem matrix calculation of major crops

Problem matrix calculation of rice

NWP - problems on rice	Ranking score =(no. of times problem occurred*Score according to the ranking in respective problem matrix), Problem ranked 1st was given score of 7 and problem of least importance was given score of 1							Combined score	Remarks
	1	2	3	4	5	6	7		
Diseases and pests	1*7=7	2*6=18	2*5=10	1*4=4	-	-	-	39	no. 1 problem in 1 out of 6 clusters
Drought and lack of irrigation	4*7=28	-	-	-	-	-	-	28	no. 1 problem in 4 out of 6 clusters
Lack of technical knowhow/advanced technology	1*7=7	2*6=18	1*5=5	1*4=4	-	-	-	34	no. 1 problem in 1 out of 6 clusters
Lack of quality seed	-	2*6=18	2*5=10	1*4=4	-	1*2=2		34	
Low yield	-	-	-	1*4=4	4*3=12	-		16	
Spikelets without grain (papata lagnu)	-	-	-	2*4=8	1*3=3	-		11	
Numerous tillers formation but less panicle formation	-	-	1*5=5	-	-	‘-	-	5	
Storage pest problem	-	-	-	-	-	3*2=6		6	
Disease infestation during nursery bed preparation	-	-	-	-	-	-	1*1=1	1	
Thataunda najharne	-	-	-	-	-	1*2=2		2	
Problem matrix of rice based on - Pithauli, Dhobadi, Deurali, Rajahar, Rakachuli lower, Shivamandir clusters									

Source: Village Screening Report 2012, SAF-BIN

Problems on maize cultivation

NWP - problems on maize	Ranking (no. of times problem occurred*Score according to the ranking in respective problem matrix). Problem ranked 1st was given score of 7 and problem of least importance was given score of 1							Combined score
	1	2	3	4	5	6	7	
Drought	6*7=42	1*6=6	1*5=5				1*1=1	53
Lack of technical know-how	2*7=14	3*6=18	3*5=15					47
Lack of quality seed	1*7=7	3*6=18	2*5=10	3*4=12				47
Diseases and pests		2*6=12		4*4=16				28
Seedless cob formation					3*3=9	2*2=4	3*1=3	16
Lodging of plant					2*3=6	2*2=4	1*1=1	11
Low yield			2*5=10				1*1=1	11
Pests			1*3=3	1*4=4		1*2=2		9
No cob formation					1*3=3	2*2=4		7
Diseases					1*3=3	1*2=2	1*1=1	6
Delay in ripening due to late sowing				1*4=4				4
Storage pest problem						1*2=2	1*1=1	3
Stem rot and leaf spot					1*3=3			3
Lack of adequate FYM					1*3=3			3

Problem matrix of maize based on - Pithauli, Dhobadi, Deurali, Dumkibas, Rakachuli upper, Mainaghat upper, Rajahar, Rakachuli lower, Shivamandir clusters

Source: Village Screening Report 2012, SAF-BIN

Annex 2: Climatic data of Dumkauli Meteorological Station, Nawalparasi

Latitude (deg/min): 27.41

Longitude (deg/min): 84.13

Elevation (m): 0154 masl

Maximum temperature recorded in °C over the last 30 years (1980-2011) in Dumkauli Meteorological Station, Nawalparasi

Year (AD) /Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	22.5	25.8	30.6	38.3	35.5	33.6	33.4	32.8	32.4	30.7	27.9	24.3
1981	22.3	26.8	29.8	32.5	33.7	34.9	32.0	32.7	32.6	31.3	27.8	24.6
1982	23.6	24.2	29.0	33.7	37.2	33.6	33.4	33.9	32.0	30.8	26.6	23.2
1983	21.6	24.8	30.6	33.6	33.6	36.3	33.6	33.7	32.8	31.4	28.4	23.3
1984	21.7	24.9	32.2	37.2	34.1	32.6	32.4	34.2	31.6	32.0	28.0	23.8
1985	23.1	25.9	32.9	37.0	35.2	34.2	31.8	33.7	31.5	30.3	28.0	24.0
1986	23.3	25.5	32.0	35.2	34.5	36.2	32.5	33.1	31.6	30.1	27.8	24.1
1987	23.2	27.3	30.6	35.4	36.8	35.8	31.5	32.2	32.4	30.8	28.9	24.9
1988	24.6	27.5	30.7	35.8	34.9	34.1	32.6	32.4	33.4	33.0	30.1	25.4
1989	22.2	24.7	31.0	37.2	36.6	34.7	31.9	34.1	32.7	32.8	28.3	24.0
1990	24.2	25.0	29.1	34.4	33.8	34.8	32.4	33.1	32.3	31.0	29.8	24.8
1991	22.0	27.3	32.1	35.6	36.5	34.0	33.1	32.4	32.2	31.9	28.0	24.0
1992	22.2	23.5	32.6	37.8	35.6	36.3	32.8	32.7	32.1	30.5	28.0	23.5
1993	20.6	26.9	29.0	33.9	34.1	34.6	33.8	32.6	32.1	32.0	28.2	25.4
1994	23.2	24.9	31.3	35.9	37.1	34.9	34.4	34.2	32.5	31.6	28.4	23.9
1995	21.9	24.9	30.8	36.9	38.9	33.5	33.2	33.7	32.5	32.2	27.8	23.7
1996	21.4	25.0	31.3	36.1	37.2	33.9	32.9	33.3	32.9	30.0	28.3	24.6
1997	22.4	24.4	31.0	32.0	36.0	35.4	34.0	33.5	32.5	30.5	27.7	21.9
1998	20.2	25.6	28.4	33.7	36.1	36.5	32.3	32.6	33.6	32.8	28.7	25.1
1999	23.0	28.3	33.6	37.8	34.6	34.4	32.7	33.0	33.2	31.8	28.4	25.1
2000	21.6	24.0	30.8	34.6	33.5	33.6	32.9	32.7	32.1	32.6	27.9	24.5
2001	22.3	26.7	32.1	35.6	33.8	33.5	33.3	33.8	32.1	31.6	28	22.8
2002	22.5	25.8	31.1	33.6	33.1	34.3	32.5	33.4	32.5	30.9	27.8	23.2
2003	19	24.7	28.7	34.6	35.1	33.6	33.3	33.3	31.9	31.2	27.4	23.7
2004	20.7	25.6	32.8	33.0	34.3	33.7	31.9	33.8	32.4	30.2	26.7	23.5
2005	22.1	25.5	31.8	35.4	35.0	36.1	32.9	32.7	33.9	30.4	27.1	24.6

2006	22.5	28.1	31.8	34.2	34.7	33.8	34	34.5	32.3	31.7	27.1	23.6
2007	21.8	23.8	29.3	34.9	36	34.8	32.5	33.7	32.3	31.7	28.1	23.8
2008	22	24.4	31.7	36.1	35.7	33.7	33	32.8	33.6	31.9	28.5	24.7
2009	23.7	28.1	32.3	37.1	35.8	35.6	34.3	33	34.2	31.6	27.2	23.4
2010	20.1	25.9	33.2	38.3	36.2	36.4	33.5	33.1	32.1	31.5	27.6	23.7
2011	20.5	25.9	31.0	34.9	33.7	34.4	32.4	33.0	32.9	31.7	26.8	21.9

Source: Raw data from Department of Hydrology and Meteorology, Nepal

Minimum temperature recorded in °C over the last 30 years (1980-2011) in Dumkauli Meteorological Station, Nawalparasi

Year (AD) /Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	8.9	11	14.7	20.2	23.6	25.5	26.3	25.8	24.6	20.1	13.7	11.1
1981	9.7	11.7	15.3	20.3	22.9	25.6	26	26.1	24.6	20.1	14	8.8
1982	9.7	10	14.8	19.7	22.4	24.7	26	26.2	24.6	19.7	15	10.6
1983	7.7	8.5	13.6	18.3	22.6	25.6	25.9	26.3	25.5	20.8	14.5	9.3
1984	7.6	9.8	14.9	19.5	24.4	25.4	25.3	25.9	23.6	21	12.8	10.4
1985	9.6	9.9	15.7	20.6	23.1	24.8	25.1	25.9	24.1	20.8	14.6	11.8
1986	9.9	11.2	14.7	18.6	22.1	26.2	25.4	25.4	24.1	19.5	15.2	10.8
1987	9.5	11.7	15.4	19	21.6	25.6	25.4	25.1	25.1	21.1	15.2	11.9
1988	9.6	12.1	15.4	19.6	23.4	25.2	26.1	25.7	25.2	20.8	13	11.7
1989	9	9.2	14.3	17	23.2	25.4	25.1	25.7	24.8	20.6	14.2	9.4
1990	10.2	11.7	14.5	19.1	23.3	26	25.8	25.8	24.8	19.9	14.8	10.6
1991	8.6	11.4	15.6	19.3	24.1	25.7	26	25.6	24.9	19.8	12.6	9.5
1992	9	10	14.6	19.6	22.8	25.1	25.2	25.7	24.3	20.9	14.6	10.6
1993	9.7	11.8	12.8	18.7	22.7	25.3	26.1	25.8	24.3	20.1	15.1	9.6
1994	10.3	10.4	16.3	18.5	23.3	25.6	26.2	26	24.4	19	13.1	9.9
1995	8.1	10.2	13.9	18.1	24.3	26.3	25.8	25.6	24.6	20.8	15.1	11.7
1996	9.9	11.6	16.3	17.8	23.3	24.7	25.9	25.7	24.6	20.3	14.8	9.6
1997	8	8.5	13.6	18.3	21.2	24.5	25.9	25.7	24.5	18.3	14.8	11

1998	9.3	11.1	14	19.2	24.1	26.5	25.8	25.8	25.4	22.9	17.5	10.7
1999	8.5	12.3	14	21.4	23.8	24.9	25.5	25.4	24.8	20.7	15.1	11.1
2000	9	9.3	13.4	19.3	23.9	25.1	25.7	25.5	24.2	20.6	16.5	9.5
2001	7.8	11	13.8	18.5	23.2	25.2	26	25.6	24.3	21.2	15.9	11
2002	9.5	11.8	15.2	20.4	23.2	25	25.7	25.9	24.1	20.2	15.4	11.4
2003	8.8	11.9	15.2	20.2	21.9	24.6	25.6	25.7	24.7	20.7	15.9	10.1
2004	9.6	11.2	17	21	23.2	24.6	25.4	25.7	24.3	19.7	14	11
2005	9.9	12.4	16.3	18.7	22.6	25.6	25.9	25.6	25.4	20.5	14.0	10.0
2006	9	14.4	14.5	19.5	23.5	24.7	26.2	25.9	24.2	20.3	15.1	11.6
2007	8.7	12.6	14.4	20.8	23.7	25.1	25.5	25.6	24.4	21.4	14.8	10.1
2008	9.3	8.9	15.7	19.9	22.9	25.1	25.7	25.4	24.3	20	14.9	12.8
2009	10.6	11.6	14.8	20.5	22.8	24.8	26.2	25.7	24.5	21	14.42	10.4
2010	9.3	10.9	17.2	21.1	23.7	25.5	26.0	25.9	24.7	21.1	16.7	9.5
2011	8.5	11.2	15.2	19.4	23.2	25.2	25.5	25.5	25.1	21.1	16.7	11.6

Source: Raw data from Department of Hydrology and Meteorology, Nepal

Annual monthly rainfall measured in mm over last 34 years (1976-2011) in Dumkauli Meteorological Station, Nawalparasi

Year(AD) /Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	2.1	0	0	105.7	132.7	597.3	457.1	377.9	170.8	83.4	0	0
1977	24.5	8	9.5	70.6	206.4	152.4	451.9	410	130.4	180.9	38.7	32.5
1978	5.5	20.3	32	43.6	286.7	786.7	617.9	327.4	398.8	0	0	12.3
1979	4.1	20	0	18.6	6.9	219.1	840.8	398.8	230.8	124.9	7.1	58.4
1980	1.2	0	8.3	4.2	117.3	470.6	406.5	414.9	366.5	100.1	0	3.7
1981	58.3	0	42.3	193.6	198.2	319.7	827	568.4	419.2	0	12.8	3.7
1982	17.5	6.6	92.6	130.3	59.1	634.2	780.3	456.9	367.2	46.7	10	6.2
1983	18.2	0	3	34.7	170.1	123.5	700.2	362.3	216.6	93.2	0	25.6
1984	33.1	6.4	3.8	24	159.8	586.6	780.7	331.9	409.4	87.6	0	8.5
1985	6.8	10	0	3.2	197.2	395.7	591.6	319.3	459.3	178.7	0	77.9
1986	0	18.6	0	37	63.4	279.2	513.9	474.6	609.9	157.4	23.7	59.9
1987	1.8	10.3	43	42.4	71.1	382.7	792.8	445.7	191.8	169.3	0	11.5
1988	0	6	48.8	157.5	232.4	318.2	757	771.4	163.8	28.4	1.1	40.6

1989	54.7	0	15	0	280.4	321.6	776.5	123.9	300.8	39.9	1	2.2
1990	0	21.1	39.5	13.3	331.7	295.4	802.6	662.5	300.4	186.1	0	7.1
1991	33.6	6.3	22.2	14	132.3	305.7	735.4	344.2	417.3	0	0	38.4
1992	7.2	18	0	36.5	65.7	360.8	562.5	330	263.6	125.4	8.2	0
1993	0	15.3	34	69.9	199.4	280.6	383.4	1026.8	293.8	8.8	0	0
1994	56.4	23.3	4.6	10.8	171.8	442.9	443.8	545	579.8	0	0	29.5
1995	5	39.9	5.4	13	142.6	747.6	741.4	597.7	302.2	2.9	58.8	2.8
1996	60	43.6	0	3.8	78.8	586.1	621.6	452.8	331.6	99	0	0
1997	3.8	2.7	1	58.6	109	109	534.7	521.3	275.2	25.7	5.1	230.7
1998	10	13.6	64.9	40.9	145.6	312.9	646.4	925.3	271.3	150.5	1.5	0
1999	2	0	0	63.2	370.8	496	671.2	727.5	194.6	90.6	0	0
2000	6.5	11	45.5	63.2	255.7	763.7	729	432.8	301.2	3	0	0
2001	4	16.8	0	110.6	209.5	486.9	772.6	772.9	504.5	42.5	58.4	0
2002	35	28.4	70.2	99.8	507	381.4	828.6	263.7	261.4	65.1	50	0
2003	42.2	58.4	62.3	79.8	90.6	617.2	1225.8	673.9	348.7	60	0	21
2004	42.7	0	0	204.8	342.6	590.7	490.3	253.9	464.9	219.2	2	0
2005	76.5	0	10.2	83.4	81.4	267.8	457.7	796.6	188.7	251.5	0	0
2006	0	0	19	266	292.2	270.9	189.4	517.4	474	67.4	0	20.2
2007	0	98.5	38.3	103.3	194.1	226.6	794.4	510.8	1060.4	215.7	22	0
2008	4	8	0	27.4	129.4	389.3	422.2	651.4	289.5	45	0	0
2009	0	0	0	0	309.6	377.7	434.3	613.2	130.8	58.8	0	0
2010	8.3	22.1	0	9.0	167.2	388.8	744.5	729.7	521.7	76.6	0	0
2011	0.4	0	12	12	264.4	338.8	741.2	388.6	292.7	0	82	0

Source: Raw data from Department of Hydrology and Meteorology, Nepal

Annex 3: Farmers' innovative practices to cope and adapt against adverse conditions

SAF-BIN NWP clusters	Farmers' innovative practices – coping and adaptive strategies
Shivamandir	Adjustment in sowing and harvesting time according to availability of rainfall
	Selection of robust seeds at local level
	Selection of appropriate seed variety, use of hybrid seed on rise
	Crop replacement and crop diversification
	Farm Yard Manure use improvement
	Out-migration as coping strategy owing to food insecurity because of low productivity
Mainaghat upper	Adjustment in sowing and harvesting time according to availability of rainfall
	Selection of robust seeds at local level
	Use of improved/hybrid seed on rise on maize
	crop diversifications, millet and mustard are no more cultivated
Dumkibas	Crops such as *millet and mustard* are no more planted
Rajahar	Late monsoon delayed planting season of maize.
	Farmers are using hybrid and improved variety of seeds for sowing especially in rice, where as earlier they were using local varieties
	Due to shift in monsoon period, crops are generally planted late
Pithauli	Adjustment in sowing and harvesting time according to availability of rainfall
	Selection of robust seeds at local level
	Selection of appropriate seed variety
	Crop diversification
Rakachuli upper	Adjustment in sowing and harvesting time of rice and maize according to availability of rainfall
Dhobadi	Adjustment in sowing and harvesting time according to availability of rainfall in maize
	Selection of robust seeds at local level, selection of hybrid variety of maize
	Selection of appropriate seed variety
	Crop replacement: wheat replaced with other crops as winter rainfall become sparse in many places.
Deurali	Adjustment in sowing and harvesting time according to availability of rainfall in maize
Rakachuli lower	Adjustment in sowing and harvesting time according to availability of rainfall.
	Selection of appropriate seed variety
Mainaghat lower	Adjustment in sowing and harvesting time according to availability of rainfall
	Selection of robust seeds at local level
	Selection of appropriate seed variety and frequent seed replacement
	Millet replaced

Source: Compiled from Village Screening Report 2012, SAF-BIN

Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN) is an action research programme under the European Union Global programme on Agriculture Research for Development (ARD). It is a multi-dimensional research that address the agricultural development challenges of developing and emerging countries. It is an initiative to promote local food and nutritional security through adaptive small scale farming in four rainfed Agro Ecosystems (AES) in South Asia. The programme is implemented by the Caritas Organisations in Bangladesh, India & Nepal in partnership with University of Natural Resources and Applied Life Sciences (BOKU), Austria and in association with Action for Food Production (AFPRO), India; Sam Higginbotom Institute of Agriculture, Technology & Sciences (SHIATS), India; Bangladesh Rice Research Institute (BRRI), Bangladesh and Local Initiatives for Biodiversity, Research and Development (LI-BIRD) to address the Food Security and Climate Change Challenges of the Smallholder Farmers living in rainfed areas in South Asia.