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For Small Farmers Future

Caritas Nepal

Bardiya
District Assessment Report

This publication contains the results of a village level assessment carried out by Caritas Nepal in 6 SAF-BIN project villages in Bardiya 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 Kaski, Nepal preparing their paddy research field in Kaski District © SAF-BIN/Caritas Nepal

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Co-Financed by:

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SAF-BIN project has been funded with support from the European Commission. This publication reflects the views only of Caritas Austria and its partners and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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 six SAF-BIN clusters from Bardiya district of Nepal

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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
PRA	Participatory Rural Appraisal
VDC	Village Development Committee

1 BACKGROUND

1.1 CLIMATE CHANGE AND ITS IMPACT

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.

1.2 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.

1.3 CLIMATE CHANGE ADAPTATION MEASURES IN AGRICULTURE

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.

1.4 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 Bardiya, 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

While choosing the project sites, agro-ecological diversity was considered. Hence, sites belonging to plains as well as hills were chosen. In Bardiya and parts of Nawalparasi, plain areas were chosen where as in Surkhet, Kaski and some parts of Nawalparasi, hilly areas were chosen as a research site. The project locations of Bardiya 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. Six clusters from Bardiya were chosen as a site of project intervention. 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 Bardiya 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 Bardiya district. The collective insights of Bardiya 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

Bardiya district lies in mid western region of Nepal under Bheri zone. In Bardiya district, SAF-BIN has been intervened in six project clusters. Six clusters in Bardiya district namely Kalika, Belawa, Gulariya, Mainapokhar, Motipur and Tarataal belongs to plain region with humid tropical climate. The details of project clusters in the Bardiya district are given in Table 1.

Table 1: Details on project intervention clusters of Bardiya

Project clusters VDC	Latitude	Longitude	Altitude in masl	Total cluster area in ha	Agri- + horticultural land in ha (% of agri land occupied)
Kalika	28°11′643″N	081°26′229″E	126	***199***	28 (14.07%) + 2 (1%)
Belawa	28° 15′340″N	081° 33′878″E	149	***478***	273 (57.11%)
Gulariya	28°14′30″ N	081°18′09″ E	145	***148***	132 (98.54%) + 5 (1.46%)
Mainapokhar	28°11′.281″N	081°28′875″E	152	***232.16***	204 (87.87%) + 3 (1.29%)
Motipur	28°15′578″N	081°32′244″E	155	***347***	300 (86.46%)
Tarataal	27°14′52″N	081°16′ 33″E	153	***40***	39 (97.5%)
Total of Bardiya cluster				***1444.16***	986 (68.27% of 1444.16 ha land)

SAF-BIN clusters of Bardiya occupy 1444.16 ha area of which 986 ha (68.27%) is used for agriculture. Map 1 provides the geographic position of the project VDCs within the Bardiya district.

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

3.2 DEMOGRAPHIC INFORMATION

Socio-demographic characteristics such as educational, household characteristics (gender and caste wise) of the clusters of Bardiya 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 **6953** within 1157 HHs of six Bardiya clusters. The average household size is 6.04. Of the six clusters, Gulariya has higher population, and it is the only cluster lying in the municipality.

Table 2: Population and household characteristics of the Bardiya clusters

SAF-BIN clusters	**Population characteristics**			**Household (HH) characteristics**			
	Male	Female	**Total**	Total HH size	Average HH size	Women headed HH	HH with differently able
Kalika	480	473	***953***	189	5.04	31	0
Belawa	656	615	***1271***	244	5.2	25	11
Gulariya	810	843	***1653***	201	8.22	9	12
Mainapokhar	632	664	***1296***	235	5.51	24	4
Motipur	575	582	***1157***	183	6.32	6	15
Tarataal	335	288	***623***	105	5.93	10	3
Summary of Bardiya cluster	3488 (50.17%)	3465 (49.83%)	***6953 (100%)***	1157	6.04	105	45

Figures in parentheses are in percentage

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

3.2.2 Ethnic characteristics of the Bardiya cluster

The ethnic diversity of the Bardiya cluster is presented in table 3. The data reveals that the cluster chosen for SAF-BIN contained majority of janajati (ethnic groups) households. In Bardiya, ethnic Tharu are in majority population wise.

Table 3: Ethnic diversity in Bardiya clusters

SAF-BIN clusters	**Ethnic characteristics of the HHs**			
	Ethnic groups/ Janajati	Advantaged caste groups	Dalits/ Disadvantaged groups	Total HH
Kalika	72 (38%)	74 (39%)	43 (23%)	189 (100%)
Belawa	207 (84.83%)	19 (7.78%)	18 (7.37%)	244 (100%)
Gulariya	128 (63.68%)	61 (30.34%)	12 (5.97%)	201 (100%)
Mainapokhar	224 (95.32%)	7 (2.98%)	4 (1.70%)	235 (100%)
Motipur	173 (94.54%)	7 (3.83%)	3 (1.64%)	183 (100%)

Tarataal	61 (58.1%)	8 (7.62%)	36 (34.29%)	105 (100%)
Summary of Bardiya cluster	865 (74.76 %)	176 (15.21%)	116 (10.03%)	1157 (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 % of literates in Motipur and Belawa clusters is higher as compared to other regions. The average literate percentage of the six Bardiya clusters is 28.33%, which is below than national literacy average. The details are given on table 4.

Table 4: Educational status of the locals of six SAF-BIN clusters from Bardiya

SAF-BIN Bardiya clusters	Literacy of the cluster population in %

	Male	Female	Average
Kalika	20.83%	26.85%	23.82%
Belawa	41.01%	15.45%	28.64%
Gulariya	29.42%	28.77%	29.10%
Mainapokhar	21.52%	20.33%	20.92%
Motipur	45.74%	43.99%	44.86%
Tarataal	24.48%	20.49%	22.64%
Summary of Bardiya clusters	***30.50%***	***25.98%***	***28.33%***

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. Only 23.41% farmers are with more than 1 ha of land where as 62.97% of people have less than or equal to 0.5 ha of land. Table 5 shows the land holding pattern of Bardiya cluster.

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

Bardiya SAF-BIN clusters	**% of landless (absolute agriculture 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 %**
Kalika	0	45.5	24.3	11.9	8.9	9.4	*100*
Belawa	0.82	20	10.2	4.08	64.49	0.41	*100*
Gulariya	0	42.29	20.4	8.458	27.86	0.995	*100*
Mainapokhar	0.5	20.2	38.3	26.8	5.5	8.7	*100*
Motipur	0.5	20.2	38.3	26.8	5.5	8.7	*100*
Tarataal	0	87.5	10.6	1.9	0	0	*100*
Overall Bardiya	***0.30***	***39.28***	***23.69***	***13.32***	***18.71***	***4.70***	***100***

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

3.4 LAND USE PATTERN

The area occupied by six clusters of Bardiya district is 1433.16 ha of which 976 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 Bardiya district in hectares in ha

SAF-BIN clusters of Bardiya	Agricultural land	Horticultural land	Pasture land	Area under forest	Area under open forest	Shrub land	Others	Total land	Registered land
Kalika	28 (14.07%)	2 (1 %)	-	167 (83.92%)	-	-	2 (1.005%)	199 (100%)	30
Belawa	273 (57.11%)	-	7 (1.45%)	198 (41.42%)	-	-	-	478 (100%)	
Gulariya	132 (98.54%)	5 (1.46%)	-	-	-	-	-	137 (100%)	132
Mainapokhar	204 (87.87%)	3 (1.29%)	-	-	25 (10.77%)	-	0.16 (0.07%)	232.16 (100%)	207.16
Motipur	300 (86.46%)	-	4 (1.16%)	33 (9.51%)	7(2.01%)	3 (0.86%)	-	347 (100%)	300
Tarataal	39 (97.5%)	-	-	-	-	-	-	40 (100%)	
Total	986 (68.27%)	10 (1.01%)	11 (0.77%)	398 (27.77%)	32 (2. 23%)	3 (0.21%)	2.16 (0.15%)	1433.16	

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 Bardiya cluster. The area consists of different kinds of soil that includes sandy, clayey and loamy soils. The details of soil and land type are given in Table 7.

Table 7: Soil characteristics in clusters of Bardiya district

SAF-BIN clusters of Bardiya	**Types of soil and their characteristics**		
	Loamy	***Sandy***	***Clayey***
Kalika	Black colored fertile	Brown colored	Yellow colored
Belawa	Black colored fertile	Brown colored	Yellow colored
Gulariya	Black colored fertile	Brown colored	Yellow colored
Mainapokhar	Black colored fertile	Brown colored	Yellow colored
Motipur	Black colored fertile	Brown colored	Yellow colored
Tarataal	Black colored fertile	Brown colored	Yellow colored
Summary of Bardiya cluster according to soil type	*Bardiya consists of Loamy, Sandy and Clayey type of soil. Expect for color of soil types no other characteristics have been recorded.*		

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. In Bardiya, almost all the areas are in plains. The details of land type are given in table 8.

Table 8: Land characteristics in clusters of Bardiya district

SAF-BIN clusters of Bardiya	***Land type***				
	Type I (Abbal)[1]	*Type II (Doyam)*[2]	*Type III (Sim)*[3]	*Type IV (Chahar)*[4]	*Total agricultural land in ha*
Kalika	10 (33.33%)	18 (60%)	2 (6.67%)	-	**30 (100%)**
Belawa	100 (36.63%)	130 (47.62%)	43 (15.75%)	-	**273 (100%)**
Gulariya	35 (26.51%)	90 (68.18%)	7 (5.31%)	-	**132 (100%)**

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

Mainapokhar	40 (19.32%)	125 (60.39%)	42 (20.29%)	-	**207 (100%)**
Motipur	152 (50.67%)	130 (43.33%)	18 (6.0%)	-	**300 (100%)**
Tarataal	10 (25.64%)	25 (64.10%)	4 (10.26%)	-	**39 (100%)**

Figures in parentheses are in percentage

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

3.6 METEOROLOGICAL INFORMATION

Since, the weather trends data for particular cluster is not available, we chose nearby weather station of ……. from Bardiya district as a representation of meteorological information of many of the clusters from Bardiya. 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, Bardiya district

	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Average monthly rainfall measured in mm (1976-2011)												
Average maximum temperature in °C over the last 30 years (1980-2011)												
Minimum temperature in °C over the last 30 years (1980-2011)												

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

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

(Source: Department of Hydrology and Meteorology data)

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

(Source: Department of Hydrology and Meteorology data)

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

(Source: Department of Hydrology and Meteorology data)

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 Bardiya.

Table 10: Physical assets in the clusters of Bardiya

Physical assets	**Bardiya clusters**					
	Kalika	*Belawa*	*Gulariya*	*Mainapokhar*	*Motipur*	*Tarataal*
All weathered road connectivity	*Yes*	Yes	Yes	Yes	Yes	Yes
Electricity facility	*Yes*	Yes	Yes	Yes	Yes	Yes
Mobile network coverage	*Yes*	Yes	Yes	Yes	Yes	Yes
Access to internet	*No*	*No*	*No*	*No*	*No*	*No*
Primary school	*Yes*	Yes	Yes	Yes	No	Yes
Secondary school	*No*	Yes	No	Yes	No	No
Community meeting place	Yes	No	Yes	No	Yes	Yes
Health centre	Yes	Yes	No	Yes	No	No
Veterinary service centre	Yes	No	No	Yes	No	No
Cottage industries/Agro-enterprises	Yes	No	Yes	Yes	Yes	Yes
VDC/GP/Union Office	No	Yes	No	Yes	No	No
Concrete drains	No	No	No	No	No	No
Markets for farm produce	Yes	Yes	Yes	Yes	Yes	Yes
Grocery and other shops	Yes	Yes	Yes	Yes	Yes	Yes

Remarks	Distance 2-3km away	Market 2km away	Veterinary Service Centre 5km away	Facilities 1km away	Services 2-3km away	-

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

All weathered roads are available in all the clusters of Bardiya which give them privilege to access various services offered in the city centres and nearby locations of Bardiya. Hence, though they might not have all the facilities within the area, the people of clusters from Bardiya have easy 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 Bardiya clusters.

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

Asset situation in six Bardiya clusters	***Kalika***	***Belawa***	***Gulariya***	***Mainapokhar***	***Motipur***	***Tarataal***
Financial Assets						
Self-help groups Microfinance	No	Yes	Yes	No	Yes	Yes
Cooperative (credit/marketing)	Yes	Yes	Yes	Yes	No	No
Branch of Rural/Cooperative Bank	No	No	No	No	No	No
Branch of Commercial Bank	No	No	No	No	No	No
Money lender	No	No	No	No	No	No
Social Assets						
Local self governance units/VDC						Yes Yes
Farmers' organizations	Yes	Yes	Yes	Yes	Yes	No
Community Forest User Groups	Yes	Yes	No	Yes	Yes	No
Water users' group	No	No	No	No	No	No
Communal/Ethnic institution	No	Yes	No	No	No	No
Community based organization	No	No	No	No	No	No
Youth club	Yes	Yes	No	Yes	Yes	No
Religious/festival committee	No	Yes	No	No	No	No
Grain/food bank	No	No	No	No	No	No
Emergency response	Yes	No	No	No	No	No

Human Assets						
Organic farming	No	No	No	No	No	No
Resource/leader farmer	No	Yes	No	No	No	No
Gardner/nursery raiser	Yes	Yes	Yes	Yes	Yes	Yes

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 Bardiya, rice is a major crop whereas wheat, maize and lentil are also widely grown. Table12 shows some key crops and their yield in tonnes/hectares (t/ha), major cropping system and food scape. Rice is a dominant food in Bardiya food scape.

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

BARDIYA 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*		
Kalika	4.84	wheat	2.5	Rapeseed	0.7			-	Rice-lentil/wheat	Rice>Wheat> Maize	No data (ND)
Belawa	3	wheat	1.7	Lentil	1.1			-	Rice-lentil/mustard	Rice>Wheat>potato/pulses	ND
Gulariya	3	wheat	1.97	Lentil	1.5	Maize		-	Rice/maize-lentil/wheat	Rice>Wheat> Maize	ND
Mainapokhar	5	wheat	1.9	Lentil	2.5	Vegetables	1.3	-	Rice-lentil/wheat	Rice>Wheat> Maize	ND
Motipur	5	maize	1.8	Lentil	1.3	Maize		-	Rice/maize-lentil/wheat	Rice>Wheat> Maize	ND
Tarataal	4.3	maize	1.7	Lentil	1.6	Maize	0.9	maize/cotton-horsegram/lentil	rice-mustard/lentil	Rice>Maize	ND

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 Bardiya clusters. It is observed that majority of households have food security for less than a year.

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

SAF-BIN clusters - BARDIYA	***Kalika***	***Belawa***	***Gulariya***	***Mainapokhar***	***Motipur***	***Tarataal***
No. of times key food crops failed in last 5 years						
Occurrence of drought over past 5 years	2	3	3	1	2	5
Disadvantaged caste group (Dalit and Janajati)						
12 months	10 (5.29%)	0	2 (0.96%)	21 (8.94%)	12 (6.56%)	0
>6 months	46 (24.34%)	51 (20.9%)	85 (42.28%)	105 (44.68%)	37 (20.22%)	31 (29.52%)
4-6months	26 (13.76%)	25 (10.25%)	36 (17.91%)	56 (27.86%)	70 (38.25%)	28 (28.67%)
2-4months	22 (11.64%)	10 (4.1%)	5 (2.49%)	28 (13.93%)	49 (26.78%)	27 (25.71%)
0-2 months	11 (5.82%)	139 (56.96%)	12 (5.97%)	21 (8.94%)	8 (4.37%)	11 (10.48%)
Others (Advantaged caste group)						
12 months	5 (2.65%)	1 (0.41%)	0	1 (0.43%)	4 (2.18%)	0
>6 months	29 (15.34%)	0	0	2 (0.85%)	1 (0.55%)	0
4-6months	14 (7.4%)	0	5 (2.49%)	1 (0.43%)	0	6 (5.71%)
2-4months	25 (13.23%)	0	12 (2.49%)	0	0	2 (1.9%)
0-2 months	1 (0.53%)	18 (7.37%)	44 (21.89%)	0	2 (1.09%)	0
Total in %						
12 months	15 (7.94%)	1 (0.41%)	2 (0.96%)	22 (9.36%)	16 (8.74%)	0
>6 months	75 (39.68%)	51 (20.9%)	85 (42.28%)	107 (45.53%)	38 (20.77%)	31 (29.52%)
4-6months	40 (21.16%)	25 (10.25%)	41 (20.4%)	57 (24.25%)	70 (38.25%)	34 (32.38%)
2-4months	47 (24.87%)	10 (4.1%)	17 (8.46%)	28 (11.91%)	49 (26.77%)	29 (27.61%)
0-2 months	12 (6.35%)	157 (64.34%)	56 (27.86%)	21 (8.94%)	10 (5.64%)	11 (10.48%)
Overall	**189 (16.34%)**	**244 (21.09%)**	**201 (17.37%)**	**235 (20.31%)**	**183 (15.81%)**	**105 (9.08%)**
Total Households	**1157 (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 six clusters of Bardiya

Storage techniques	**Clusters using the techniques**
Rice stored in bamboo bins	Motipur
Metal drum or bins	Kalika, Gulariya, Mainapokhar, Tarataal
Plastic drums for wheat	Kalika
Wood bins	Kalika, Mainapokhar
Plastic sacs	Kalika, Belawa, Gulariya, Mainapokhar, Motipur, Tarataal
Mudbins(Deheri)*	Kalika, Belawa, Mainapokhar, Motipur, Tarataal
Suli (raised str. with thatched roof for maize storage)	Mainapokhar, Motipur
Storage by hanging on ceiling of garlic bulbs	Mainapokhar, Motipur
Vegetable seeds covered with muslin clothes and placed inside the small glass or plastic cans or containers	Mainapokhar, Motipur
Traditional practice still followed in storing cereal grains. However, traditional storage methods are being replaced by metal and plastic bins due to their good storability. Still the adoption is not so fast.	
Harvesting techniques	
Manual	Belawa, Gulariya, Mainapokhar, Motipur, Tarataal
Tractors	Kalika, Belawa (for maize), Gulariya, Motipur, Tarataal
Thresher (used sp. for rice, bullocks are being replaced by threshers)	Kalika (for rice and wheat), Belawa, Gulariya, Mainapokhar, Motipur, Tarataal
Processing	
In mills	Kalika, Belawa, Gulariya, Mainapokhar (for maize), Motipur (for rice), Tarataal
Traditional cereal pounder	Kalika, Belawa, Mainapokhar (for rice only), Motipur
Mortar and pestle	Kalika, Mainapokhar
Manual	Kalika, Belawa, Gulariya, Mainapokhar, Motipur, Tarataal

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

Bamboo bins, mud bins, plastic sacs are commonly used for storage, whereas use of metal bins is spreading across the clusters. Though might be expensive, use of closed mouth metal bins are recommended for maintaining better quality during storage of seed. Metal bins are used in

Kalika, Gulariya, Mainapokhar, and Tarataal clusters. Harvesting is done manually in all the clusters. Threshing of rice has been mechanized. Both traditional and contemporary processing methods are followed to process key cereal crops.

Notable Indigenous/Traditional food and crop storage practices in the cluster

Traditional crops and seeds storage practices:

Storage of grains in Deheri:

Deheri is a grain storage structure commonly used in western Terai including Bardiya clusters particularly among the Tharu ethnic groups. This storage structure is being used since times immemorial. The storage structure is constructed simply by mixing clay-soil and fine paddy husk produced during the winnowing. It varies in size from 25 kg to 10/12 quintals and bigger. Usually women construct them as a part of their household chores.

Advantages of *Deheri* over other storages

Figure 1: Deheri at the Belawa cluster, Bardiya

Source: Shankar Bhattarai, Caritas Nepal

Farmers assert that grains stored inside deheri are subjected to less damage with less or no attack of insect pests during storage condition. The average pest damage is about 2.5% if grains are properly dried before storage. Even if there is a pest infestation, only top layer of the stored grains are damaged and no pest damage is observed in the middle and lower portion. Farmers share the experience that dusting the inner walls of *Deheri with* lime keeps storage grain pests at bay (100% safe from store grain pests attack). In the exceptional case, upto 5% storage pest loss is attributed during storage in *Deheri*. Moreover, farmers believe that mud structure provide cool atmosphere inside and it is also safe from the possible fire hazards. As of farmers' perception, this structure provides space for aeration inside so that seed does not rot.

Kuniyo method: paddy stacked in circular heaps

Farmers in Bardiya clusters spread the harvested paddy in the field and leave them for 3-5 days for drying. After few days of sun drying, for storing the paddy without threshing, harvested and sundried paddy are stacked in circular heaps on the threshing floor so that it can be threshed whenever farmers are free. The heap of paddy is locally called as Kuniyo. The peasants of Bardiya thresh the stored paddy from December to March to because they need the straw to feed their livestock.

Seed storage by mixing with Kati **(semi-solid extracts yielded during milling of mustard seeds for oil)**

The grain for seed purpose is stored by mixing the seeds with semi-solids extracts generated after milling mustard seeds for soil. At first, grain is sun-dried and mixed with Kati (semi solid extracts after separating mustard oil). In general, the ratio of Kati to grains is maintained approximately at 5:100 for mixing before storage. These grains are filled in a plastic container and sealed tightly. This technique of storing seeds is considered to be very effective against storage grain pests. This practice of storing the lentil is believed to be of their traditional methods and its history goes back to old times.

3.11 MAJOR CROP VARIETIES AND SEED SOURCE

Rice is the major kharif season (monsoon) crops with farmers followed by maize. Maize is widely cultivated alongside rice in Motipur, Belawa and Tarataal clusters during Kharif season. In some parts of Tarataal, which is slightly upland as compared to others, upland variety of rice - Bhadaiya is cultivated. Major rabi season crops of the region are mustard, lentil and wheat (Rana, 2012). Farmers cultivated both improved and local varieties of the crops in the clusters. The table 15 below provides varietal information of seed of major crops used in the clusters.

Table 15: Major crops varieties grown in Bardiya clusters

SAF-BIN clusters Bardiya	***Varieties cultivated in the clusters (L=local, I=improved, H=hybrid)***			
	Rice	***Wheat***	***Maize and others***	***Others***
Kalika	I: Radha-4, Surabhi, Janaki, Sabitri, Sundar, Sawa mansuli, Sindoor, H: US312	I: Gautam	L: Sathiya; I: Rampur Composite, Arun-2	
Belawa	I: Ghaiya 1, Sarju-52, Radha-4, H: 6444	I: Bhrikuti, NL 297		

Gulariya	L: Bhadaiya, I: PR101, Radha-4, Sarju-52, Sabitri, Sawa mansuli, Hardinath, Shankar	L: local wheat, I: Kundan		H: Manisha (tomato)
Mainapokhar	I: Radha-4, Saurabh, Sabitri, Mansuli, H: PA6444	L: Bhuse, I: Gautam, Kundan	I: Arun-2	
Motipur	L: Jhinuwa (in verge of extinction), Kalo Mansuli, I: Radha-4, Hardinath, Bindeshwori, Janaki, Sabitri, H: Used no data on varieties	No data	I: Arun-2	Kabre
Tarataal	L: Bhadaiya, I: Radha-4, Bijaya-42, Hardinath	No data	Local : No data	L: 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 Bardiya clusters

SAF-BIN Bardiya clusters	***Seed Source (L=local source, E=external source)***				***Major vegetables consumed and produced***
	Rice	**Wheat**	**Maize**	**Millet**	
Kalika	L: 50, E: 50	-	-	-	Potato, tomato, cabbage, garlic, leafy vegetables, chilli
Belawa	L: 60, E: 40	E: 100	-	-	Potato, tomato, cabbage, garlic, leafy veg, chilli,, wild mushroom
Gulariya	L: 50, E: 50	-	L: 90, E: 10	-	potato, onion, cabbage, garlic, leafy vegetables, chilli
Mainapokhar	No data	E: 100	-	-	Potato, onion, cauliflower, cabbage, garlic, leafy vegetables, chilli
Motipur	L: 60, E: 40	-	L: 80, E: 20	-	Potato, onion, cauliflower, cabbage, garlic, leafy vegetables, chilli
Tarataal	L: 80, E: 20	-	E: 100	-	Potato, onion, cauliflower, garlic, leafy vegetables, chilli

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.

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 Bardiya.

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

Cultivation practices	Clusters following	No. of followers	Area in ha	Crops/system
Integrated Pest Management	Kalika, Gulariya	127 +91=218	5 +3=8	Rice/Vegetables+Potato/cabbage
Integrated Nutrient Management	Kalika, Gulariya	127 +62=189	5 +6=11	Rice/Vegetables+Vegetable/rice

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

In Bardiya, Integrated Pest Management (IPM) and Integrated Nutrient Management are the innovative practices worth mentioning. However, these activities are practiced in the limited area.

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 six Bardiya clusters

Status of the local livestock and birds

SAF-BIN clusters Bardiya	Cow	Buffalo	Bullocks	Goat	Sheep	Pig	Poultry/ birds	Others
Kalika	15	20	90	300	0	10	400	100 pigeons

Belawa	*60*	180	80	450	30	2	450	
Gulariya	*12*	53	136	356	27	39	357	138 pigeons
Mainapokhar	2	55	120	230	200	20	100	
Motipur	*200*	100	100	400	10	200	200	500 pigeons
Tarataal	*60*	20	80	100	0	15	300	
Total	***349***	***428***	***606***	***1836***	***267***	***286***	***1807***	***738 pigeons***

Status of the improved livestock and birds

SAF-BIN clusters Bardiya	**Cow**	**Buffalo**	**Bullocks**	**Goat**	**Sheep**	**Pig**	**Poultry/birds**
Kalika	2	0	0	300	0	7	200
Belawa	0	0	0	200	0	30	1060
Gulariya	0	0	16	37	0	47	750
Mainapokhar	0	0	0	100	0	0	300
Motipur	0	0	0	150	0	11	1000
Tarataal	0	0	0	0	0	0	0
Total	2	0	16	787	0	95	3310

Status of Local and improved livestock and poultry combined

SAF-BIN clusters Bardiya	**Cow**	**Buffalo**	**Bullocks**	**Goat**	**Sheep**	**Pig**	**Poultry/birds**
Kalika	17	20	90	600	0	17	600
Belawa	60	180	80	650	30	32	1510
Gulariya	12	53	152	393	27	86	1107
Mainapokhar	2	55	120	330	200	20	400
Motipur	200	100	100	550	10	211	1200
Tarataal	60	20	80	100	0	15	300
Total	**351**	**428**	**622**	**2623**	**267**	**381**	**5117**

Average livestock per HH

SAF-BIN clusters **Bardiya**	**Total HH size**	***Cow***	***Buffalo***	***Bullocks***	***Goat***	***Sheep***	***Pig***
Kalika	189	0.09	0.11	0.48	3.17	0.00	0.09
Belawa	244	0.25	0.74	0.33	2.66	0.12	0.13
Gulariya	201	0.06	0.26	0.76	1.96	0.13	0.43
Mainapokhar	235	0.01	0.23	0.51	1.40	0.85	0.09
Motipur	183	1.09	0.55	0.55	3.01	0.05	1.15
Tarataal	105	0.57	0.19	0.76	0.95	0.00	0.14
Summary	**1157**	***0.30***	***0.37***	***0.54***	***2.27***	***0.23***	***0.33***

(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 improved breeds are uncommon which may be due to the lack of financial resources owing to meager production of crops and lack of good income source. 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 Bardiya clusters

According to the farmers of the cluster,

- *Changes perceived on the amount of rainfall in different seasons:*

  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 causing flood in latter part of Monsoon, where as in other cases, there is lack of optimum rainfall during critical growth stages of crops such as rice and maize. In case of rice, lack of water at heading stage is a problem. 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. Motipur cluster is also affected time to time by hailstorm. Hence, farmers in Bardiya cluster have started adopting drought tolerant and short duration rice varieties including hybrid varieties in the majority of locations. Erratic monsoon rainfall has delayed planting season of maize.

- *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 Bardiya.
- Timely plantation of crops is becoming difficult, so cultivation of monsoon maize has been delayed in clusters of Bardiya. Even in rice, farmers shift the transplanting date depending upon the onset of monsoon or choosing the late variety. Likewise, farmers opted for dry nursery bed or used electric pumps.
- Outbreak of diseases and pests on plants have been increased,
- Summer and spring seasons are getting warmer.

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

BARDIYA - problems on rice	**Weighted score**	**Score wise problem ranking**	**Remarks**
Unable to set bed on time	23	1st	no. 1 problem in 1 out of 6 clusters
Unable to transplant seedling on time causing ageing of seedlings due to late onset of monsoon	21	2nd	no. 1 problem in 1 out of 6 clusters
Diseases and pests	10	3rd	
Lack of rainfall at growth stages points e.g. at heading stage	7	4th	no. 1 problem in 1 out of 5 clusters. Problem in only two clusters
Rainfall during harvesting season	6	5th	
Problems during tillering stage, numerous tillers but less panicle	3	6th	
Lack of timely fertilizer availability	3	6th	
Weed	2	7th	
Flood and Hailstrom	1	8th	
Problems during flowering stage	1	8th	
Problem matrix of rice based on – Kalika, Mainapokhar, Belawa, Gulariya and Motipur			

Source: Village Screening Workshop, 2012

From the compiled problem matrix of rice, unable to set seed bed on time has been registered as biggest problem in three clusters. Late onset of monsoon leading to delayed transplanting is 2nd biggest problem in Bardiya clusters. Problems of diseases and pests ranked third score wise in Bardiya. The most recurrent problems ranked no. 1 and 2 are related with changing climate.

Table 20: Problems on maize cultivation

BARDIYA - problems on maize	**Weighted score**	**Score wise problem ranking**	**Remarks**
Unable to sow the maize due to lack of rainfall	10	1st	no. 1 problem in Belawa and Motipur
Pest and disease infestation such as maize stem borer in Belawa	7	2nd	
Lodging of plant due to wind	4	3rd	
Problems of weed	3	4th	
Unavailability of rainfall during cob formation stage	2	5th	

Germination of grain on plant due to heavy rainfall	2	5th
Cobless maize	2	5th
Problem matrix of maize based on – Belawa and Motipur		

Source: Village Screening Workshop, 2012

Data on problem matrix of maize is available for only two clusters of Bardiya namely Belawa and Motipur. From the problem matrix of maize in these two clusters when compiled, unable to sow maize due to lack of timely rainfall was ranked as greatest problem in two clusters of Bardiya for maize crop. Hence, inability to set seed bed in case of rice and inability to sow maize in time, owing to lack of timely and adequate rainfall has been observed as key problems respectively in rice and maize crops in Bardiya clusters.

Lack of occurrence timely rainfall is associated with climate change in a sense that inconsistencies observed in rainfall pattern led to delayed sowing of crops, decreased the yield of crops. 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). If dry monsoon is anticipated. Both the wet and dry beds are prepared, if there is change in weather condition famers uproot the seedlings are keep it below the shade and use for transplanting purpose.
- Selection of robust seeds at local level
- Selection of appropriate seed variety such as choosing drought tolerant variety
- In plain clusters of Bardiya, farmers started cultivating short duration, drought tolerant hybrid 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.

4 CONCLUSION

Caritas Nepal has used this base line information to form small farmer groups. In Bardiya, from 6 clusters, 18 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

BARDIYA - 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**
	1	2	3	4	5	6	7	
Unable to set bed on time	3*5=15	2*4=8	-	-	-	-	-	23
Unable to transplant seedling on time causing ageing of seedlings due to late onset of monsoon	1*5=5	4*4=16	-	-	-	-	-	21
Diseases and pests	-	-	2*3=6	1*2=2	2*1=2	-	-	10
Lack of rainfall at growth stages points e.g. at heading stage	1*5=5	-	-	1*2=2	-	-	-	7
Rainfall during harvesting season	-	-	-	1*2=2	2*1=2	-	1*1=1	5
Problems during tillering stage, numerous tillers but less panicle	-	-	1*3=3	-		-		3
Lack of timely fertilizer availability	-	-	1*3=3	-	-	‘-	-	3
Weed	-	-	-	1*2=2	-	-		2
Flood and Hailstorm	-	-	-	-	1*1=1	-		1
Problems during flowering stage	-	-	-	-	-	1*1=1		1
Problem matrix of rice based on – Kalika, Belawa, Gulariya, Mainapokhar, and Motipur								

Source: Village Screening Report 2012, SAF-BIN

Problems on maize cultivation

BARDIYA - 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	
Unable to sow the maize due to lack of rainfall	2*5=10					10	1*1=1	53
Pest and disease infestation such as maize stem borer in Belawa		1*4=4	1*3=3			7		47
Lodging of plant due to wind		1*4=4				4		47
Problems of weed			1*3=3			3		28
Unavailability of rainfall during cob formation stage				1*2=2		2	3*1=3	16
Germination of grain on plant due to heavy rainfall					2*1=1	2	1*1=1	11
Cobless maize				1*2=2		2	1*1=1	11
Problem matrix of maize based on – Motipur and Belawa								

Source: Village Screening Report 2012, SAF-BIN

Annex 2: Climatic data of Dumkauli Meteorological Station, Bardiya

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 Meteorological Station, Bardiya

Year (AD) /Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980												
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1982												
1983												
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2006

2007

2008

2009

2010

2011

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

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

Year (AD) /Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980												
1981												
1982												
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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, Bardiya

Year(AD) /Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976												
1977												
1978												
1979												
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Source: Raw data from Department of Hydrology and Meteorology, Nepal

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

1. Hybrids seeds: adopted in all VDCs.
2. Cultivation: machine adopted
3. Harvesting machine: adopted
4. Seed storage technology: use of the metal bins is increasing but the adoption is not satisfactory so, it is under adopted. The use of metal bins for storage is more common in Gulariya, Kalika and Mainapokhar it may be due to easy accessible to market Gulariya, Nepalgunj and Rupadiya (Indian) market. In Motipur and Belawa VDCs the use of traditional store materials are common. So, the adoption of the traditional bins is over adopted.
5. Post harvest technology: drying of grain products on sun is not new practices. But they don't dry up grain in optimum condition. Now farmers dry grains in optimum moisture condition. The scientific drying is well adopted in Bardiya district.

Source: Compiled from Village Screening Report 2012, SAF-BIN (Copied from PRA report prepared by Dilip Rana

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.