INTEGRATED WATERSHED MANAGEMENT PLAN
NIKACHHU WATERSHED

AUGUST 2017

Watershed Management Division
Department of Forest and Park Services
Ministry of Agriculture and Forests
Royal Government of Bhutan

INTEGRATED WATERSHED MANAGEMENT PLAN

for

degraded sub-watersheds in Nikachhu watershed
(Sangchhu & Nimdrokhangchhu),
(July 2018 - June 2023)

AUGUST 2017

Watershed Management Division
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AUTHORITY FOR PREPARATION, REVISION AND APPROVAL

PERIOD OF THE PLAN

This Plan is valid for the period of 5 years from July 2018 to June 2023

AUTHORITY FOR PREPARATION, REVIEW AND APPROVAL

The authority for preparation of this plan was given to the Watershed Management Division, Department of Forest & Park Services, Ministry of Agriculture & Forests, Royal Government of Bhutan.

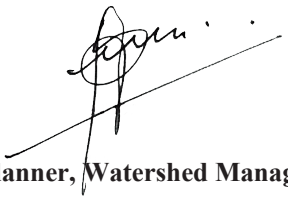
PROVISION FOR REVISIONS AND CHANGES

This Plan may be revised during the period when it is in effect. If major changes occur in the watershed, or if new information becomes available, that may have significant bearing on the implementation of the Plan, the Head of Department, DoFPS, can authorise a revision of this plan.

APPROVAL

This plan has been examined by a wide section of user groups, clients and organisations. The plan was presented and endorsed by the 8th TAC meeting held at DoFPS. It has been further reviewed and recommended for implementation by the Director, Department of Forest & Park Services (DoFPS) and approved by the Honourable Secretary, Ministry of Agriculture & Forests, Royal Government of Bhutan.

Submitted for approval:



Lead Planner, Watershed Management Division

Reviewed and recommended for approval:

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Recommended for Approval:

Director
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APPROVED

Hon'ble Secretary
Ministry of Agriculture and Forests

Executive summary

The Nikachhu watershed is a tributary of the Mangdechhu sub-basin with the catchment north and south of the west-east national high way running from Pele La to Tangsibji located in Trongsa dzongkhag. The rapid assessment of the watershed indicated that the watershed is 'normal' by score in the current circumstances. However, the watershed was selected for management planning based on the functionalities of the watersheds in consultation with the stakeholders. The watershed is important for drinking water, irrigations and generation of the hydropower. Therefore, the plan is developed with the purpose to continue protection and conservation of the watersheds, and to prevent degradation from the present and future human activities.

The plan was developed with intensive consultations involving relevant stakeholders at various levels of Dzongkhag, gewog and chiwogs. The field assessments were carried out by RNR technical staff led by Watershed Management Division. However, the team sought the endorsement through stakeholder consultations at various stages of the plan. The issues with explicit link to provision of watershed goods and services were identified by the stakeholders, filtered and field validated.

The core element of the management plan is the Logical framework Analysis (LFA) matrix which explicitly summaries various activities and agencies responsible for implementation. These activities are designed to mitigate or remove the degrading influences and to improve the condition of the watershed, which needs to be integrated into their respective plans and programs. The integrated Watershed Management Plan for the degraded sub-watersheds in Nikachhu watershed (Sangchhu and Nimdrokhangchhu) has been endorsed by the Technical Advisory Committee (TAC) of the Department of Forest and Park Services.

This plan like any other plan is not a standalone plan, but is an amalgamation of the activities identified as being necessary to minimize degradation of the watershed in the future. The activities are expected to be incorporated in to area based planning frameworks (Five Year Plans and Annual Plans) of dzongkhag, geog and agencies. The plan is for a duration of five years. The monitoring and evaluation will be conducted and shall be revised as and when necessary.

Acknowledgement

The Watershed Management Division, Department of Forests & Park Services, Ministry of Agriculture & Forests extends its deep appreciations to Dasho Dzongdag along with RNR sectors heads of the Dzongkhag administration Wangduephodrang for their full support in terms of deputing relevant officials for assessments as well as consultations for the watershed management plan.

Our special thanks to the Wangchuck Centennial National Park (western park range), Gup and geog RNR staffs of Sephu geog for contributing and helping the team with the watershed assessment and preparation of this management plan. The representatives from Wangdue territorial forest division, Tangsibji Hydropower project is also highly acknowledged for their cooperation and support.

We express our sincere gratitude to the Director, Department of Forests & Park Services for his enormous guidance and support provided during the preparation of this document.
Our sincere thanks to all the participants of the various stakeholder consultation workshops and individual members for their valuable information and inputs.

Finally, we would like to thank World Wildlife Fund (WWF), Bhutan for funding the preparation and implementation of the watershed management plan.

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Glossary of Bhutanese terms

Bhukhari	Heating device
Chhu	River
Chiwog	Village or a group of villages
Chorten	Stupa
Dzongkhag	District
Geog	Block/administrative unit/County
Goshep Nenshep	Senior Knowledgeable community representative
Gup	Elected leader of a geog
Kamzhing	Dryland
Mangmi	Deputy elected leader of a geog
Nu	Ngultrum
Tshogpa	Elected chiwog representative
Yartsho Guenbub	*Ophiocordyceps sinensis*
Dzongdag	District Administrator
Tsho	Lake

List of abbreviations

AI	Artificial Insemination
BMPs	Basin Management Plans
BPC	Bhutan Power Corporation
BTC	Bhutan Tourism Council
CF	Community Forest
CFO	Chief Forest Officer
DAO	Dzongkhag Agriculture Officer
DE	Dzongkhag Engineer
DGPC	Druk Green Power Cooperation
DLO	Dzongkhag Livestock Officer
DPO	Dzongkhag Planning Officer
DoFPS	Department of Forest and Park Services
DoR	Department of Roads
DzEdu.O	Dzongkhag Education Officer
DzEnvi.O	Dzongkhag Environment Officer
DWMC	Dzongkhag Water Management Committee
EFRC	Environmentally Friendly Road Construction
FNCR	Forest & Nature Conservation Rule
FYM	Farm Yard Manure
FYP	Five Year Plan
GAEO	Geog Agriculture Extension Officer
GAO	Geog Administrative Officer
GLEO	Geog Livestock Extension Officer
GLOF	Glacial Lake Outburst Flood
GNHC	Gross National Happiness Commission
ha	Hectare
HH	Household
HP	Hydropower Plant
HWC	Human Wildlife Conflict
IWMP	Integrated Watershed Management Plan
JSMNP	Jigme Singye Wangchuck National Park
KM	kilometer

kW	Kilowatt
LFA	Logical Framework Analysis
LFAM	Logical Framework Analysis Matrix
LRO	Land Record Officer
Ltr	Litre
m.a.s.l	meters above sea level
m	Meter
m3	Meter square
mm	Millimeter
MPU	Milk Processing Unit
MoAF	Ministry of Agriculture and Forest
MoH	Ministry of Health
MW	Mega Watt
NIWRMP	National Integrated Water Resource Management Plan
NWFP	Non-wood Forest Product
PAs	Protected Areas
PES	Payment for Environmental Services
RGoB	Royal Government of Bhutan
RBC	River Basin Committee
RBMP	River Basin Management Plan
RDC	Research Development Center
RF	Rainfall
RLDC	Regional Livestock Development Center
RNR	Renewable Natural Resource
RNR RC	Renewable Natural Resource Research Centre
RWMC	River Basin Management Committee
RWSS	Rural Water Supply Scheme
SLM	Soil & Land Management
Sq. km	Square kilometer
TAC	Technical Advisory Committee
TD	Territorial Division
ToR	Terms of Reference
WCNP	Wangchuck Centennial National Park

WMC	Watershed Management Committee
WMD	Watershed Management Division
WMP	Watershed Management Plan
WPR	Western Park Range
WUA	Water Users' Associations
WWF	World Wildlife Fund

1. INTRODUCTION

1.1. Policy settings

The Department of Forest and Park Services (DoFPS) under the Ministry of Agriculture and Forests (MoAF) is mandated to plan and manage watersheds for all river basins in the country. The Watershed Management Division (WMD) under the DoFPS in consultation with relevant stakeholders carries out watershed assessment, classification and planning for the river basins in the country. WMD is the competent authority to develop and implement watershed and wetland management plan as per the Water Act of Bhutan 2011 and Water Regulation of Bhutan 2014, which will contribute to National Integrated Water Resource Management Plan (NIWRMP) & River Basin Management Plans (BMPs) of the National Environment Commission Secretariat. The management of watersheds in the country forms third program within the 11th Five Year Plan of the DoFPS (GNHC, 2013).In the 12th FYP, watershed management is part of the National Key Result Area (NKRA) and Agency Key result Area (AKA).

The Royal Government policies support on protection and management of natural resources, water resources, river basins and watersheds is crucial for long time sustenance of natural resources, as enshrined in Article 5.1 of the Constitution of the Kingdom of Bhutan. For effective watershed management, Bhutan 2020 Vision clearly states that "*the effective management of watersheds must be considered a key component of efforts to place the nation's development on a sustainable path*". Other important policies and regulatory documents that influence the preparation of integrated watershed management plans in the country include National Forest Policy 2011, Bhutan Water Policy 2007, Forest and Nature Conservation Act, 1995, Land Act 2007 and Waste Management Act 2009. The Water Regulations 2014 and the Roadmap for watershed management in Bhutan clearly sets the framework for carrying out integrated watershed management in Bhutan.

1.2. Context of the Watershed Management Plan

1.2.1. Rationale

The sub-watersheds within the Nikachhu watershed are an important source of water for drinking and irrigation for the communities within the watershed. The same watershed also serves to generating mini-hydropower of 70kW at Chendebji and 0.03 MW at Tangsibji benefiting 31 households and 53 households respectively (Bhutan Media Services 2013). Recently, the Royal Government of Bhutan has initiated 118 MW Tangsibji Hydropower project (a run-of-river scheme) on the Nikachhu. Further, the outflow from Nikachhu Project into the Mangdechhu reservoir provides additional energy generation of 323.77 MU to the Mangdechhu Hydroelectric Project (720 MW). Therefore, the sustenance of both quality and quantity of water in Nikachhu River is important for the enhancement of community livelihoods and hydropower generation as an economic backbone of the country. The rapid assessment of watersheds with the use of Watershed Classification Guideline indicated that the Nikachhu watershed is in "Normal" condition. However, two sub-watersheds have been identified as degraded by function.

1.2.2. Purpose

The Road Map for Watershed Management in Bhutan 2011 (WMD 2011) states that "WMD would not produce watershed management plan per se rather the plan is essentially made up on an amalgamation of many activities which have an explicit link to watershed management objectives that find their expression in existing planning frameworks" (p. 64). The purpose of the watershed management plans is to address the degrading influences and attempt to the extent possible to return the degraded or critical watersheds to a "normal" or "pristine" condition. The current plan is developed with the purpose to continue protection and conservation of the watersheds, and therefore to prevent degradation from the present and future human activities.

2. DESCRIPTION OF THE WATERSHED AREA

2.1. Geographic and administrative description

The Nikachhu watershed is a tributary of the Mangdechhu sub-basin with the catchment north and south of the west-east national high way running from Pele La to Tangsibji located in Trongsa dzongkhag. The Nikachhu catchment has an area of 45,126 hectares. The watershed which spread over parts of Wangduephodrang in the north and Trongsa in the south is located at 27°31'07.88"N to 27°34'37.32"N and 90°18"08.26"E to 90°20"12.29"E. The elevation of the watershed area ranges from 1415 masl (at the confluence of Mangdechhu and Nikachhu, Tangsibji geog) to 5000 masl (Tempeyla, Sephu geog). Of the total 186 watersheds delineated in the country for effective watershed planning and implementation by WMD (2011), whole of Nikachhu catchment falls in watershed No. 70 (Figure 1). Within this watershed, there are numerous streams and springs contributing to the flow of Nikachhu river.

The watershed covers two gewogs namely Sephu and Tangsibji. The Sephu geog comprises of five chiwogs (Busa-Zeri, Rukhubji, Longtoed, Bumilog and Nakha). Sephu geog consists of an estimated area of 110801.221 ha, which is highest among the other geogs under Wangdue. The chiwogs are scattered from each other but the households under individual chiwogs are nucleated. The total geographical area of Sephu geog is 1105.70 sq km.

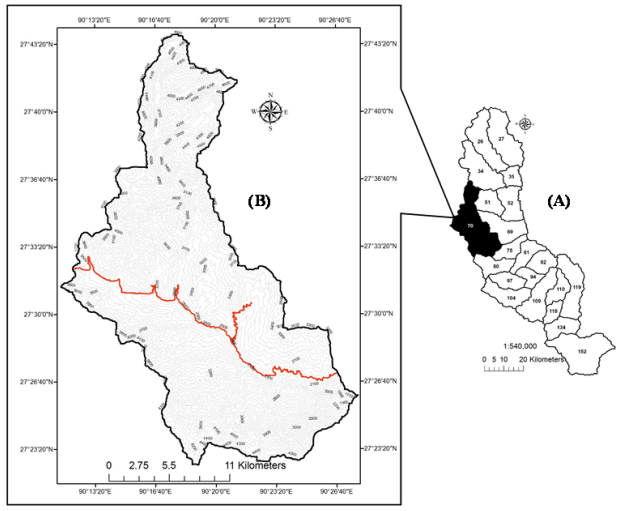

Figure 1: Nikachhu watershed falls in watershed no. 70 of the total 21 watersheds in Mangdechhu (out of 186 watersheds delineated for the country).

2.2. Sub-watersheds (Sangchhu and Nimdrokhangchhu)

Both sub-watersheds serve as important drinking water source for communities, school, shops, milk processing unit, and for irrigation of the vegetable crops. The water source(Nimdrokhangchhu) is used by about 150 students, 7 teachers with family, 18 households residing nearby school including shops and Sangchhu is used by 23 households in Menchugang village. The sub-watersheds are located on the same slope facing east (Nimdrokhangchhu left side and Sangchhu right side of Busa school). The total area of the sub-watershed is about 1013ha. The dominant land cover is mixed conifer forest followed by meadows and shrub. Agriculture is dominated by dry land farming and cash crops such as potato, cabbage, broccoli and peas are widely cultivated in the watershed. Livestock rearing both local and improved breed are also common and livestock is equally important for their livelihood including manure for crop production. Within these two sub-watersheds boundary (Fig. 2, Table 1) , there are many developmental activities taking place such school, new shops, milk processing unit, and both the watershed sources become more important for drinking, household use and irrigation. Out of five chiwogs under Sephu geog, Busa-Zeri chiwog is highly populated and the two degraded sub-watersheds are one of the important water resources for the community.

Table 1: Land use details of the degraded watershed

Land cover	Area (in Acres)	Area (in %)
Agriculture Dryland	69.17	2.77
Built Up Areas	5.49	0.22
Broad Leaf Forest	113.66	4.55
Blue Pine Forest	150.63	6.03
Mixed Conifer Forest	1043.72	41.78
Meadows	770.98	30.86
Shrub	344.71	13.80
Grand Total	2498.37	100

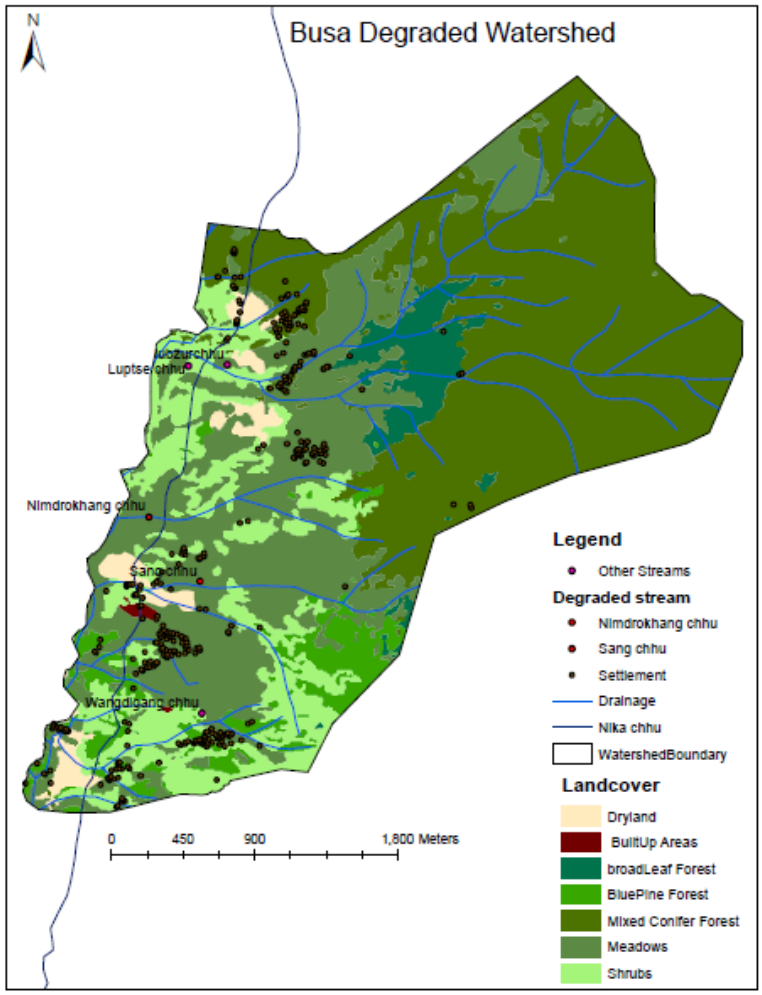

Figure 2:Degraded sub-watersheds under Busa chiwog

2.3. Climate

The climate in the Nikachhu catchment ranges from warm temperate at the confluence with Mangdechhu under under Tangsibji geog to alpine in the north of Sephu geog. The perception of the communities on the pattern of climate change (temperature and rainfall) were garnered through interviews and focus group discussions. The representatives were asked as to how they perceive the changes related to temperature, rainfall and snowfall.

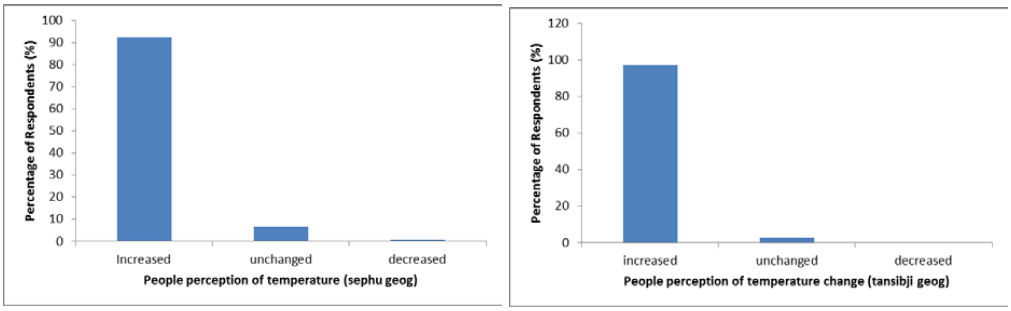

Figure 3: Perception of people on temperature change in Nikacchu watershed

Most respondents (92.6% and 97.2%) were of the view that the temperature is increasing across Sephu and Tansibji geogs respectively while a few residents (6.5% and 2.8%) perceieved the temperature to have remained unchanged (Figure 3).

Similarly for rainfall, majority of the respondents (79.6% and 86.1%) in Sephu and Tangsibji geogs respectively had the opinion that the annual rainfall pattern has changed as compared to 20 years ago (Figure 4), with increasing incidences of erratic and unreliable annual rainfall pattern. The duration of rainy days has increased and people have observed heavy showers and high intensity rainfall like in the southern foothills. However, 12% of the respondents in Sephu geog and 13.9% of respondents in Tangsibji geog believed that there is no change in rainfall pattern.

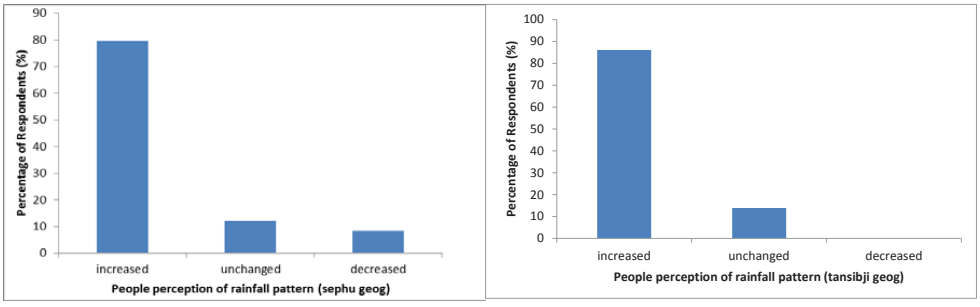

Figure 4: Perception of people on rain fall pattern change in Nikachhu watershed

The local perceptions conform to temperature data over two decades in Wangdiphodrang and Trongsa dzongkhags which shows increasing trend in temperature (Figure 5 and 6).

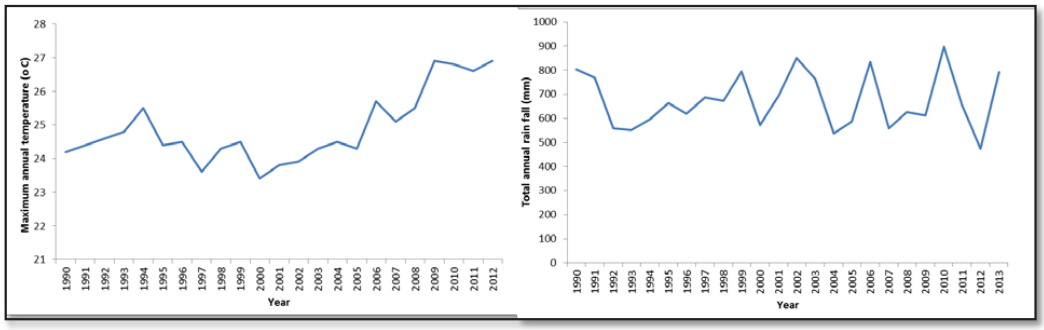

Figure 5: Maximum annual temperature and total annual rain fall trend for Wangdiphodrang Wangduephodrang: RNRRC "Class" A (Max temp),(A) 13640046 (annual RF)

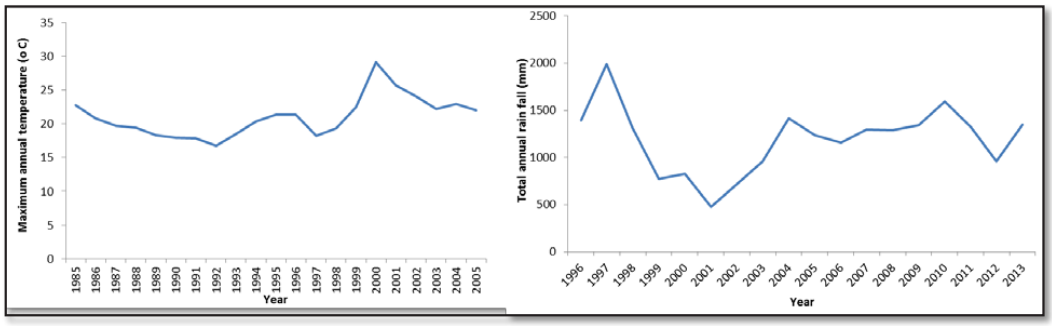

Figure 6: Maximum annual temperature and total annual rain fall trend for Trongsa class A (Max temp), Trongsa "C" 14520044 (annual RF)

Similarly for Trongsa dzongkhag (Figure 6), the maximum annual temperature increased gradually over the years from 1985 to 2005 and annual total rain fall showed an erratic pattern (1996 to 2013) conforming to perceptions of local people in the dzongkhag. However, due to short time series data on temperature, it is difficult to estimate by how much degree celsius the temperature is increasing annually. The key informants also identified 5 hazards during the focus group discussion namely windstorm, erratic rainfall, hailstorm, flash flood and earthquake that affected their lives and livelihoods.

2.4. Hydrology

There are no glacial lakes in the catchment and therefore the catchment is free from the risk of Glacial Lake Outburst Flood (GLOF). The catchment is supplied with snow-melt water and rainfall, most of which is channeled through many smaller tributaries that join the Nikachhu. It has a catchment area of 373 km^2 (from the dam site of Nikachhu Hydropower Project). According to DGPC (2015), Nikachhu originates at an elevation of 3,918 masl and most of which discharge in the monsoon (June-September). There are three high altitude lakes along with minor lakes at the head water source of Nikachhu. The significant lake in the head water source is Umta Tsho (Figure 7).

Figure 7: Satellite image of Umta Tsho at 4500 masl (source: Mr. Tilak, WCNP)

Discharge measurement for individual streams was carried out during the assessment time in the month of September 2015. Highest discharge was from Zereechhu followed by Bachagangchu over 10000 ltr/second. The lowest discharge recorded was Dolawa, Wangdigangchhu and Nimdrokhangchhu as shown in figure 8. The average lean flow of the Nikachhu at the proposed dam site is 4.8 m3/sec (recorded between December and March) as reported by DGPC (2015).

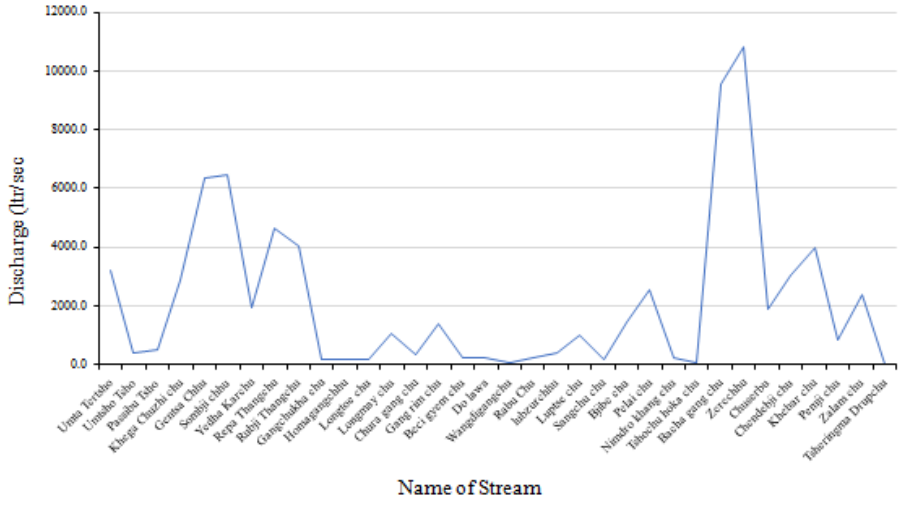

Figure 8: *Shows discharge measurement taken during assessment time for different tributaries of Nikachhu*

2.5. Land use in the watershed

2.5.1. Flora and Fauna

The vegetation ranges from cool broadleaved forest (9.53%), blue pine forest, mixed conifer forest, fir forest and to alpine meadows. The broad leaved forest is seen mostly in Tangsibji geog and conifer forest to alpine meadows in Sephu geog. Mixed Conifer Forest is the dominant land cover (51.20%). The high altitude rangelands are important head water tower of Nikachhu. The community depends in these areas for their livelihood (grazing, collection of Yartsa Guenbub (*Ophiocordyceps sinensis*) other non wood forest products). Grazing is one of the main component in the watershed for cattle, yak, horses and wildlife.

Figure 9: High altitude Rangeland and summer grazing camps in Nikachhu head water watershed

The dominant tree species in conifer forest are *Pinus wallichiana, Tsuga dumosa*, *Picea sp*., *Juniperus sp*., &*Betula sp*., with under growth of *Rhododendron, Yushinia*&*Larix sp*. The dominant tree species in broadleaved forests include *Quercus lamellosa, Q. glauca, Q. oxyodon, Q.lanata, Alnus nepalensis, Betula, Castonopsis hystrix.*

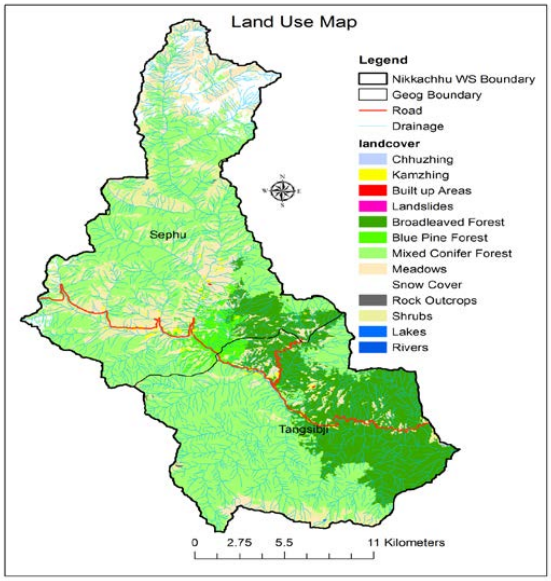

Figure 10: Land use map within the Nikachhu watershed boundary

Table 2: Landuse details of Nikachhu watershed

Land Cover	Sum of Area (in acres)	Area (in %)
Agriculture Wetland	40.73	0.04
Agriculture Dryland	567.03	0.51
Built Up Areas	70.28	0.06
Landslides	6.29	0.01
Broadleaf Forest	21773.72	19.53
Blue Pine Forest	3048.23	2.73
Mixed Conifer Forest	57087.79	51.20
Meadows	11395.13	10.22
Snow Cover	5398.28	4.84
Rock Outcrops	40.42	0.04
Shrubs	12037.18	10.79
Lakes	6.69	0.01
Rivers	36.93	0.03
Grand Total	**111508.70**	**100**

Further, the Nikachhu catchment is also a habitat for important wildlife such as Tiger (*Panthhera tigris tigris*), Snow leopard (*Panthera uncia*), Bhutan Takin (*Budorcas taxicolo whitei*), Musk deer (*Moschus leucogaster*), Himalayan black bear (*Ursus thibetanus*), Red panda (*Ailurus fulgens*), Sambar deer, Tibetan wolf, and wild pigs. The Himalayan monal (*Lophophorus impejanus*), blood pheasant (*Ithaginis cruentus*), Satyr Tragopan (*Tragopan satyra*), blue-bearded bee-eater and spot-winged starling are some of the important bird species found in the watershed.

2.5.2. Agriculture

The farming system is dominated by dry land and paddy cultivation exists only in the lower part of the watershed in Tangsibji geog. The main dry land crops are potato, wheat, mustard, maize and vegetables such as cabbage, cauliflower, carrot, radish and turnip. In Sephu geog, radish and turnip are grown abundantly for both human consumption and as supplement cattle feed in winter. Potato is the main cash crop grown in the watershed.

Figure 11: Semi-commercial crop (potato and cabbage) cultivation in the head water sources of Nikachhu by the communities of Sephu geog

2.5.3. Forest Management Regimes

High altitude rangelands are important head water tower of Nikachhu. The community depend on these areas for their livelihood (grazing, collection of Cordyceps and other non rangeland products). Within the Nikachhu watershed, there are five Community Forests and one Forest Management Unit (FMU). However, none of them fall within the boundary of degraded sub-watersheds.

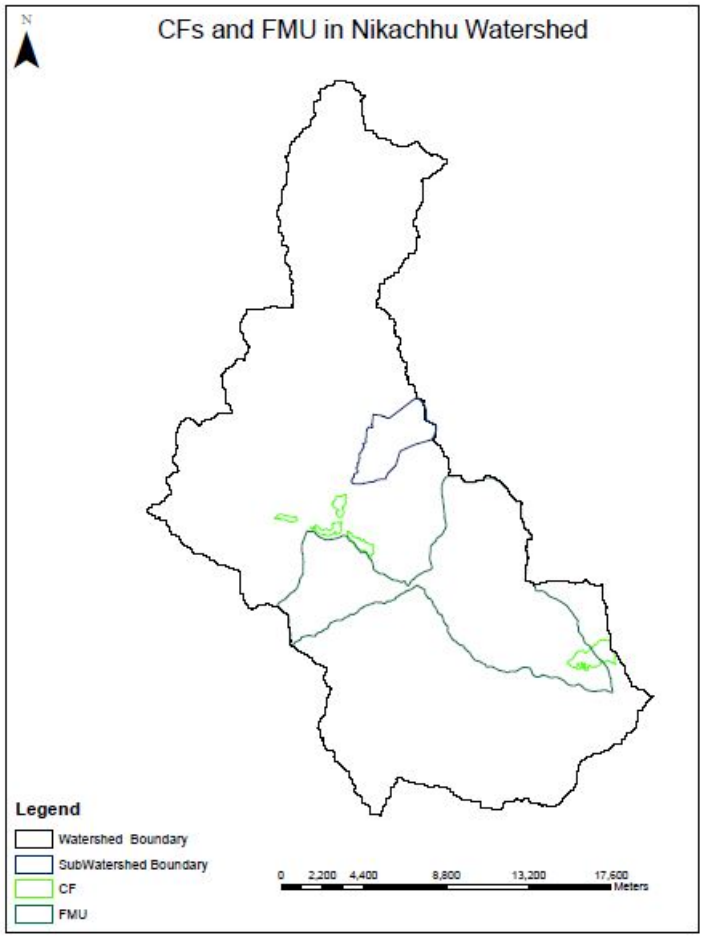

Figure 12: CFs and FMU in Nikachhu watershed

About 11 % and 28 % of the Nikachhu watershed boundary falls under the two Protected Areas of Wangchuck Centennial National Park (WCNP) and Jigme Singye Wangchuck National Park (JSWNP) respectively, while about 35% falls under North Corridor and 26% outside protected areas. The watershed is also both entry and exit point for the Snowman trek of Bhutan Tourism Council (BTC).

2.5.4. Livestock

Livestock play integral role in the farming system. Beside milk production, farm yard manure (FYM) is the main source of soil fertility and it widely used in both the geogs for crop production. Livestock production system is predominantly depended on free range grazing. Transhumant yak husbandry is prevailing in Sephu geog and each households have designated areas for winter, spring, summer and autumn within the Nikachhu watershed. Small area of improved pastures is maintained by individual farmers at household level and stalled fed mostly to the improved breed (jersey cross & Brown Swiss). Improved breed (jersey cross) is gaining popularity in Tangsibji geog compared to Sephu geog. The trend on livestock rearing & production system of keeping large numbers of local cattle breed is changing and local cattle breed is on decline. Most farmers are now going for few heads of improved cattle breed of jersey and Brown Swiss cross. For easy marketing of dairy products, the communities have dairy cooperative groups.

Figure 13: Rangeland, , horses, Improved cattle (Jersey cross) and yak grazing in watershed.

In 2016, total cattle population alone in Nikachhu watershed is 5207 (Livestock census 2016) excluding migratory herd that also graze in the watershed. Local cattle population in 2007 was 9.2% in Sephu geog and 12.5% in Tangsibji geog (Figure 14). In 2016 local cattle in Sephu geog is 3.5% and 7.3% in Tangsibji goeg. This clearly justifies the statement the trend in cattle population is decreasing as reported above. Similarly, the population of improved breed in both geogs have increased (Figure 15). Whereas yak population in Sephu geog has slightly increased by 6.6 % within the period of nine years.

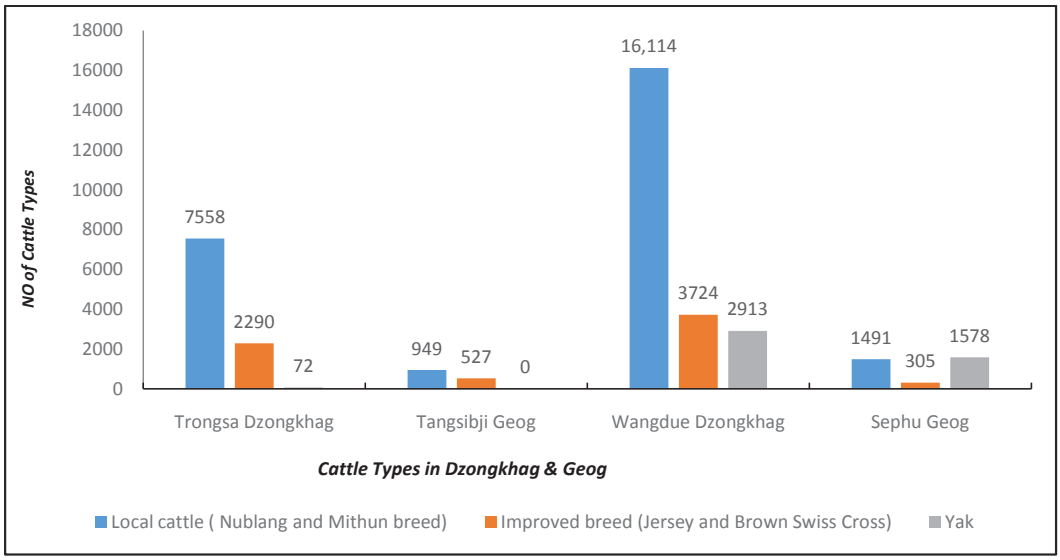

Figure 14: Local & improved cattle population in Nikachhu watershed in 2007

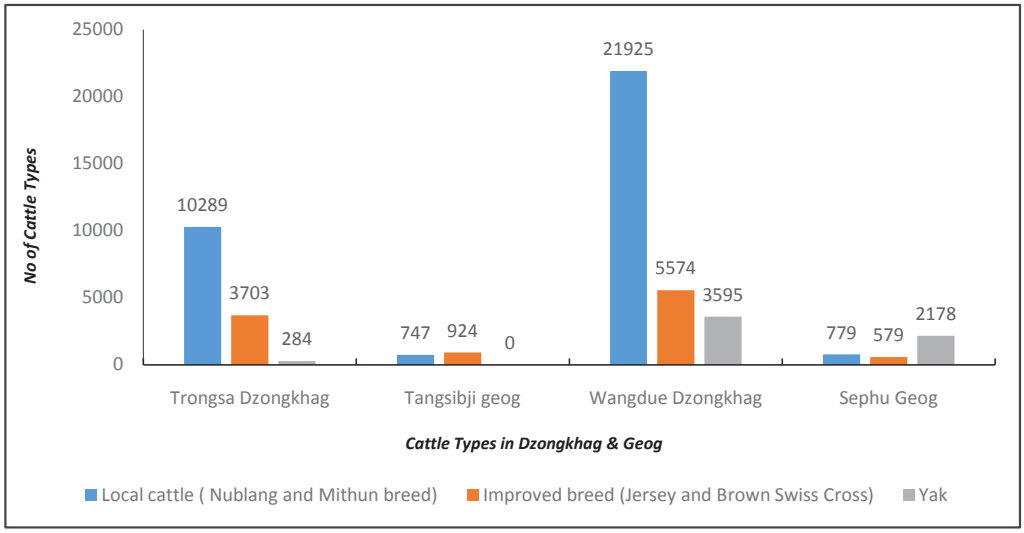

Figure 15:Local & improved cattle population in Nikachhu watershed in 2016

2.6. Socio-economic conditions

As for the Tangsibji geog, the population is sparse compared to Sephu geog. Tangsibji geog has population of 1848 with total households of 232. The geog has five chiwogs with the geographical area is 371.6 sq km (Bhutan Media Services, 2013). The figure 16 shows the settlement in the Nikachhu catchment. The total population in the watershed is approximately 3353 (1505 in Sephu geog and 1848 in Tangsibji geog).

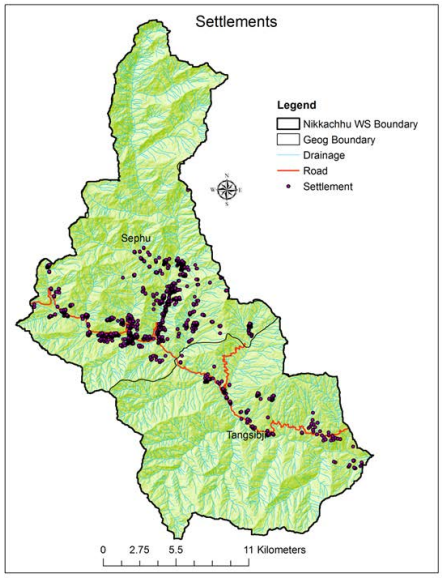

Figure 16: Map of Nikachhu watershed boundary showing settlement areas of Sephu & Tangsibji geogs

One of the main sources of income for Sephu geog is from sale of Yartsha Guenbub (*Ophiocordyceps sinensis*). People in the higher regions of Wangduephodrang, Paro, Thimphu, Gasa, Lhuentse, Trashigang . Trashiyangtse, Haa and Bumthang can *Ophiocordyceps sinensis*collect legally, following a **Royal Decree** issued June 17, 2014 (RA Online).The Sephu community collect Cordyceps from head water sources of Nikachhu (> 4000 masl)and maximum collection area is from head water sources of Mangdechhu . Cash income generated from sale of Cordyceps is between Nu. 20,000 to 500,000 in a year as per personal communication with Sephu Gup, Mr. Rinchen Penjor on 7th May 2017. In alpine area, herders also collect NWFP such as medicinal plants and leaves of rhododendron sp. for incense burning. Another source of income is from sale of potato and annual income ranges from minimum of Nu. 20,000 to 150,000. The communities also generate cash income from sale of other commodities such as vegetables and dairy products.

Figure 17:High altitude niche product Ophiocordyceps sinensis and Rhododendron leaves collected for incense

Livelihood resource ranking: The most important livelihood resources were ranked through a participatory livelihood resource ranking process during the focus group discussion. In Sephu and Tangsibji geogs, agriculture, forests and livestock were identified as the most important resources to sustain their livelihood. In Sephu geog, although the major source of income for the households was from sale of *Ophiocordyceps sinensis*, the farmers ranked it quite low (5^{th}) since there were quite concerned about its sustainability and fluctuating flushes yearly. Agriculture was the major source of livelihood in both the geogs, farmers grow and sell potatoes and cabbage to earn cash income. Farmers also depend on livestock for cash income through sale of dairy products.

Livelihood resource vurnerability: During the participatory process, agriculture was identified as the most vulnerable resource in both the geogs. Agriculture is climate sensitive and therefore the high intensity and erratic rainfall pattern could cause landslides and flash floods, which renders agriculture vulnerable.

3. ISSUES IMPACTING WATERSHED DEGRADATION

The problems and issues that impinge on the condition of the Nikachhu watershed was identified through the stakeholder consultations and field validations. These issues will provide guidance in designing the interventions necessary to diminish the degrading influences and, to the greatest extent possible, return the watershed to "normal" or "pristine" condition.The Human Wildlife Conflict (HWC) and change in cropping pattern was raised repeatedly as an issue of concern. However, no linkages of these issues as drivers of watershed degradation was seen. Therefore, it was not relevant to completely address these issues within the scope of this watershed management plan, and it may be appropriate to address by other relevant agencies. However, some activities related to livelihoods such as organic agriculture, green house vegetable production, traditional bamboo crafts were implemented during the process of planning watershed management.

3.1. Livestock grazing

The continuous grazing by the livestock particularly in sub-watershed is reported as one of the degrading influences in the watershed with yak population of around 150 yaks in winter months (October to March). The migratory cattle herd of more than 250 heads also graze for the duration of 3-4 months every year (June to September). Therefore, grazing takes place throughout the year in the open rangeland within the watershed. Signs of overgrazing were also evident in some areas of rangeland. The grazing was repeatedly raised as an issue at all levels of stakeholder consultations (linkage to 2.5.4).

Figure 18: Summer migratory cattle camp and grazing land in the watershed.

3.2. Drying water sources

Most of the tributaries of Nikachhu were found in good condition except in few sub watersheds in the settlement areas. However, the community of Busa chiwog, under Sephu geog raised an issue of drying of water sources. Similarly, the spring water source drying have been reported in many Dzongkhags and the causes of drying water sources is yet to be studied. However in case of Busa chiwog, the use of water has increased in each households compared to past 10 years. The main cause of the shortage of drinking water is due to the poor infrastructure. For example, the reservoir tank has not been designed as per the number of users and the distribution system inappropriate. The few households in the watershed also directly pump drinking water from the nearby open and disturbed ponds (Fig. 19).

Figure 19: Drinking water taping points from ponds and pipe line for individual use near Busa school

3.3. Forest degradation

The upper water catchment area of both Sangchhu and Nimdrokhangchhu are degraded. The causes of degradation were reported as due to timber & fuel wood collection by the communities. Fuel wood consumption is high due to the cold weather conditions. The community uses Bukhari for almost eight months in a year. The water catchment is the grazing ground for local cattle and yaks, which results to grazing throughout the year leading to degradation of watershed. The degrading influences identified during rapid assessment (Annex 7.2) also supplement the less forest cover and overgrazing as major issues in the water catchment.

Figure 20: Collection of fuel wood and timber in the watershed

3.4. Infrastructures

The infrastructures issues with explicit links to the degradation of Nikachhu watershed are poor farm road conditions, expansion of shops and houses. The 21 farmers have purchased land near Busa school, of which seven of them have already constructed houses and rest are under process. The expansion is attributed to the scope for business in the future owing to increasing schools and other offices. It is learnt that there was only one household in the area before 10 years. The rise in these infrastructures within the watershed may lead to increasing pressure on the watersheds and water resources.

Figure 21: New house construction under process below Busa school

3.5. Farm roads

The poor farm road with no proper drainage and exposed soils are causes of landslides, soil erosion, gully formation especially during rain seasons. The sediments along with other pollutants can deteriorate the drinking water quality. During the monsoon season, roads are mostly not pliable (Fig. 22). Therefore, the activities to improve the farm road drainage and bio-engineering works are proposed as major intervention activities in the watershed.

Figure 22: Farm roads without drainage system in watershed

3.6. Sanitation and waste

The watersheds survey team observed the location of pit toilets along the sides of stream which is a notable water sanitation issues. Around 12 households have pits toilets along the stream bank, which requires appropriate intervention from the aspect of water quality, health and hygiene, and aquatic life.

The wastes in the watershed was another issue in the locality, which can lead to degrading quality of watersheds. The waste disposal problem was also reported in the head water sources of Nikachhu mainly by the Cordyceps collectors, yak herders, and tour operators along Snowman trek. The same trail is also being used by the remote communities of Lunana under Gasa Dzongkhag for carrying the basic supplies. Both the entry and exit point of the snowman trail are within the Nikachhu watershed. These issue was raised repeatedly at various level of stakeholder consultations.

Figure 23: Pit toilet and wastes along the Sangchhu and Nimdrokhangchhu

4. PROCESS OF WATERSHED MANAGEMENT PLANNINING

4.1. Rapid assessment of Nikachhu watershed

Rapid assessments of streams in the Nikachhu watershed were carried out in 2015 by Geog RNR extension agents of Wangdue and Trongsa, Wangchuck Centennial National Park (WCNP) western range, Territorial Division (Wangdue), RNR RDC (Yusipang) facilitated by WMD. The rapid assessment and classification of watersheds were carried out using 'Guideline for Classification of Watershed 2010 (WMD). A total of 32 streams falling within the Nikachhu watershed were assessed in Sephu geog, Wangdue and Tangsibji geog, Trongsa Dzongkhags. However, few streams opposite to Chendebji chorten to Tangsibji was deemed inaccessible to assess, of which forest over this stretch is considered as hot spot for biodiversity (WMD July 2017). Of the 32 streams assessed in the Nikachhu watershed, 31 streams were classified as normal and one stream as pristine (Annex 7.3).None of the watershed is degraded or critical by score in the whole of Nikachhu watershed. However, four sub-watersheds were classified as degraded by function as it serves for drinking water and irrigation (Table 3).

Table 3: Degraded sub-watersheds in Naikachhu watershed

Dzongkhag	Degraded sub-watersheds	Watershed ID	Geog	Chiwog	Area (ha)
Wangdue Phodrang	Sangchhu	70	Sephu	Busa	1013 ha
	Nimdrokhangchhu	70	Sephu	Busa	
Trongsa	Zalamchhu	70	Tangsibji		960 ha
	Tsheringma	70	Tangsibji		
	Drupchhu				

4.2. Consultations

4.2.1. Dzongkhag

The planning process started with consultative meetings at the Dzongkhag level, wherein the results of the watershed assessment in Nikachhu sub-basin were presented. Issues and concerns relating watershed degradation and appropriate interventions were discussed. The consultation workshop was attended by RNR Sector heads, Dzongkhag engineer, Dzongkhag Health Supervisory Officer, Dzongkhag Planning Officer, Dzongkhag Environment Officer and including representatives from Tangsibji Hydro power, WCNP & Wangdue Territorial Division, and RNR extension staff of Sephu geog.


Figure 24: Stakeholder consultation at Dzongkhag level

4.2.2. Gewog

Following the dzongkhag level consultations, gewog stakeholders were consulted. In addition, local government officials (Gups, Mangmi, Tshokpa, GAO), CF chairmen and senior knowledgeable community representatives (*Goshaap Nenshaap*) in the geog presented the common problems and perspectives for the remedial measures. The other participants included RNR-Extension Agents, staff from the Territorial Forest Division, and western park range WCNP Sephu. During the meetings, issues that impacted on the delivery of watershed services were identified through participatory methods for degraded sub-watersheds under Busa chiwog.

4.2.3. Chiwog

Field verification followed by prioritization of the site specific issues and management activities were done at the chiwog level. The RNR geog officials accompanied the team from WMD, RDC Yusipang and Forestry Officials from Wangdue TD for the meetings and field visits. The representatives included Chiwog Tshogpa and members from the majority of households. The chiwog level meeting helped to identify relevant issues within the degraded sub-watershed. This was followed by field visits and detailed assessments to validate the issues in the watershed.

Figure 25: Stakeholder consultation at geog and chiwog level

4.3. Plan formulation

The plan was formulated with the development of a Logical Framework Analysis Matrix (LFAM), building from the issues and problems (the degrading influences) identified during the various stages of the planning process. A "filter" was applied to ensure that only those issues that contribute directly to the purpose of removing or mitigating degrading influences were addressed in the plan.

The application of the LFA led to the development of activities, outputs, objectives and a goal for the plan. The LFAM (Annex 7.1) is the core part of the plan for implementation. The Logical Framework Analysis (LFA) exercise consisted of teams from WMD (facilitator) and respective RNR extension. This led to the construction of a problem tree with causes and effects of the core problems, which led in turn to the construction of an objective tree, with outputs, objectives and a goal (Figure 26). These are the influences that must be addressed or mitigated during implementation in order to return the watersheds to normal or pristine condition (to the greatest extent possible).

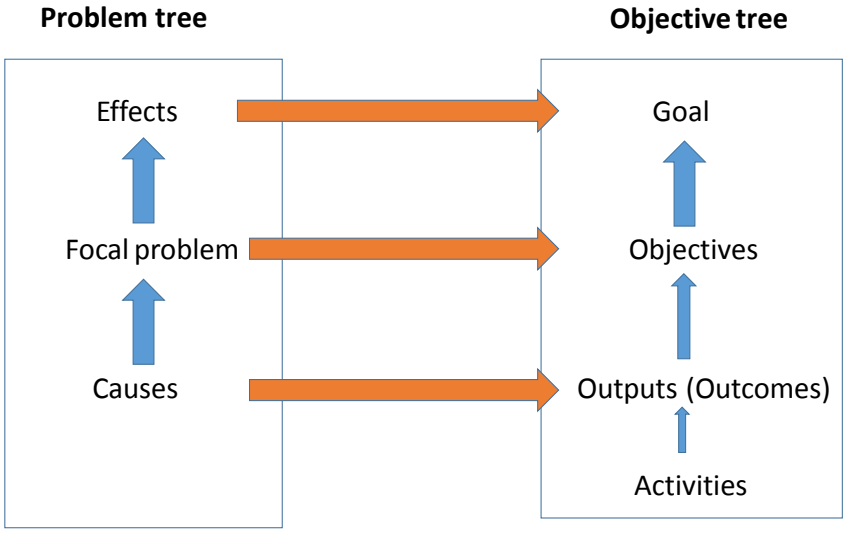

Figure 26: Problem tree and objective tree used to convert issues/problems identified during the planning process into an intervention strategy to mitigate the degrading influences.

Figure 27: Key stakeholders during LFA matrix workshop

4.4. Write shops

Following the above mentioned stakeholders 'consultation meetings, write shops were organized to discuss the format and contents of the plan as well as synthesizing information collected from the field. Participants of the write shops consisted of the management planning team and technical experts from relevant agencies within the DoFPS, Ministry of Agriculture & Forests. The field focal person for degraded watershed was also invited for the write shop. The maps and relevant information was also generated through GIS analysis by WMD. The plan was presented and endorsed during the 8th Technical Advisory Committee (TAC) meeting of the Department.

5. The PLAN

While conducting the rapid assessment of Nikachhu watershed, a total of four sub-watersheds have been identified as degraded watersheds by function (Sangchhu, Nimdrokhangchhu under Busa chiwog, Sephu geog and Tsheringma Drupchhu and Zalamchhu under Tangsibji geog). However, the particular plan is developed only for two sub-watersheds (Sangchhu and Nimdrokhangchhu) under Busa chiwog, Sephu geog based on the field situations.

5.1. Goal

Busa watershed managed to enhance watershed functions and yield high quality drinking water for local communities in the context of climate change.

5.2. Objectives and Outputs

Objective 1. To restore degraded forest land and regulate grazing within the carry capacity (livestock units)

Output 1.1:Degraded forest land restored

The sub-watersheds is the drinking water source for Busa village, Busa school and shops. Same catchment is also source for irrigation water for Busa village. As the source area for drinking water and irrigation, there is need to manage the forest and rangeland in the watershed sustainably for provision of quality water for now and future.

Output 1.2: Grazing land sustainably utilized within the carrying capacity

Continuous grazing by cattle and yak is taking place in the sub-watershed year round and resulting land degradation. Activities to reduce cattle grazing in the watershed will contribute to improving overall health of watershed.

Objective 2. To manage quality of drinking water in compliance with water quality standards 2016 and improve potable water infrastructures for local and downstream users.

Output 2.1. Reservoir tank to service school and expanding downstream communities in place

The existing drinking water supply infrastructure is not designed as per the water users and some individuals tap drinking water directly from ponds which is health hazard. Activities to establish standard infrastructure for drinking water storage and supply will contribute to improving the water supply to the communities, Busa school and expanding shops.

Output 2.2. Waste management system in compliance with waste management guideline 2012 in place.

Despite waste management awareness and efforts initiated by WCNP, MoH and Local Government in the watershed, there are still waste problems along the streams and in open watershed areas. There is need to sensitize the communities and students on proper waste management and put in measures. Besides, there are migratory cattle herd camp and cattle grazing activities taking place in the watershed that need to be regularly monitored. Besides, there are pit toilets along the stream bank and activities to relocate with proper structure will improve sanitation and hygiene in the watershed

Objective 3. To stabilize exposed soils and improve drainage in existing farm roads in compliance with farm road construction guidelines.

Output 3.1. Existing farm roads managed in conformity with EFRC rules

One of the major problems in the watershed is poor farm road conditions with no proper drainage system and exposed cuts and filled slopes. During the rainy season, farm roads are not ply able and the major sources of erosion in the watersheds come from these poorly managed farm roads. Activities to improve cross drainage and rehabilitate cut and fill areas will decrease erosion and consequent stream sedimentation.

5.3. Implementation mechanism

This plan for the Nikachhu watershed will be implemented within the period of 5 years starting from July 2018 - June 2023 (in line with 12FYP). However, major part of the planned activities will be implemented under the financial support of WWF Bhutan Program on IWMP for Nikachhu & Kurichhu (July 2017 to December 2017) as demonstration site. The remaining activities shall be mainstreamed in to the 12th Five Year Plan and annual work plan of the relevant stakeholders (as indicated in LFAM, Annexes 7.1) and implemented by the agencies accordingly, as required by the Roadmap for Watershed Management in Bhutan.

5.4. Funding

Implementation of planned watershed activities in Western and Eastern Park Range of WCNP will be funded by WWF Bhutan for most of the activities (Nu.13.2 million). For the activities not covered under the project, it shall be met from regular government budget. However, this management plan can also be used as a basis to solicit funds from hydro-power projects or other donors. WMD as the coordinating agency will facilitate the relevant agencies to incorporate watershed activities in their plans and accordingly seek budgetary provisions from RGoB during the annual and five yearly planning processes. The incorporation of activities of the watershed management plan into respective plans and budgets of local administration will be done in consultation with the WMD.

The possibility to apply Payment for Environmental Services (PES) mechanisms as a financial strategy could be explored in order to ensure sustainable funding to support watershed management activities. Under such a scheme, downstream water users such as Tangsibji Hydropower Project and other major water users benefiting from watershed management activities are encouraged to contribute financially to implement remedial activities under an appropriate and mutually agreed framework.

5.5. Monitoring and Evaluation

The activities identified in this management plan as being necessary to achieve the goal and objectives of the plan are designed to be integrated into the area based management plans of a variety of agencies and organizations, particularly the geog and Dzongkhag annual and 5-year plans. These organizations will monitor implementation and submit the progress report to WMD. The verifiable indicators in log frame matrix (Annexes 7.1) will assist in the monitoring of watershed management activities. Evaluation of the impact of the management

plan and the extent to which it has achieved its objectives and contributed to attaining the goal should be carried out by the WMD towards the end of the plan period.

5.6. Revision and Amendment

The plan is for a period of five years. The plan will be reviewed and amended by WMD in collaboration with field offices and line agencies based on the report from monitoring and evaluation team.

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7. ANNEXES

7.1. Log frame matrix with activities, outputs and indicative budget

Outputs	Activities	Verifiable indicators	Lead agency& collaborators /person for implementation	Local area based plan	Budget (Nu. in million)
Objective 1. To restore degraded forest land and regulate grazing within the carry capacity (livestock units)					
1.1. Degraded forest land restored	1.1.1.Carry out plantations of native tree species and bamboo (5 hectares) in SRF land at Menchugang, Busa chiwog	Planted area	GBCL, WCNP (WPR), Geog Admn and Community	GBCL,WPR/WCNP annual plan	0.5
	1.1.2.Protect existing forest area within the watershed area from degradation and tiger migrating route by awareness campaigns	Area, notification letters	WPR/WCNP, Geog Admn	WPR/WCNP annual plan	0.2
	1.1.3. Maintain the plantation created in 1.1.1.	Monitoring Reports, Field inspection	GBCL,WPR/WCNP	GBCL, Geog annual plan	0.7
	1.1.4.Enhance monitoring of fuel wood collection as per the FNCR rules	Monitoring Reports	WPR/WCNP, TD	WPR/WCNP annual plan	0.1
	1.1.5.Create public awareness campaigns on FNCR rules	No. of awareness campaigns, reports	WPR/WCNP, TD	WPR/WCNP annual plan	0.15

	1.1.6.Create awareness on energy efficiency and use of alternate source of energy (eg. Bio-briquette) including yay herders & Cordyceps collectors	No. of awareness campaigns, community survey, reports, no. of HH using alternative source of energy	WCNP,WMD, DoT	Geog annual plan	0.40
1.2.Grazing land sustainably utilized within the carrying capacity	1.2.1. Develop Pasture and fodder crop (20 hectares) to reduce grazing pressure in the tsamdro, Busa chiwog	Area	DoL (GLEO &, DLO), WCNP, Geog Adm, Community	WPR/WCNP annual plan	1.0
	1.2.2. Demonstrate fodder conservation (silage making) in at least in 5 households	No. of HH	DoL (GLEO & DLO), WCNP, Geog Adm Geog & Community	WPR/WCNP annual plan	0.3
	1.2.3. Introduce silvo-pastoral technology to reduce pressure (at- least 1.00 Acre on trial bases in Govt. Land	Area	DoL (NHRDC), WMD,GLEO WPR/WCNP, Geog Adm	WPR/WCNP annual plan	0.4
	1.2.4. Support improved breed programs (One Breeding bull, AI facilities: liquid nitrogen, AI gun, etc	No. of improved breeds/AI facilities	DoL (GLEO & DLO), Geog, WPR/WCNP, Geog Adm	Geog annual plan	0.3
	1.2.5. Support winter fodder development (oats+legume) 30 acres	Area	Geog adm, DLO/GLEO, WCNP	Geog annual plan	0.1

	1.2.6. Conduct baseline study on native grassland carrying capacity, SRF above Busa school	Reports	DoL(NHRDC) WPR/WCNP, GLEO, WMD, Geog Admn	WPR/WCNP annual plan	0.5
Objective 2. To manage quality of drinking water in compliance with water quality standards 2016 and improve potable water infrastructures for local and downstream users.					
2.1. Reservoir tank to service school and expanding downstream communities in place	1.2.1. Construct reservoir tank (1 no. distribution tank above school) for drinking water for school and community	Number	Geog/Dzongkhag Engineer, WPR/WCNP	Geog annual plan	0.5
	1.2.2. Provide materials (pipes) for distribution of water supply on cost sharing basis	Number	RWSS (MoH),Geog Adm ,WPR/WCNP	WPR/WCNP annual plan	0.3
	1.2.3. Form Drinking Water User group	User form formed	Geog Adm, WPR/WCNP	Geog annual plan	0.1
2.2. Waste management system in compliance with waste management guideline 2012 in place	2.2.1. Conduct awareness cum training campaign on waste management, Busa chiwog	No. of awareness	Geog Adm, WPR/ WCNP	WPR/WCNP annual plan	0.2
	2.2.2. Identify waste disposal site (landfill)	Number	Geog Adm, WPR/ WCNP	WPR/WCNP annual plan	0.3
	2.2.3. Construct waste disposal pits (10 nos.)(2pits in school,3pits in Busa	Number	Geog Adm, WPR/ WCNP	WPR/WCNP annual plan	0.25

	village and 5pits alone the main farm roads from school to Chazam)				
	2.2.4. Monitor waste management compliance	Report	WPR/WCNP, Geog Admn	WPR/WCNP annual plan	0.1
	2.2.5. Conduct awareness cum training on waste management at head water source of Nikachhu (yak herders, Cordyceps collectors and tour operators	Nos of awareness	WPR-WCNP,Geog admn	WPR-WCNP annual plan	0.3
	2.2.6. Install signage on waste management (10 nos) from Chazam to headwater source of Nikachhu	Number	WPR-WCNP,Geog admn	WPR-WCNP annual plan	0.2
Objective 3. To stabilize exposed soils and improve drainage in existing farm roads in compliance with farm road construction guidelines.					
3.1. Existing farm roads managed in conformity with EFRC rules	1.2.4. Form Farm road User group	User group formed	DoA (DAO, GAEO) Geog Adm, WPR/ WCNP	Geog annual plan	0.2
	1.2.5. Construct drainage (5.5KM) 2.5 km for Wangdigompa, 1.5km for Lambji & 1.5 Lubzur farm roads) @ Nu. 0.5M/km	Length of drainage, km	Geog Adm, WPR/ WCNP, DE, DAO/DAEO	Geog annual plan	3.0
	1.2.6. Maintain farm road drainage 3km	Length of drainage	Geog, WCNP, Dz.	Geog annual plan	1.05

	@ 0.350M/km	(km)	Engineer, DAO/GAEO		
	1.2.7. Carry out bio-engineering works along the newly constructed farm roads within the watershed boundary (5 ha) at Lamji, Wangdigonpa & Lubzur.	No. of area	Geog Adm, WPR/ WCNP, DE, DAO/GAEO	Geog annual plan	1.5
Total Budget Nu:					**12.65**

7.2. The degrading influences identified during rapid watershed assessment exercise

Degraded sub-watersheds	No of degrading factors	Degrading factors	Geog/Dzongkhag
Sangchu	09	Unstable geology, short distance of human activities from the stream, high presence of mass movements, numerous gullies present, high signs of overgrazing, high signs of forest degradation, heavy use of streams, steepness of the slope & shape of valley, and high pressure on NWFPs.	Sephu (Busa chiwog), Wangduephodrang
Nimdrokhangchhu	08	Low Forest cover, Unstable geology, short distance of human activities from the steam , high signs of overgrazing, high signs of forest degradation, heavy use of streams, poor farm road, and shape of valley	Sephu (Busa chiwog), Wangduephodrang
Tsheringma Drupchhu	05	Forest cover, steepness of slope, orientation of rocks, signs of overgrazing, and use of stream,	Tangsibji geog, Trongsa
Zalamchhu	05	Shape of valley, gradient of stream, use of stream, irrigation channel, and incidence of forest fire	Tangsibji geog, Trongsa

7.3. Rapid Watershed Assessment & Classification Summary of Nikachhu

Sl.No	Geog	Name of stream	Altitude (m)	Northing/Latitude			Easting/Longitude			Mean score	Class	Remarks
1	Sephu	Do lawa	2873	27	34	32.3	90	19	3.5	51.6	Normal	
2	Sephu	Beci gyemchhu	2875	27	34	12.4	90	19	1.3	49.5	Normal	
3	Sephu	lubzurchhu	2812	27	33	40.4	90	18	52.4	59.8	Normal	
4	Sephu	Bacha gangchhu	2693	27	33	3.4	90	18	16.2	52.8	Normal	
5	Sephu	Nimdro khangchhu	2717	27	33	9.2	90	18	34.4	58.6	Normal	Note: Drinking water source for Busa community, Busa school area degraded by function
6	Sephu	Gangchukhachhu	3297	27	32	52.6	90	12	58.5	53.7	Normal	
7	Sephu	Homagangchhu	3253	27	32	36.6	90	13	3.8	58.5	Normal	
8	Sephu	Longtoechhu	3199	27	31	57.3	90	13	4.4	54.2	Normal	
9	Sephu	Longmaychhu	3090	27	31	44.8	90	14	40.8	55.7	Normal	
10	Sephu	Pelaichhu	2733	27	30	46.3	90	16	46.3	56.1	Normal	
11	Sephu	Bjibechhu	2746	27	30	57.2	90	16	41.1	52.7	Normal	
12	Sephu	Zerechhu	2585	27	30	42.5	90	17	50.9	60.3	Normal	
13	Sephu	Luptsechhu	2767	27	33	40.2	90	18	43.5	58.7	Normal	
14	Sephu	Sangchuchhu	2758	27	32	56	90	18	46.1	46.2	Normal	Note: Drinking water source for Busa village & School degraded by function
15	Sephu	Wangdigangchhu	2856	27	32	29	90	18	46.5	53.4	Normal	
16	Sephu	Tshochu hokachhu	2694	27	32	29.1	90	18	5	50.6	Normal	
17	Sephu	Rabuchhu	2847	27	31	48.9	90	19	22.6	55.3	Normal	

18	Sephu	Gang rimchhu	2881	27	31	43.4	90	19	25.6	54	Normal	
19	Sephu	Chura gangchhu	2882	27	31	37.1	90	19	27.2	55.3	Normal	
20	Sephu	Khega chuzhichhu	3831	27	40	43.9	90	17	46.7	45	Normal	
21	Sephu	Gyentsachhu	3670	27	40	42.2	90	16	52.6	47	Normal	
22	Sephu	Repathangchhu	3065	27	35	43.8	90	18	50.4	53.2	Normal	
23	Sephu	Rubjithangchhu	3064	27	35	57.96	90	18	1.07	48.9	Normal	
24	Sephu	Yedakarchhu	3178	27	36	31.8	90	17	42.7	50.5	Normal	
25	Sephu	Sombjichhu	3550	27	38	19.6	90	17	6.9	55	Normal	
26	Tangsebji	Chhuserbu	2507	27	29	56.7	90	18	51.3	55.6	Normal	
27	Tangsebji	Chedebjichhu	2449	27	28	31.9	90	21	0.2	58	Normal	
28	Tangsebji	Khabarchhu	2496	27	29	9.5	90	29	9.6	60.1	Normal	
29	Tangsebji	Nyalalemchhu	2491	27	28	28.6	90	23	13.7	57.5	Normal	
30	Tangsebji	Zalamchhu	2418	27	27	0.1	90	26	19.4	50.4	Normal	Main Irrigation source & Mini Hydro exist degraded by function
31	Tangsebji	Tsheringmadrupchhu	2391	27	27	3.1	90	36	36.4	55.5	Normal	Drinking water source for the whole Tangsibji community degraded by function
32	Tangsibji	Chunap		27	27	33.3	90	21	45.8	67.3	Pristine	

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