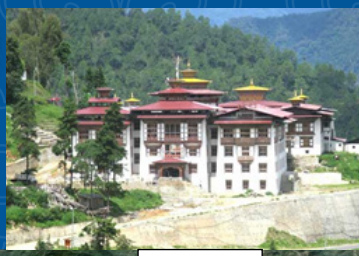
# INTEGRATED WATERSHED MANAGEMENT PLAN
## KURICHHU SUB-BASIN





**JUNE 2017**

**Watershed Management Division**
**Department of Forests & Park Services**
**Ministry of Agriculture & Forests**
**Royal Government of Bhutan**

# Integrated Watershed Management Plan
# for
# the degraded watersheds in Kurichhu sub-basin
## (July 2018 - June 2023 )

**JUNE 2017**

Watershed Management Division
Department of Forest and Park Services
Ministry of Agriculture and Forests
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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 and Park Services, Ministry of Agriculture and 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 of DoFPS. It has been further reviewed and recommended for implementation by the Director, Department of Forests and Park Services (DoFPS) and approved by the Honourable Secretary, Ministry of Agriculture and Forests, Royal Government of Bhutan.

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**Reviewed and recommended for approval:**

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**Recommended for Approval:**

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**Department of Forest & Park Services**

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**Citations:**

Tenzin, J., Gyeltshen, T., and Dem, K. 2018 Integrated Watershed Management Plan for the degraded watersheds of the Kurichhu sub-basin. Department of Forests & Park Services, Ministry of Agriculture & Forests, Royal Government of Bhutan, Thimphu, Bhutan.

## ACKNOWLEDGEMENT

The Watershed Management Division, Department of Forests & Park Services, Ministry of Agriculture & Forests extends its deep appreciations to all organizations, both within the Government as well as outside the Government administrations, and specially the individuals working in those organizations for contributing valuable information for the preparation of this watershed management plan.

Special thanks to Dasho Dzongdas along with the sectors heads of the two Dzongkhag administrations of Lhuentse and Monggar for their full support while preparing this plan. We would also like to thank the Gups and geog RNR staffs of all geogs falling within the Kurichhu sub-basin for contributing and helping the team with the watershed assessment, planning and preparation of the this management plan. The representatives from Wangchuck Centennial National Park (eastern park range) Monggar territorial forest division, Phrumsengla National Park Range office, municipal office of Monggar & Lhuentse, UWICER (RNR-RDC Yusipang) and Kurichhu Hydropower project is also acknowledged for all their support.

We express our sincere gratitude to Director, Department of Forests & Park Services for their enormous guidance and support provided during the preparation of this document. Special thanks to Dr. Don Gilmour Sr. Australian Volunteer for helping during the Logical Framework Analysis (LFA) Planning for this plan.

Our sincere thanks to all the participants of the various stakeholder consultation workshops and the members of the preparation team from Watershed Management Division for their valuable information and inputs into this valuable and informative document.

Finally, this plan was all possible with financial support of EU-GCCA and World Wildlife Fund (WWF), Bhutan and is fully acknowledged.

## Glossary of Bhutanese terms

| | |
|---|---|
| *Chhu* | River |
| *Chiwog* | Village or a group of villages |
| *Chuzhing* | Paddy field |
| *Dzong* | Fort/monastery |
| *Dzongda* | District Administrator |
| *Dzongkhag* | District |
| *Dratshang* | Monk body |
| *Geog* | Block/administrative unit/County |
| *Gup* | Elected leader of a geog |
| *Kamzhing* | Dryland |
| *Mangmi* | Deputy elected leader of a geog |
| *Tshogpa* | Chiwog representative |
| *Tsho* | Lake/Wetland |

## List of abbreviations

| | |
|---|---|
| AI | Artificial Insemination |
| BNB | Bhutan National Bank |
| BoB | Bank of Bhutan |
| BPC | Bhutan Power Corporation |
| CF | Community Forest |
| CFMG | Community Forest Management Group |
| CFO | Chief Forestry Officer |
| DAMC | Department of Agriculture & Marketing Cooperatives |
| DAO | Dzongkhag Agriculture Officer |
| DE | Dzongkhag Engineer |
| DES | Department of Engineering Services |
| DPO | Dzongkhag Planning Officer |
| DoA | Department of Agriculture |
| DoL | Department of Livestock |
| DoFPS | Department of Forest &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 |
| FMU | Forest Management Unit |
| FNCR | Forest & Nature Conservation Rules & Regulations |
| GAEO | Geog Agriculture Extension Officer |
| GAO | Geog Administrative Officer |
| GLEO | Geog Livestock Extension Officer |
| GNH | Gross National Happiness |
| ha | Hectare |
| HH | Household |
| HP | Hydropower Plant |
| HWC | Human Wildlife Conflict |
| Km | kilometer |
| LRO | Land Record Officer |
| m.a.s.l | meters above sea level |
| m | Meter |
| mm | Millimeter |
| M & E | Monitoring & Evaluation |
| MoAF | Ministry of Agriculture &Forests |
| MoH | Ministry of Health |

| | |
|---|---|
| MoE | Ministry of Education |
| MoWHS | Ministry of Works & Human Settlement |
| MP | Management Plan |
| MW | Mega Watt |
| NDDC | National Dairy Development Cooperation |
| NFFDP | National Feed & Fodder Development Program |
| NSSC | National Soil ServiceCenter |
| NPPC | National Plant Protection Center |
| NWFP | Non-wood Forest Product |
| PA | Protected Area |
| PES | Payment for Environmental Services |
| PRA | Participatory Rural Appraisal |
| PVC | Poly Vinyl Chloride |
| RGoB | Royal Government of Bhutan |
| RBC | River Basin Committee |
| RGoB | Royal Government of Bhutan |
| RDC | Research Development Center |
| RLDC | Regional Livestock Development Center |
| RNR | Renewable Natural Resource |
| RWSS | Rural Water Supply Scheme |
| SALT | Soil and Land Management Technology |
| SFED | Social Forestry & Extension Division |
| SLM | Soil & Land Management |
| ToR | Terms of Reference |
| WM | Watershed Management |
| WMC | Watershed Management Committee |
| WMD | Watershed Management Division |
| WMP | Watershed Management Plan |
| WUA | Water Users' Associations |

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## 1. Introduction

Bhutan's topographical and climatic features put together results in a mosaic of watersheds with wide array of ecosystems and immense biodiversity, which provide the basis of people's wellbeing. While most of the watersheds are in good condition owing to strong environmental policies and practices put in place by our visionary leaders, certain watersheds are now showing signs of degradation due to increasing population and infrastructure developments (Department of Forests & Park Services, 2013; Forest Resources Management Division, 2013). The pressure on the watershed resources are intense in the areas with dense settlements (Tenzin and Hasenauer, 2016).Such watersheds need to be identified through watershed assessment and accordingly put in place the watershed management plans to mitigate the degrading influences (Tsering, 2011).

As outlined in the Forest and Nature Conservation Rules 2017(FNCR 2017) (Deparment of Forests & Park Services, 2017), a watershed management plan is required if a watershed is classified as "degraded" or "critical" following the application of the watershed classification guidelines (Watershed Managment Division, 2010). The purpose of such watershed management plans is to address the degrading influences and attempt (to the greatest extent possible) to return the watersheds to a "normal" or "pristine" condition. Watershed management plans are also developed to protect and manage the watersheds which are important drinking water source.

The Watershed Management Division (WMD) under the Department of Forests & Park Services (DoFPS), Ministry of Agriculture & Forests (MoAF) in consultation with relevant stakeholders is mandated to carry out watershed assessment, classification and planning for the watersheds (Tenzin, 2011; Tsering, 2011). As per the outcomes and outputs specified in the current five year plan (2013-2018) (Gross National Happiness Commission, 2013), the Kurichhu river basin was taken up for watershed assessment, classification and accordingly develop watershed management plans. The Kurichhu sub-basin is a major source of water for drinking and irrigation for the people inside as well downstream. The sub-basin also serves for the generation of the 60 MW Kurichhu hydropower plant and several other mini hydropower plants. The importance of the basin is further augmented by the inception of 1125 MW Kuri-I hydropower project. Therefore, the assessment and development of management plan for the sub-basin is of paramount importance. The financial support for the same was provided by the EU-GCCA for the watershed assessment and developing the management plan while the World Wildlife Fund (WWF) Bhutan supported the part focusing Gangzur geog under Lhuentse Dzongkhag.

## 2. Description of the Kurichhu sub-basin

This management plan was developed for the Kurichhu sub-basin of the Manas river basin (Figure 1). The Manas River Basin comprises four sub-basins (Mangdechhu, Chamkharchhu, Kurichhu and Drangmechhu) in the central and eastern parts of the country. The management plan focuses on the identified degraded sub-watersheds within the Kurichhu sub-basin (Watershed Management Division, 2017b).

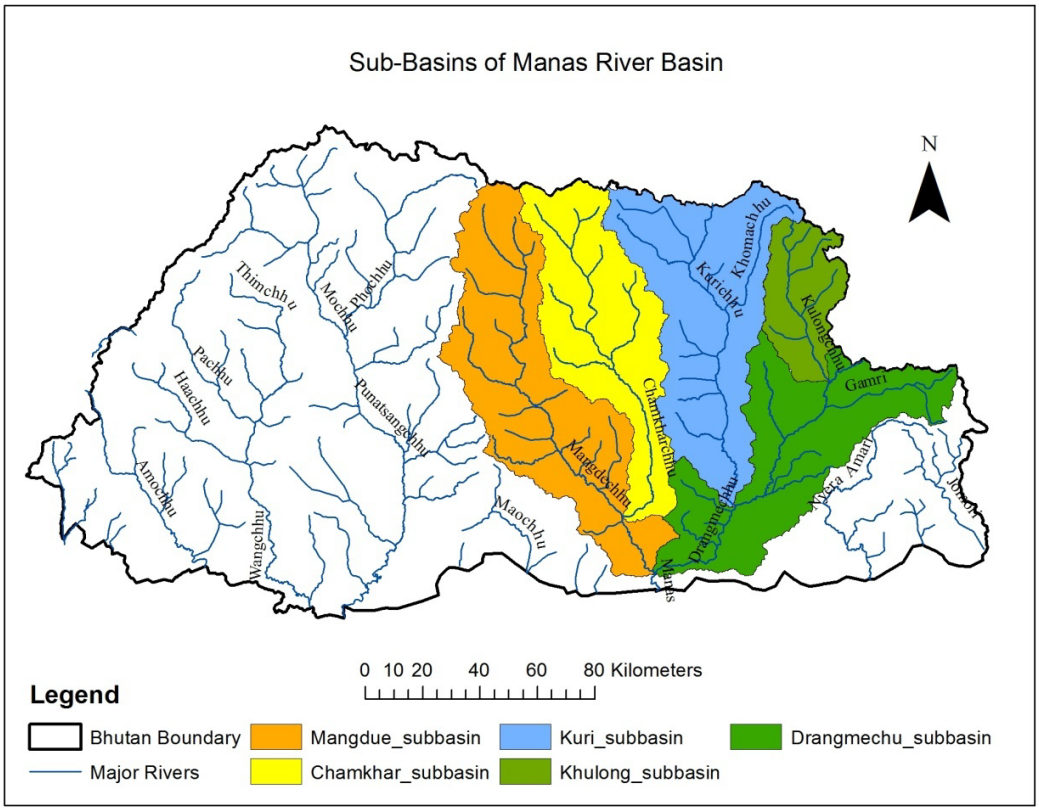


*Figure 1: Manas river basin along with the sub-basin of Kurichhu*

### 2.1 Geographic and administrative description

The Kurichhu sub-basin covers a total area of 3836 km$^2$ comprising all of Lhuentse and parts of Monggar Dzongkhag (Figure 2).The elevation of the Kurichhu sub-basin ranges from about 300 m.a.s.l in the south to 6400 m.a.s.l in the north and contains different agro-ecological zones ranging from sub-tropical in the downstream parts of the basin through warm temperate and cool temperate in the higher hills to arid alpine in the north of the basin (Table 1).

Table 1: Agro ecological zones of Bhutan(National Biodiversity Centre, 2009).

| **Agro-ecological zone** | **Altitude (m.a.s.l)** | **Temperature° C** | | | **Rainfall (mm)** |
|---|---|---|---|---|---|
| | | **Max** | **Min** | **Mean** | |
| Alpine | >3500 | 12.0 | -1.0 | 5.5 | <650 |
| Cool temperate | 2500-3500 | 22.0 | 1.0 | 10 | 650-850 |
| Warm temperate | 1800-2500 | 26.0 | 1.0 | 13 | 650-850 |
| Dry sub-tropical | 1200-1800 | 29.0 | 3.0 | 17 | 850-1200 |
| Humid sub-tropical | 600-1200 | 33.0 | 5.0 | 20 | 1200-1500 |
| Wet sub-tropical | 150-600 | 35.0 | 12.0 | 24 | 2500-5500 |

The Lhuentse Dzongkhag consists of eight geogs and the settlements are mainly concentrated towards the river valley. The Dzongkhag has a geographical area of 2837 km$^2$ and a population of 17,961. The most populated area is in Maenbi geog (Figure 2).

In Monggar Dzongkhag, from the total of 17 geogs, only 10 geogs (Chali, Drepong, Gongdu, Jurmey, Kengkhar, Monggar, Saling, Silambi, Tsakaling and Tsamang) with an area of 962 km$^2$ fall within the Kurichhu sub-basin. However only some portions of Silambi, Gongdue, Kengkhar and Jurmey geogs are part of the Kurichhu sub-basin. The total population of the Dzongkhag in the watershed is around 45,348.

Table 2: Dzongkhags and Geogs in the Kurichhu sub-basin

| **Dzongkhag** | **Geogs in the sub-basin** | **Area in sub-basin [km$^2$]** | **Population** |
|---|---|---|---|
| **Lhuentse** | 8 | 2837.49 | 17,961 |
| **Monggar** | 10 | 961.69 | 45,348 |

*Source :Dzongkhag at glance ,National Statistical Bureau (2017)*

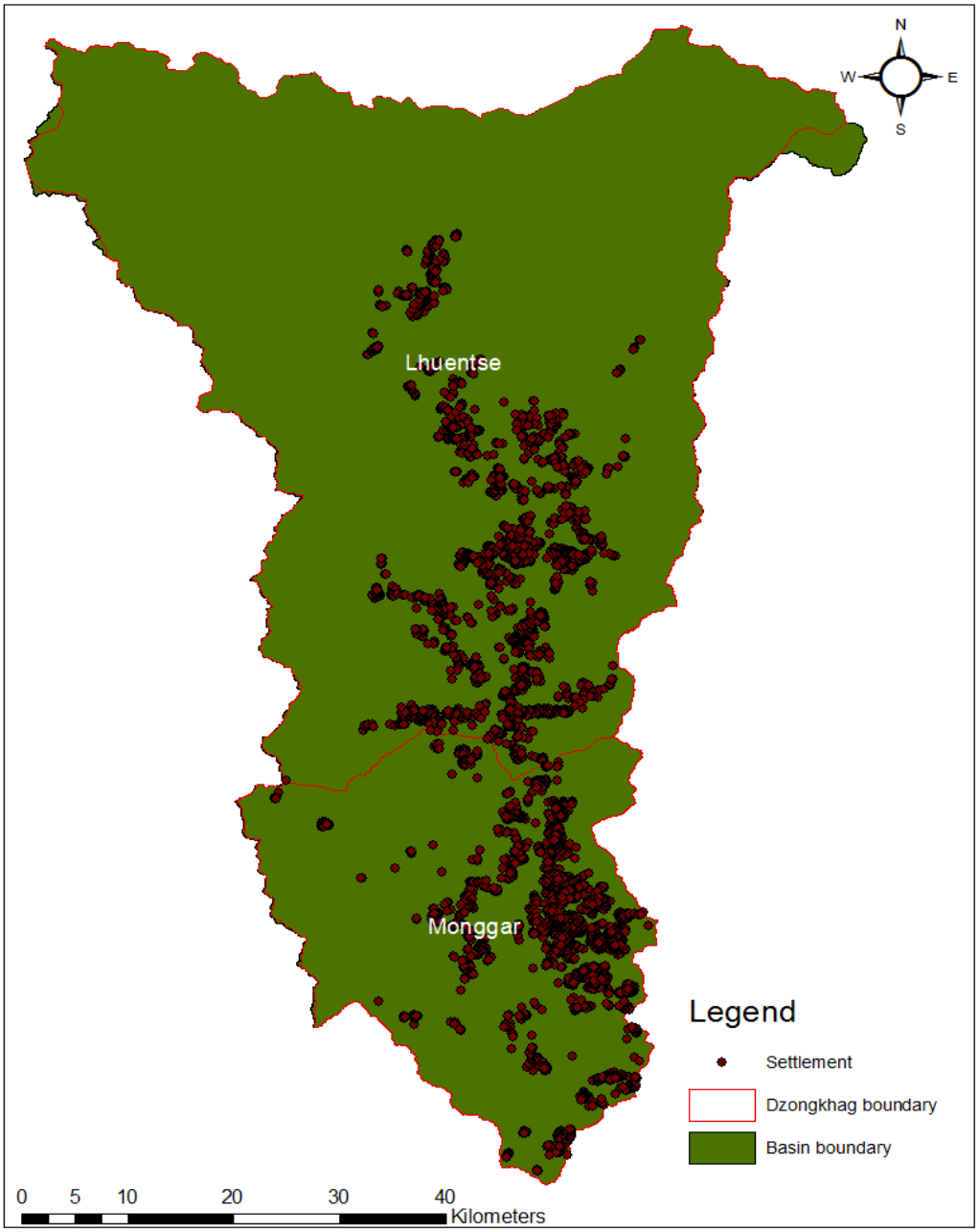


*Figure 2: Settlement in the Kurichhu sub-basin*

## 2.2 Hydrology

The sub-basin is drained by the main river of Kurichhu. The Kurichhu crosses into Bhutan at a relatively low altitude of 1200 meters, flowing in a southerly direction up to Ney village under Gangzur geog and changes its course to south-easterly till it reaches Lhuentse Dzong. In Lhuentse part of the sub-basin, some of the important sub-watersheds of the Kurichhu are Bazaguruchhu, Tangrigangchhu, Khargangchhu, Druksumchhu, Thongangchhu, Phaugangchhu, Kilungchhu, Khomachhu, Baegangchhu, Ongarchhu, Rindibechhu and Phowanchhu under Lhuentse Dzongkhag. The significant sub-watersheds under Monggar Dzongkhag include Morichhu, Gangolachhu and Rewanchhu (Figure 3). In addition to these significant tributaries, there are numerous streams and springs that contribute to the sub-basin.

*Figure 3: Some of theTributaries joining Kurichhu (Khomachhu, Lhuentse and Morichhu, Lingmethang Monggar.)*

Further downstream the Kurichhu flows in a south-westerly direction and joins Drangmechhu at Kurigongri confluence at an elevation of approximately 300 m.a.sl under Jurmi goeg. The Drangmechhu joins the Manas River in Panbang under Zhemgang Dzongkhag. Manas is the largest river basin of Bhutan and drains most of the rivers of eastern and central part of Bhutan.

### 2.3 Land use in the sub-basin

The major land use in the sub-basin is under forest (69%), followed by shrubs (10%) and least under water bodies (river, lakes and reservoirs) (0.45%). Only about 2% of the area is under agricultural land consisting of chuzhing, kamzhing, orchards and built up areas. The sub-basin also has small area of about 2 % under meadows (Figure 4). With a cover of 39 % the dominant forest type is broadleaved in the sub-basin and about 29 % is under conifer forest. The conifer forests consists of fir forests (11.5%), mixed conifers (9.9%), Chirpine (8%) and Blue pine (0.06%).

In the Lhuentse part of the sub-basin, the forest area is dominated by broadleaved species. The valley bottom is dominated with *Pinus roxburghii* indicating dry valley. The lower valleys of the Monggar Dzongkhag, along the Kurichhu are mainly dominated by *Pinus roxburghii* while the mid and upper slopes are dominated by broadleaved forest (mainly *Quercus sp*). Mixed conifer and fir forest dominates the north-western part of the Dzongkhag.

In Lhuentse, dry land is predominant in the areas where crops like maize, potatoes and chilies are commonly grown (Figure 5A). The existence of shifting cultivation practice is still visible in some of the geogs. Backyard farming of dairy, poultry, piggery and goat are present in few villages. Abandonment of agriculture land is also common in most of the geogs.

Similarly, in Monggar Dzongkhag, maize cultivation is the predominant crop (Figure 6A, 7) and paddy cultivation is restricted only in few pockets and in the lower valleys (Figure 7). Despite shortage of drinking and irrigation water, there is increasing number of farmers growing horticulture crops and vegetables with improvement to market access (Figure 6B). Apart from agriculture farming, the livelihoods of the communities are also very much dependent on livestock farms as well as collection of NWFPs.

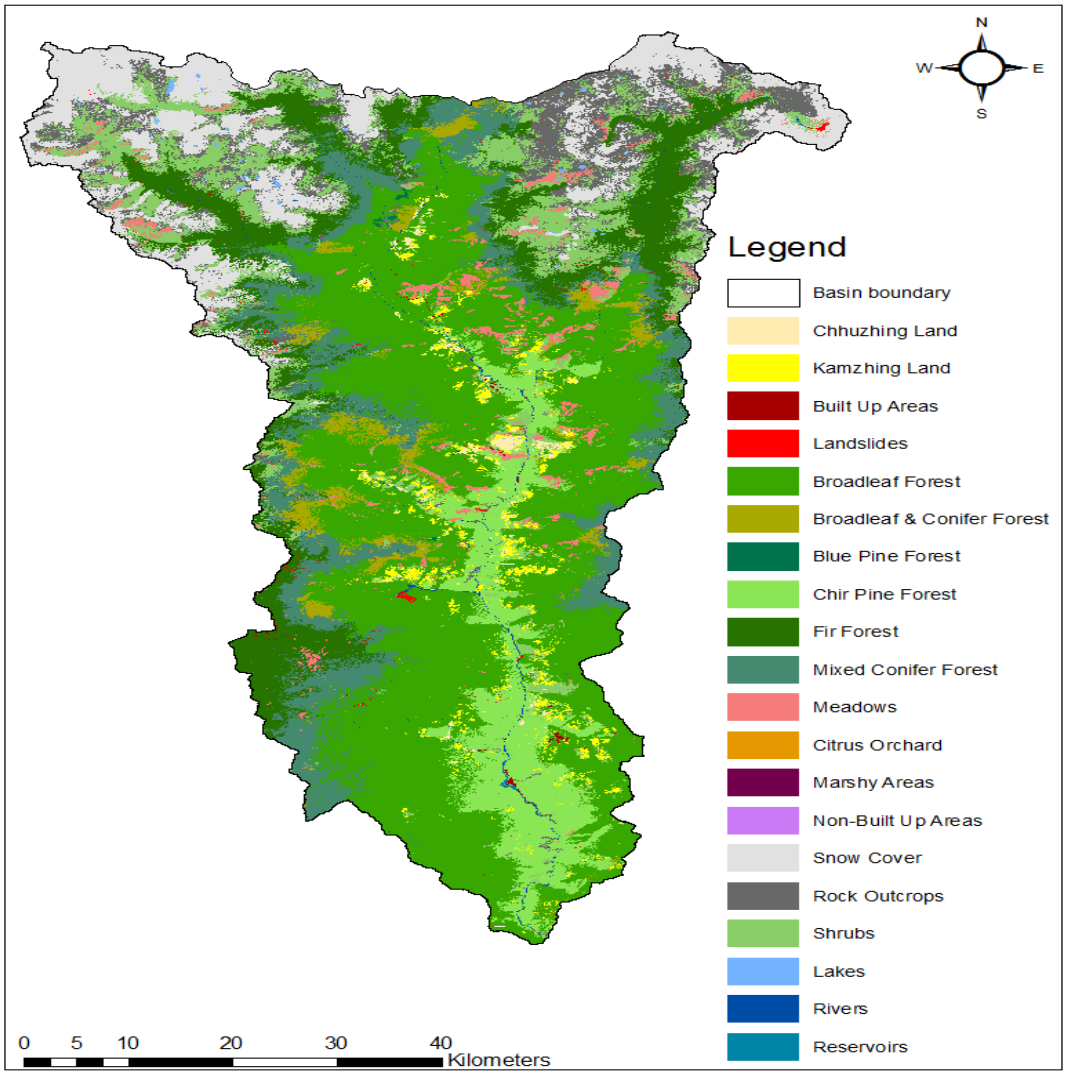


*Figure 4: Land use map of the Kurichhu sub-basin*


*Figure 5: Major land use practices: (A) Maize cultivation in Metso Geog, (B) Paddy cultivation in Maenbi Geog, (c) shifting cultivation & (D) sokshing (Quercus griffithii) in Lhuentse*


*Figure 6: Major Crops: (A) Maize field in Drepong & (B) Fruit trees and Maize in Chali village in Monggar Dzongkhag.*

*Figure 7: Paddy & maize cultivation at Chali geog & Drepung geog and Tangmachhu, Maenbi geog*

### 2.4 Degraded watersheds in the sub-basin

The WMD has delineated 186 watersheds in the whole country for effective watershed planning and implementation. As per this delineation, Kurichhu sub-basin has 12 watersheds (Figure 8). There are numerous streams and springs within this watersheds contributing to the main Kurichhu River. These streams are referred to as sub-watersheds in this management plan. The sub-watersheds were assessed using the classification guidelines of WMD (Watershed Managment Division, 2011).

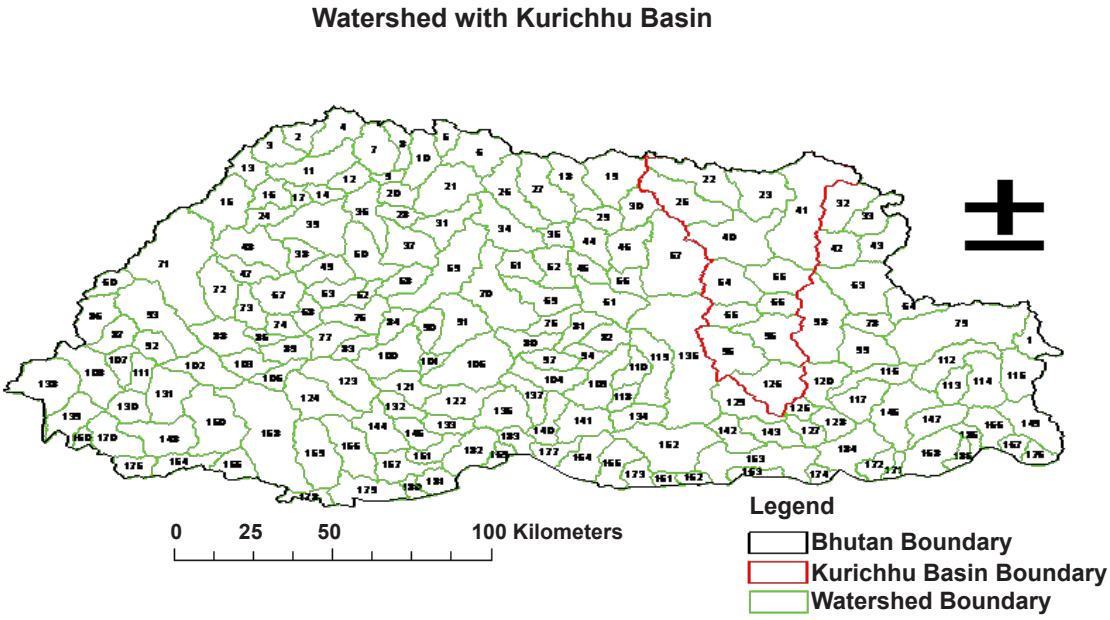


*Figure 8: Delineated watersheds in Bhutan with emphasis in Kurichhu sub-basin*

All the sub-watersheds of the Lhuentse Dzongkhag part of the Kurichhu sub-basin were under normal category (Watershed Management Division, 2017b), which only requires periodical monitoring and not management planning as per the watershed classification guideline (Watershed Managment Division, 2010; Watershed Management Division, 2017b). However, there are few sub-watersheds which serve the upstream and downstream communities with water for drinking and irrigation besides other ecosystem functions. Such watersheds are classified as “degraded watersheds by function” (Table 3) and are taken up for watershed management planning as in Baychhu watershed and Kholongchhu sub-basin management plan (Watershed Management Division, 2015, 2017a).

In the Monggar part of the sub-basin, a total of 12 sub-watersheds were classified as degraded. Further there are 8 sub-watersheds, which are important locally for supplying reliable water to the expanding communities, schools and municipalities which were classified as “degraded watershed by function”.

Considering the important factors as stated above, there is a need to address the degrading influences observed within the sub-watershed. Therefore, the WMD team along with relevant stakeholders during various consultation meetings identified 23 sub-watersheds as the target watersheds for management interventions in this management plan of Kurichhu sub-basin (Table 3). As such, the activities and

outputs identified in this management plan are mostly aimed at addressing the detailed management need of these 23 sub-watersheds to improve their conditions.

Table 3: Degradedsub-watersheds within Kurichhu sub-basin

| Dzongkhag | Degraded sub-watersheds | Watershed ID | Geog | Area [ha] |
|---|---|---|---|---|
| **Lhuentse** | Lekpagangchhu/Gangzurchhu | 40 | Gangzur | 3,261 |
| | Baegangchhu | 55 | Maenbi | 4,290 |
| **Monggar** | Wrongre/ Tongpalungpa/ Chubar/ Lebare | 96 | Saling | 4,752 |
| | Yongri/ Nyrunmori/ Zunglentsho/ Bespalingri/ Dotheri | 126 | Drepong | 4,587 |
| | Wangrongmachu/ Redaza/ Chompa I/ Chompa II/ Kamang/ Yakpugang | 95 | Chali/ Monggar | 7,077 |
| | Manchhuri(Deysungri)/ Tsangpori/ Moitangri/Sunkari/Sengri | 126 | Jurmey/ Kengkhar | 5.858 |

## 3. Planning Process

The Kurichhu sub-basin management planning process was initiated following the existing policies, acts, rules and guidelines. Due to the presence of numerous stakeholders in the watershed, it is intended that the activities planned for the improvement of the sub-watersheds will be reflected in the operational plans of the stakeholders. For this to be achieved, it is necessary for the plan to be developed in a participatory manner with the active involvement of key stakeholders. Accordingly, consultative meetings were conducted with stakeholders at the Dzongkhag, geogs and chiwog levels and findings were refined through technical field assessments and expert write shops. Information gaps were filled using information from various focal agencies/persons. The consultation process is outlined below.

*Figure 9: Stakeholder consultation & Planning at various level*

The planning process started by holding consultative meetings with the Lhuentse and Monggar Dzongkhag Administration (Figure 9). The results of the watershed assessment in Kurichhu sub-basin and the identification of degraded watersheds were presented at the meetings. Problems causing degradation of the watersheds were discussed and measures to resolve them were suggested.

After the meeting with stakeholders at the Dzongkhag level, meetings were held in the geogs falling within the degraded watershed to narrow down the problems and come up with possible remedial measures. During the meetings, results of the Dzongkhag level meeting including an overview of problems and suggested remedial measures were presented. In addition, geog officials were asked to present the problems and suggest remedial measures from the perspective of their geogs. The meeting came up with a list of prioritized issues and relevant activities to solve those issues in the degraded watershed.

Field verification followed by prioritization of the site specific issues and management activities were done at the chiwog level. At the chiwog meetings, the representatives included chiwogTshogpas and members from the majority of households. The chiwog level meeting was the most important one, as it helped to identify issues of each chiwog within the degraded watershed. For each issue, appropriate measures were discussed. This was followed by field visits and detailed assessments to validate the issues in the watershed.

## 4. Issues in the degraded watersheds of the sub-basin

The problems or issues in the sub-watersheds were identified and listed at various stages of the planning period. The first record of the issues were made during the rapid watershed assessment and classification of the sub-watersheds. All those factors with a very low score were marked as issues of concern (Table 4). After identification of the degraded sub-watersheds, various community consultations meetings were held to list and verify the issues recorded during the assessment. Further, field verification visits were carried out to understand the issues and also to verify the issues raised during the consultative meetings.

The rapid assessment reported more degraded watersheds in the sub-watersheds under Monggar Dzongkhag, which can be categorized as the drier sites of the sub-basin (Table 3 and 4). The various land-use issues which was commonly reported by the stakeholders are drying up of water sources (shortage of drinking water), human-wildlife conflicts, forest and agricultural land degradation (forest fire, steep slopes, livestock grazing and landslides due to seepage from paddy field, poor drainage farm road and rill & gully erosion from steep dry land farming). These key issues which are discussed below forms the basis for designing interventions in the watershed management plan.

Table 4: Degrading influences identified during watershed assessment exercise

| Degraded sub-watersheds | Degrading Factors | Geog | Dzongkhag |
|---|---|---|---|
| Lekpagangchhu | Short distance of human activities from the stream, heavy use of streams, poor farm roads, poor irrigation channels, high pressure on NWFPs, less land management activities undertaken, high stream gradient. | Gangzur | Lhuentse |
| Gangzurchhu | Less land management activities undertaken, high stream gradient. | Gangzur | |
| Baegangchhu | Unstable geology, short distance of human activities from the steam, less land management activities undertaken, high presence of mass movements, poor farm roads. | Maenbi | |
| Wrongre | Unstable geology, human activities carried within the proximity of streams, presence of mass movement, numerous gullies present, high grazing pressure, high signs of forest degradation, poor farm roads, high pressure on NWFPs, high gradient of stream, heavy use of streams. | Saling | Monggar |
| Tongpalungpa | Unstable geology, high sediment yield, human activities carried within the proximity of streams, high presence of mass movement, numerous gullies present, high grazing pressure, high sighs of forest degradation, poor farm roads, high pressure on NWFPs, presence degraded arable lands. | Saling | |
| Chubar | Low forest cover, unstable geology, short distance of human activities from the stream, high Presence of mass movements, high signs of overgrazing, high signs of forest degradation, heavy use of streams, poor farm roads, high pressure on NWFPs, presence of degraded arable lands. | Saling | |
| Lebare | Low forest cover, unstable geology, short distance of human activities from the stream, high Presence of mass movements, high signs of overgrazing, high signs of forest degradation, poor farm roads, high pressure on NWFPs. | Saling | |
| Yongri | Low forest cover, unstable geology, short distance of human activities from the stream, high Presence of mass movements, presence of gullies, high signs of overgrazing, high signs of forest degradation, heavy use of streams, poor farm roads, poor irrigation channel, high pressure on NWFPs, presence of degraded arable lands, incidence of forest fire. | Drepong | |
| Nyrunmori | Low forest cover, unstable geology, short distance of human activities from the stream, high Presence of mass movements, presence of gullies, high signs of overgrazing, high signs of forest degradation, heavy use of streams, high pressure on NWFPs, presence of degraded arable lands, high gradient of stream. | Drepong | |

| Degraded sub-watersheds | Degrading Factors | Geog | Dzongkhag |
|---|---|---|---|
| Zunglentsho | Low forest cover, unstable geology, short distance of human activities from the stream, presence of gullies, high signs of overgrazing, high signs of forest degradation, heavy use of streams, high pressure on NWFPs, high gradient of stream. | Drepong | |
| Bespalingri | Low forest cover, unstable geology, high Presence of mass movements, presence of gullies, high signs of overgrazing, high signs of forest degradation, poor farm roads and irrigation channel, high pressure on NWFPs, presence of degraded arable lands, high gradient of stream, less land management activities carried out, low presence of wild animal. | Drepong | |
| Dotheri | Low forest cover, unstable geology, high sediment yield, short distance of human activities from the stream, high Presence of mass movements, presence of gullies, high signs of overgrazing, high signs of forest degradation, heavy use of streams, poor farm roads, poor irrigation channel, high pressure on NWFPs, presence of degraded arable lands, incidence of forest fire, low presence of wild animals. | Drepong | |
| Wangrongmachu | Low forest cover, unstable geology, high sediment yield, high Presence of mass movements, presence of gullies, heavy use of streams, poor farm roads, poor irrigation channel, high pressure on NWFPs, presence of degraded arable lands, less land management activities carried out. | Chali | |
| Redaza | Unstable geology, high human activities carried within the proximity of streams, high presence of mass movement, numerous gullies present, high grazing pressure, high signs of forest degradation, poor farm roads, high pressure on NWFPs, presence degraded arable lands. | Monggar | |
| Chompa I | Unstable geology, high human activities carried within the proximity of streams, high pressure on NWFPs, less land management activities carried out, medium incidence of forest fire, low presence of wild animals. | Monggar | |
| Chompa II | Unstable geology, high human activities carried within the proximity of streams, high signs of forest degradation, heavy use of stream, high pressure on NWFPs, less land management activities carried out, low presence of wild animals. | Monggar | |
| Kamang | Low forest cover, unstable geology, short distance of human activities from the stream, presence of gullies, high signs of forest degradation, poor farm roads, poor irrigation channel, high pressure on NWFPs, presence of degraded arable lands, less land management activities carried out. | Monggar | |
| Yakpugang | Presence of gullies, heavy use of streams, poor farm roads, poor irrigation channel. | Monggar | |

| Degraded sub-watersheds | Degrading Factors | Geog | Dzongkhag |
|---|---|---|---|
| Manchhuri | Unstable geology, short distance of human activities from the stream, presence of gullies, heavy use of the stream, poor farm road condition. | Jurmey | |
| Tsangpori | Presence of gullies, high Presence of mass movements, poor farm roads, less land management activities carried out. | Jurmey | |
| Sengri | Low forest cover, short distance of human activities from the stream, heavy use of stream, high grazing pressure, high signs of forest degradation, high pressure on NWFPs, low presence of wild animals. | Jurmey | |
| Moitangri | Presence of gullies, high Presence of mass movements, heavy use of stream. | Kengkhar | |
| Sunkari | Unstable geology, high sediment yield, steep gradient of the stream, high signs of pressure on natural resources. | Kengkhar | |

### 4.1 Quantity and quality of Drinking water

Drying up of water sources and wetlands was one of the issue reported in all the identified degraded watersheds of the sub-basin. Zhunglentsho in Drepong and Yokhoitsho in Chali geog were reported to be drying up (Figure 10). During the field verification, it was observed that some of the water sources might have dried up because of developmental activities in the area (farm road cutting through the water source). The drying up of water sources has contributed to the shortage of drinking water for the communities in the sub-watersheds.

*Figure 10:Yokhoitsho in Chali geog and Zhunglentsho in Drepong geog*

In some of the identified degraded watersheds, poor infrastructures like lack of reservoirs or leakage in the distribution networks and too many tapping points (Figure 11) has further worsened the problem of water shortage. Around 8 reservoir tanks were found to be requiring maintenance in the Jurmey geog watershed. Furthermore settlements are located on the hill tops while the water sources or streams are located below. Some villages in Khenkhar and Jurmey geog, people still carry water for household use from the source below, which takes them about 5 hours. Increasing settlements due to rapid development have also increased water users, which have further increased the pressure on the water sources in the sub-basin. Rain water harvesting structures were in place, however, quality of the water is an issue after storing for longer time.

*Figure 11: One of the main drinking water source (Sengri at Jurmey geog) and multi tapping points at Redaza, Monggar*

Water quality was one of issue reported in the sub-basin. Erosion from the farm roads and dumping of excavated materials of the ongoing east west highway widening project (Monggar town to Korila top) have led to water source contamination. Additionally, the use of chemical fertilizers in the agriculture field, the labor camps (Figure 12) and free grazing cattle in sub-basin were other possible causes of water contamination in the sub-watersheds.

*Figure 12: Labor camps and waste in the watersheds*

### 4.2. Agricultural land degradation

The loss of agriculture productivity due to steep land terrain and traditional agricultural practices is the one of the major issue in the sub-basin. Steep terrain, high precipitation and inappropriate land-use practices have led to considerable erosion of agricultural land (Figure 13). Around 115 acres of land are required to be brought under land management activities to prevent further erosion. Sheet erosion have occurred on steep slopes and have ultimately led to rill erosion in places where water is channeled.


*Figure 13: Causes of land degradation: (A) Steep land terrain with settlements in the hill tops & (B) Farm road with high gradient (> 45$^{o}$) without proper drainage system (C) Freshly burnt area for shifting cultivation and (D) Free cattle grazing*.

Erosion caused by inappropriate handling of irrigation water discharged from paddy terraces was also observed to lead to rill and later to gully erosion in several locations of Gangzur and Chali geogs. Loss of paddy fields to flash floods near the streams was also observed in the Gangzur geog (Figure 14). About 200 meters of the river bank would require interventions immediately to prevent further loss in the Gangzur geog.

*Figure 14: Paddy field left uncultivated (bottom part) due to flash flood by Gangzurchhu, Lhuentse.*

Lack of proper irrigation facilities, poor water management and surface erosions have led to increase in the incidences of several fallow lands. For instance about 9.5 km of earthen irrigation channels needs to be concretized to prevent further water loss while about 15 km of the channel needs to be repaired. The use of chemical fertilizers such as urea and other insecticides/pesticides would also gradually deplete soil and land over the years.

### 4.3. Forest degradation

There are 4 FMUs and 27 CFs functional in the sub-basin (Annex 3). With particular to the selected degraded sub-watersheds, partly 2 FMUs and 13 CFs are falling within the sub-watersheds (Annex 4). The watershed assessment and classification reports the presence of high forest degradation in the watersheds (Table 4). Higher exploitation of forest resources and forest fires in the drier sites of the sub-basin are some of the causes reported during the consultation meetings. Increasing accessibility in the forest areas due to increasing farm roads might have further led to increasing resources extraction as reported by Tenzin and Hasenauer (2016) in a watershed in Dagana, Bhutan. With the increase of the population in the sub-basin, pressure on the forest resources in terms of timber and firewood is expected to increase constantly. More and more forests are expected to open up to meet the increasing demand of rural timber and firewood.

Regeneration status of the areas harvested following the single tree selection system is lacking at the moment. Regeneration both natural and artificial is important to ensure sustainability of the resources for future use. Several plantation have been created in the watershed by the divisional forest office and the erstwhile Dzongkhag Forestry Sector (now clubbed with Monggar Forest Division). However, most of the plantation were with poor survival category and some of the reasons for the poor survival were grazing, lower maintenance budget, lack of weeding etc.

The damage caused by the cattle is one of predisposing factor for degradation, although the intensity of the impact remains un-assessed. The MoAF through the Department of Livestock is promoting the policy to reduce local cattle population and support improved cattle through backyard farming. Inputs such as breeding bulls, AI facilities, pasture seed, veterinary services are provided to support the livestock development program in the country. It has observed that over the years, the local cattle population has reduced. However, there are still local cattle in the remote villages and main fodder resources are grazing in the forest/open areas nearby by the settlement (Figure 13). Trans-boundary cattle grazing inside the watersheds was a concern for the communities of the Monggar geog. Most of Themnangbi-Jaibab community practices stall feeding, however, free release of *tshethar* animals (scrub cattle & horse), permanent settlement of herders at watershed and temporary cattle

migration from the adjacent geogs (mostly from Chaskar and Nagtshang geog of Monggar) are the some of the causes of degradation. As per Tshogpa, there are 10 horses, 90 scrub cattle and three herds (permanent- 2 & semi-permanent- 1) with approximately 100 heads of cattle foraging in the watershed.

### 4.4. Landslides/erosions

Landslides and erosions as discussed briefly in the above sections was also one of the major issue reported and observed in the sub-basin. The landslides and erosions could be due to natural phenomenon such as unstable geology, steep slopes and steep stream gradients. However, certain landslides/erosions were exacerbated by land-use practices and infrastructure development such as poorly constructed farm roads, irrigation channels, drinking water supply and power transmission lines.

*Figure 15: Impact from the road widening on the streams*

Poor planned and constructed farm roads are reported as one of the cause of landslides and erosions in most of the watersheds across the country. For instance a study done by Waiba (2015) observed absence of drainage facilities such as side drains, culverts and fords leading to excessive runoff over the road surface rendering it unusable for vehicles during rainy season. Similarly in the sub-basin, around 150 km of farm roads are without proper drainage while about 90 km of farm road are in need of maintenance. Additionally about 100 acres of the road are exposed, requiring stabilization in the watersheds. The poor farm road without proper drainage and steep gradient increasing the frequencies of landslides and erosions was observed. For instance the lose materials dumped below the road from the highway widening has constantly blocked the farm road leading to one of the communities in the sub-basin (Figure 15).

Leakage from the traditional earthen irrigation channel (9.5 km) in the sub-basin leading to erosion and gully formation are common and also reported during the consultation meetings. Earthen channels are prone to leakage along their length and this water loss contributes to a reduction in water availability for irrigation. The

leakage from the water pipes and infrastructure (though minor) observed in certain areas of the sub-basin can also lead to erosion and gully formation in the long run.

## 5. The Plan

### 5.1. Plan formulation

Following the above mentioned consultations, 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 Ministry of Agriculture & Forests.

During the consultation and write-shops, the Logical Framework Analysis (LFA) Matrix was developed, building from the issues and problems (the degrading influences) identified during the various stages of the planning process. This led to the construction of a problem tree with causes and effects of the issues/problems, which in turn led to the construction of an objective tree, with outputs, objectives and a goal (Figure 16). A "filter" was applied to ensure that only those issues/problems that contribute directly to the purpose of removing or mitigating degrading influences were addressed in the plan.

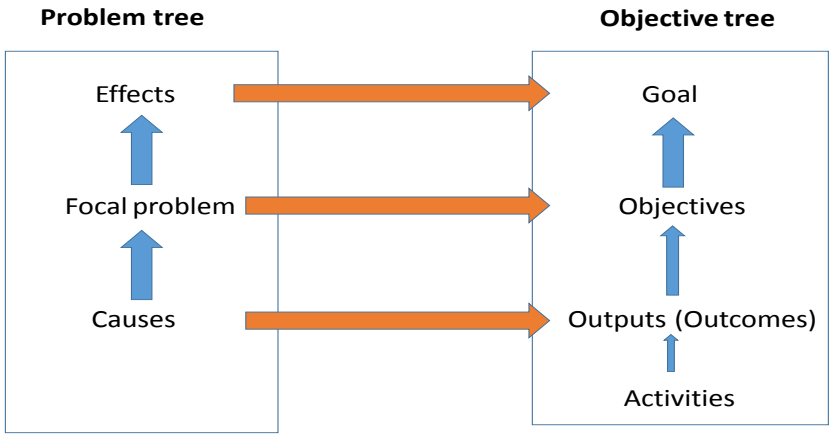


*Figure 16: Problem tree and objective tree used to convert issues/problems identified during the planning process into an intervention strategy to mitigate the degrading influences.*

### 5.2. Goal and objectives

The goal and objectives for managing the Kurichhu sub-basin was framed after series of consultation meetings with the relevant stakeholders. The basic purpose of

the plan is to identify and implement interventions that can mitigate the effect of degrading influences and return the watersheds to normal or pristine condition (to the greatest extent possible).

The overall goal for managing the Kurichhu sub-basin is:
*Kurichhu sub-basin managed to minimize the degrading influences and yield high quality water for local livelihood and downstream users in the context of climate change.*

The objectives set to attain the goal are:
**Objective 1**. To manage the watershed to enhance quality and quantity of water in conformity with existing environmental guidelines (FNCR 2017, Bhutan Drinking Water Quality Standards 2016)

**Objective 2**. To manage farm roads, irrigation water, forest and agriculture land to minimize erosion in conformity with existing environmental guidelines (EFRC, National Irrigation Master Plan 2016, FNCR 2017 and Land management guideline).

### 5.3. Outputs and description of activities

A total of 9 outputs followed by set of activities are proposed towards achieving the goal and objectives of this plan (Table 5). The outputs and activities along with verifiable indicators, an indicative budget, relevant local area-based plan where the activities can occur and the person/official responsible for ensuring the implementation takes place are detailed in the Table 5:

Table 5: Kurichhu sub-basin management plan: Table of outputs, activities and budget-Logical Framework Matrix

**Goal:** Kurichhu sub-basin sustainably managed to minimize degrading influences and yield high quality water for local livelihood and downstream users in the context of Climate Change

| **Outputs/Activities/Sub-activities** | **Verifiable indicators** | **Lead /Collaborating agency** | **Location/name of streams** | **Local area based plan** | **Budget (M Nu)** |
|---|---|---|---|---|---|
| ***Objective 1.*** To manage farm roads, irrigation water, forest and agriculture land to minimize erosion in conformity with existing environmental guidelines (EFRC, National Irrigation Master Plan 2016, FNCR 2016 and Agriculture Land Development Guidelines (ALDG)-2017 | | | | | |
| **Output 1: Degraded forest area restored and degrading influences minimized** | | | | | |
| **Activity 1.1 Improve forest management in the watersheds** | | | | | |
| **Sub-activities:**<br>1.1.1 Create plantation in degraded area in degraded SRF **... 129.5 acres** (@ Nu. 42240/acre) | Area under plantation | TD/Range Office, Geogadm, GBCL, WCNP | Monggar geog-**12.5**, Drepong geog-**25**, Chali geog-**10**, Kengkhar geog-**10**, Jurmey geog-**12**, Saling geog-**10**, Ganzur goeg-**12**, Maenbi goeg-**25**. | Annual plan / FYP of TD | 5.470 |
| 1.1.2 Maintain plantation created above **... 104.5 acres** (@ Nu. 24000/acre) | Area under plantation | TD/Range Office, Geogadm, GBCL, WCNP | Monggar geog-**12.5**, Drepong geog-**25**, Chali geog-**10**, Kengkhar geog-**10**, Jurmey geog-**12**, Saling geog-**10**, Gangzur geog-**25.** | annual plan / FYP TD | 2.508 |
| 1.1.3 Maintain existing plantation and natural regeneration **... 38 acres** (@ 24000/acre) | Area under plantation | TD, Geogadm, GBCL | Monggar geog-**10,**Chali geog-**5**, Saling geog-**5**, Gangzur geog **(**Merculing&DenkalingReneysa CF)-**6**, Maenbi geog-**12,** (below Takila). | TD, annual plan / FYP | 0.912 |

| Outputs/Activities/Sub-activities | Verifiable indicators | Lead /Collaborating agency | Location/name of streams | Local area based plan | Budget (M Nu) |
|---|---|---|---|---|---|
| 1.1.4 Provide training on silviculture | Number of trainings | FMU,TD/Range Office, GeogAdm | Monggar, Drepong, Saling, Chali, Kengkhar, Jurmey geogs. Maenbi geog | TD, annual plan / FYP | 2.000 |
| 1.1.5 Implement pilot scheme to encourage natural regeneration of degraded sites (involving local communities) ... **2 pilot sites** | Reports | TD/ UWICER, WMD, SFED, Geog Adm. | Drepong geog, | TD annual plan | 0.400 |
| 1.1.6 Create awareness program on importance of watershed and FNCR to communities and field staff | Number of Awareness on FNCR | FMU,TD/Range Office,Geog Adm., WCNP | Monggar, Drepong, Saling, Chali, Kengkhar, &Jurmey geogs, Gangzur geog | TD, annual plan / FYP | 1.000 |
| **Activity 1.2 Strengthen forest fire management** | | | | | |
| **Sub-Activities:**<br>1.2.1 Supply of forest fire equipment | Number of equipment | TD/Range Offices, GeogAdm, Community | Drepong geog-Water Bag-**10** nos, Helmets-**70** nos, Goggles -**70** nos, Hand gloves-**100**nos, Mouth Masks-**100**nos, Spade-**10**nos and Fire rack-**15**nos).<br>Gangzur geog- Waterbag-**10**, Helmets-**10**, fire rack -**10**, spade-**10**, goggles- **10**, handgloves-**10**, mask-**10**. Maenbi geog (water bag-**25**, helmet-**25**, spade-**25**, goggles**25**, hand gloves-**25**, mask-**25**) | TD annual plan / FYP | 0.450 |

| Outputs/Activities/Sub-activities | Verifiable indicators | Lead /Collaborating agency | Location/name of streams | Local area based plan | Budget (M Nu) |
|---|---|---|---|---|---|
| 1.2.2 Create awareness on forest fire management in fire season (@ Nu. 0.050/campaign) | Number of Awareness created on forest fire | TD/Range Offices, GeogAdm, WCNP | Drepong geog-**5**, Gangzur geog-**5**, Maenbi geog-**5.** | TD annual plan /FYP | 0.750 |
| 1.2.3 Advertisement on forest fire in Gyelpozhing through local broadcasting channel yearly during fire season | Frequency of awareness | TD /Range Office, GeogAdm and Gyelpozhing Municipal. | Drepong geog (Gyelpozhing), | TD annual plan/Geog FYP | 0.050 |
| 1.2.4 Gyelpozhing forest fire management plan review **... 4 times** | Management plan | TD/Range Office ,GeogAdm and Gyelpozhing Municipal | Drepong geog (Gyelpozhing), | TD annual plan/Geog FYP | 0.100 |
| **Activity 1.3 Strengthen waste management in the watersheds** | | | | | |
| 1.3.1 Construction of garbage pit and signage in order to maintain sanitation in and around catchment area **... 10 nos** | Number of garbage pits and signage | TD/Range Office,GeogAdm, Dz. Env. Officer | Monggar geog (Chompa) | TD, annual plan / FYP | 0.050 |
| **Output 2: Reduction in number of free grazing cattle in the watersheds** | | | | | |

| Outputs/Activities/Sub-activities | Verifiable indicators | Lead /Collaborating agency | Location/name of streams | Local area based plan | Budget (M Nu) |
|---|---|---|---|---|---|
| **Activity 2.1 Provide support to livestock sectors in breeding Programme** | | | | | |
| **Sub-Activities:**<br>2.1.1 Supply necessary equipment for breeding program | Number of AI, breeding bulls, no. of progeny | GLEO, DLO/ DVH, DoL (NDDC), GeogAdm | Monggar geog (Redaza,Yakpogang): AI crate/Trevis**... 2 nos** (@ Nu. 0.040), Universal AI gun **... 4 nos** (@ 7000), Mobility (Bike) ... **2 nos** @ Nu 0.150million/bike, Portable can ... **4 nos**@ Nu 0.017, Imported semen ... **600 doses**@ 500, Gloves, Sheath, Field gear ... **20 nos** each | Geog. annual Plan / FYP | 1.0 |
| 2.1.2 Provided AI center with full basic equipment ... **2 sites** @ 0.4million/AI | Number of progenies | -do- | Kengkhar geog-**1**,<br>Jurmey geog-**1**. | | 0.800 |
| 2.1.3 Provide improved breeding bulls ... **11 Jersey bulls** @ Nu. 20,000/bull | Number of progenies | -do- | Drepong geog-**4** (Laptsa, Zhunglen),<br>Saling goeg-**1**, Kengkhar geog-**2**, Jurmey geog-**2**, Maenbi geog-**2**. | | 0.220 |
| 2.1.4 Create awareness on mass sterilization of scrub bulls ... **10 chiwogs** @ Nu. 60,000/chiwog | Number of Awareness created & scrub bulla sterilized | -do- | Drepong geog-**5**, Saling geog-**1**, Maenbi geog-**4**. | | 0.600 |
| 2.1.5 Capacity building for CAIT in NDDC, Yusipang**... 2 times** (@ Nu. 0.050) | Number of trainings | -do- | Monggar geog (Redaza,Yakpogang) | | 0.100 |
| **Activity 2.2 Carry out pasture development and fodder tree plantation** | | | | | |

| Outputs/Activities/Sub-activities | Verifiable indicators | Lead /Collaborating agency | Location/name of streams | Local area based plan | Budget (M Nu) |
|---|---|---|---|---|---|
| **Sub-Activities:**<br>2.2.1 Temperate grasses mixture **... 90 acres** (@ Nu 2500 for seed and fertilizer/acre). | Area under temperate grasses mixture | GLEO/ DLO, NCAN, WCNP &GeogAdm | Monggar geog-**20** (Redaza and Yakpugang) Drepong geog-**15**, Kengkhar geog-**25**, Jurmey geog-**20**, Maenbi geog-**5**, Gangzur geog-**5.** | Geog annual Plan / FYP | 0.225 |
| 2.2.3 Subtropical pasture mixture **... 90 acres** ( @ Nu 3000/Acre for seed and fertilizer) | Area under subtropical pasture mixture | -do- | Chaligeog -**5** (Degraded watershed area), Saling geog-**5**, Kengkhar geog-**25**, Jurmeygeo-**40**, Maenbi geog-**10**, Gangzur geog-**5.** | | 0.270 |
| 2.2.4 Fodder tree seedlings **... 23,000 seedlings** ( @ Nu 15 per seedling) | Number of fodder tree seedlings planted | -do- | Monggar geog-**5000** Drepong geog-**5000** Chali geog-**500**, Saling geog-**2000,** Kengkhar geog-**2000**, Jurmey geog-**2500**, Maenbi goeg-**1000**, Gangzur geog-**5000.** | | 0.345 |
| 2.2.5 Barbed wire **... 6500 kg** (@ 80 per kg) for fencing improved pasture areas. | Area of pasture fenced | -do- | Monggar geog-**3000**, Maenbi geog-**1500**, Gangzur geog-**2000.** | | 0.520 |
| 2.2.6 Chaff's cutter ... **15 nos** (@ 0.005/piece). | Number of Chaff's cutter | -do- | Monggar geog-**10**, Gangzur geog-**5**. | | 0.750 |
| 2.2.7 Winter fodder development ... **65 acres** (@ 2000/acre for oat & legume seed). | Area under winter fodder/Quantity of winter fodder | -do- | Monggar geog-**30**, Drepong geog-**20**, Chali geog-**10**, Gangzur geog-**5**. | | 0.130 |

| Outputs/Activities/Sub-activities | Verifiable indicators | Lead /Collaborating agency | Location/name of streams | Local area based plan | Budget (M Nu) |
|---|---|---|---|---|---|
| 2.2.8 Napier & other fodder slips supply... **25,000 slips**(@ Nu 7/slip) | Area under Napier and other fodder slips | -do- | Monggar geog-**15000**, Saling geog-**10000.** | | 0.175 |
| **Activity 2.3 Promote biogas and diary shed management in the watersheds** | | | | | |
| **Sub-Activities:**<br>2.3.1 Construction of bio digester plant (Bio gas-6000m$^3$) on cost sharing basis ... **130 plants** (@ Nu. 050 /plant). | Number of biogas plants | GLEO/ GeogAdm, DoL, TD | Monggar geog-**20,**Drepong geog-**25**, Chali geog-**10**, Saling geog-**10**, Gangzur geog-**25,**Maenbi geog-**20**, Kengkhar geog-**10**, Jurmey geog-**10**. | Geog annual plan | 6.500 |
| 2.3.2 Supply of dairy shed construction materials inclusive of Silo pit on cost sharing ... **215 sheds** (Cement, Nails and CGI sheet - @ Nu 0.100million/shed) | Number of dairy sheds constructed | GLEO/ GeogAdm, DoL, TD | Monggar geog-**20**, Jurmey geog-**50**, Kengkhar geog-**20**, Gangzur geog-**25**, Maenbi geog-**100**. | Geog annual plan | 2.150 |
| 2.3.3 Implement pilot scheme on installation of biogas plant for high altitude ... **10 households** (including heating system). | Number of households | GLEO/ GeogAdm, DoL, TD | Drepong geog (Laptsa and Zunglen) | Geog annual plan | 0.350 |
| **Output 3: Farm road drainage improved and exposed soil stabilized** | | | | | |
| **Activity 3.1 Improve farm road management in the watershed** | | | | | |

| Outputs/Activities/Sub-activities | Verifiable indicators | Lead /Collaborating agency | Location/name of streams | Local area based plan | Budget (M Nu) |
|---|---|---|---|---|---|
| **Sub-Activities:**<br>3.1.1 Construct farm road drainage system **... 148.5 KM** (@ Nu 0.05 million/km) | Length of farm road drainage system | GAEO/ GAdm, DAO, GeogAdm, WCNP, Dz Engineer | Monggar geog-**32**, Drepong geog-**15**, Chali geog-**20**, Kengkhar geog-**15**, Jurmey geog-**26**, Saling geog-**22**, Gangzur geog-**12**, Maenbi geog-**6.5** | Geog. annual Plan / FYP | 74.250 |
| 3.1.2 Maintain existing farm road drainage**... 91 KM** (@ Nu 0.350million/km) | Length of drainage | GeogAdm, GAEO/ DAO, Dz. Engineer, DzEvn. Officer, WCNP | Monggar geog-**12**, Drepong geog-**15**,Chali geog-**5**, Kengkhar geog-**8**, Jurmey geog-**15**,Saling geog-**22**, Gangzur geog-**5**, Maenbi geog-**9** | Geog. annual Plan / FYP | 31.850 |
| 3.1.3 Form Farm road User group **... 22 groups** (@ Nu 50,000/group) | Number of farm road user group | GAEO/ GeogAdm, DAO, DzEvn. Officer,WCNP | Monggar geog-**5**, Drepong geog-**5**, Chal geog-**1**, Kengkhar geog-**1**, Jurmey geog-**2**, Saling geog-**2**, Gangzur geog-**1**, Maenbi geog-**5** | Geog. annual Plan / FYP | 1.100 |
| **Activity 3.2 Carry out bio-engineering activities for stabilizing exposed farm roads in the watershed** | | | | | |
| 3.2.1 Avenue plantation, transplant grass slips, check dams... **85 acres, 19000 trees (@**Nu 3000/acres and avenue plantation Nu 12/seedling) | Area under bioengineering works | TD/ GAEO, GeogAdm, Dz. Evn. Officer, Dz. Engineer, GAEO, GLEO, WCNP | Monggar geog-**50&2000**, Drepong geog-**5&5000,**Chali geog-**5&1000**, Kengkhar geog-**5&3000**, Jurmey geog-**5&3000**, Saling geog-**5&3000**, Gangzur geog-**5&3000**, Maenbi geog-**5&2000** | Geog. annual Plan / FYP | 0.583 |
| **Output 4: Agriculture land brought under sustainable land management** | | | | | |
| **Activity 4.1 Carry out land management activities in conformity with SALT** | | | | | |

| Outputs/Activities/Sub-activities | Verifiable indicators | Lead /Collaborating agency | Location/name of streams | Local area based plan | Budget (M Nu) |
|---|---|---|---|---|---|
| **Sub-Activities:**<br>4.1.1 Stabilize water outlets from paddy fields by bio-engineering activities. | Area under land management activities | TD/ GAEO, GeogAdm, Dz. Engineer,DAO, GAEO, GLEO | Chali geog (**20** stone check dams &**15** wood log check**, 5** outlets, gabion wall construction, alignment of concrete drains to drain outlet the spillover and excessive water during season -**1km**)), Maenbi geog ... **5 nos**(Check dams and outlets). | Geog. annual Plan | 12.10 |
| 4.1.2 Land management activities for dry land agriculture (Structural and vegetative measures) **... 106 acres** (@ Nu. 0.011/acres) | Area under land management activities | GAEO/DAO, GeogAdm, ARDC | Monggar geog-**20**, Chali geog-**10**, Drepong geog-**40**, Kengkhar geog-**10**, Jurmey geog-**20**, Gangzur geog-**5**, Maenbi geog-**1**. | Geog annual Plan / FYP | 1.166 |
| 4.1.3 Support horticulture plantation in the degraded lands (assorted Fruit trees) ... **9acres** (108tress/acre x Nu.150**)** | Area brought under horticulture | GAEO/DAO, GeogAdm, ARDC, WCNP | Monggar geog-**5**, Chali geog-**1**, Drepong geog-**2**, Gangzur geog-**1**. | Geog annual Plan / FYP | 0.146 |
| 4.1.4 Training on SLM **... 2 times** | Number of Awareness | -do- | Monggar geog-**once**, Gangzurgeog-**once**, | | 0.200 |
| **Activity 4.2 Carry out options for protecting paddy fields from flash floods** | | | | | |
| **Sub-Activities:**<br>4.2.1 River bank protection to prevent loss of paddy field by flash flood ... **170 meters** long and 3 m tall gabion wall | Length of the river bank/Area of paddy field protected | Dzo Engineer, GAEO, DAO, WCNP,Geogadm. WMD, | Gangzur geog | Geog Annual Plan | 4.500 |

| Outputs/Activities/Sub-activities | Verifiable indicators | Lead /Collaborating agency | Location/name of streams | Local area based plan | Budget (M Nu) |
|---|---|---|---|---|---|
| 4.2.2 Plantation of native trees/bamboo along river bank protection wall **... 3 acres** | Area under plantation | GeogAdm, TD,WCPN, | Gangzur geog | Geog Annual Plan | 0.127 |
| ***Objective 2.*** To manage watershed to enhance quality and quantity of water in conformity with existing environmental guidelines (FNCR 2016, Bhutan Drinking Water Quality Standards 2016 | | | | | |
| **Output 5: Knowledge on water sources drying up and chemical pollution of drinking water enhanced** | | | | | |
| **Activity 5.1 Carry out study on water sources drying up and chemical pollution in the watershed** | | | | | |
| **Sub-Activities:** 5.1.1 Carry out study on spring water sources drying ... **Each Geog (1)** | Reports | WMD/ UWICER, TD , WCNP | Monggar geog-**1**, Drepong geog-**1**(Domphari), Chali geog-**1**, Kengkhar geog-**1**, Jurmey geog-**1**, Saling geog-**1**, Gangzur geog-**1**. | WMD annual plan / FYP | 1.400 |
| 5.1.2 Carry out study on drying of wetland (lakes) | Reports | WMD, TD,Geog Adm., DzEnv. O, UWICER | Drepong geog (Zhunglentsho),Chali geog(YokhoiTsho), | WMD annual plan / FYP | 0.500 |
| 5.1.3 Carry out study on chemical pollution of drinking water **(@Nu. 0.150/site)** | Reports | WMD, NSSC, MonggarTD,Geog Adm., DzEnv. O, | Monggar geog, Drepong geog (Dotheri), Chaligeog, Gangzur geog | WMD annual plan / FYP | 0.600 |
| **Activity 5.2 Carry out awareness on water use and management in the watershed** | | | | | |

| Outputs/Activities/Sub-activities | Verifiable indicators | Lead /Collaborating agency | Location/name of streams | Local area based plan | Budget (M Nu) |
|---|---|---|---|---|---|
| **Sub-Activities:**<br>5.2.1 Awareness on proper water use management ... **90 households** | Number of Awareness on proper water use | TD,Geog Adm., DzEnv. O,GAEO,DAO, DHSO | Chali geog | Geog annual plan | 0.100 |
| 5.2.2 Awareness on management and use of chemicals in watershed area. | Report | WCNP, DzoEnv. Officer, GeogAdm, DAO/GAEO, GLEO | Gangzur geog (Jang,Ngar, Denkaling) | Geog annual plan | 0.150 |
| **Output 6: Proper infrastructure for supply of drinking irrigation water in place** | | | | | |
| **Activity 6.1 Construct and maintain reservoir tanks for improving water storage and supply** | | | | | |
| **Sub-Activities:**<br>6.1.1 Construction of reservoir tanks for winter crops ... **5 nos** | Number of reservoir tanks/ Area irrigated by the reservoir tank | DAO/GAEO,GeogAdm, GLEO | Gangzur geog-**5**, | Geog annual plan | 0.800 |
| 6.1.2 Construct reservoir tanks **... 8 nos**(@ Nu 1 million/tank) | Number of reservoir tanks/Number of households benefitted | GeogAdm, Dz. Engineer, Monggar Municipal, WCNP | Monggar geog-**1**(Redaza), Kengkhar-**1**, Jurmey-**2**, Saling geog-**3** (1reservoir &2BP tank), Gangzur geog-**1**, | Geog Annual Plan / FYP | 8.000 |

| Outputs/Activities/Sub-activities | Verifiable indicators | Lead /Collaborating agency | Location/name of streams | Local area based plan | Budget (M Nu) |
|---|---|---|---|---|---|
| 6.1.3 Repair reservoir tanks **... 8 tanks** | Number of reservoir tanks | GeogAdm, Dz. Engineer, DHSO (RWSS) | Jurmey geog-**8** | Geog Annual Plan / FYP | 0.400 |
| 6.1.4 Shift the municipal water intake points upwards of Lekpagangchhu ..**2km** (present intake point below Jang village & contamination from farming communities) | New tapping points | GeogAdm,Dz. Engineer, Municipal, WCNP, | Gangzurgeog (Lekpagangchhu)-**2**. | Geog Annual Plan | 0.800 |
| 6.1.5 Form water user group ... **7 groups** | Number of Water user group formed | GeogAdm, DHSO (RWSS), GAEO, GLEO | Jurmey geog-**2**,Kengkhar geog-**2**, Saling geog-**1**, Maenbi geog-**2** | Geog Annual Plan | 0.350 |
| **Activity 6.2 Implement rain water harvesting technologies in the watershed** | | | | | |
| **Sub-Activities:** 6.2.1 Construct rain water harvesting reservoir tank (earthen) ... **2 nos** | Rain water harvesting reservoir in place/Number of households benefitted | GeogAdm,TD, DAO/GAEO | Drepong geog (Laptse&Zhunglen), | Geog Annual Plan | 2.000 |
| 6.2.2 Rain water harvesting technology ... **410 hh** | Number of households with | GeogAdm, DHSO | Jurmey geog-**210**, Kengkhar geog-**200** | Geog Annual | 2.000 |

| Outputs/Activities/Sub-activities | Verifiable indicators | Lead /Collaborating agency | Location/name of streams | Local area based plan | Budget (M Nu) |
|---|---|---|---|---|---|
| | rain water harvesting technology | (RWSS), NGOs | | Plan | |
| **Activity 6.3 Improve the existing irrigation channels** | | | | | |
| **Sub-Activities:**<br>6.3.1 Construct concrete channels in place of earthen channels ... **9.5 km** (@Nu 1.5million/km) | Length of irrigation channel | Geog, Adm,GAEO, Dz. Eng., DAO, WCNP | Drepong geog-**1.5**, Chali geog-**3**, Gangzur geog-**3**(Jang), Maenbi geog-**2.** | Geog Annual Plan / | 14.250 |
| 6.3.2 Maintain existing irrigation channels ... **15 km** (@ Nu 0.5million/km) | Length of irrigation channel | GeogAdm,GAEO/Dz.Engineer, WCNP | Chali geog-**2**, Gangzur geog-**4**, Maenbi geog-**9**. | Geog Annual Plan / FYP | 7.500 |
| 6.3.3 Construct intake tank for irrigation | Irrigation intake tank in place | GeogAdm, GAEO, Dz. Eng., DAO | Drepong geog-**1**(Oakang), | Geog Annual Plan | 0.500 |
| 6.3.4 Supply of HDPE pipes, environmental friendly construction of irrigation channel in place of earthen channel... **5km** | Length of HDPE pipes/ Area irrigated | GeogAdm,GAEO, Dz. Eng., DAO, WCNP | Gangzur geog (Jang, Denkaling) | Geog Annual Plan | 3.000 |
| **Total Budget** | | | | | **Nu.197.255** |

# 6. Implementation strategies and mechanisms

## 6.1 Implementation strategy

This plan for the Kurichhu sub-basin will be implemented from the July 2018-June 2022 (12FYP). As such the activities proposed in the plan should be mainstreamed in to the FYP and annuasl work plan of the relevant stakeholders. It should be implemented in a manner that is consistent with other natural resource and water related policies. The operational and organizational framework involving relevant institutions and agencies to implement the plan is shown in Figure 17.

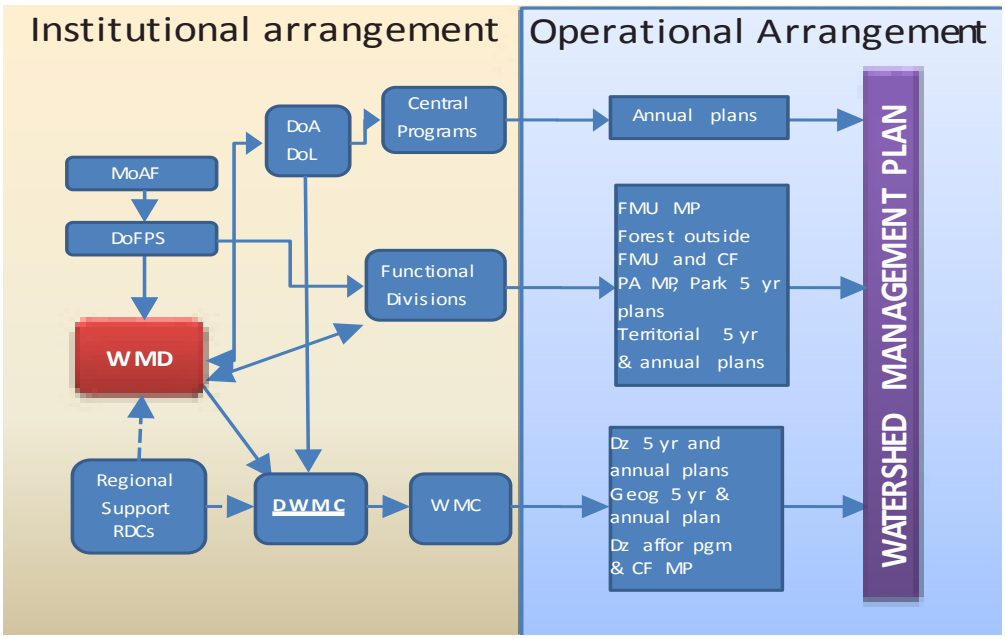


*Figure 17: Implementation arrangement framework (Tsering, 2011)*

To ensure effective implementation of the plan, it is also imperative to operationalize watershed management committees at various government levels. Key stakeholders include the relevant Watershed Management Committees (WMC) and Dzongkhag Water Management Committees (DWMC), as well as the River Basin Management Committees (RBMC). At the Dzongkhag level, the DWMC will be established as per Water Regulation of Bhutan (National Environment Commission, 2014) and will facilitate the implementation of this plan. Similarly, at the watershed level, the WMC will be instituted to coordinate the implementation of this plan. This committee will be consulted for various activities within the watershed. Table 6 proposes ToR for the various committees and institutional partners and Annex 3 outlines the responsibilities of different agencies.

Coordination between different line agencies at the Dzongkhag and geog levels will be critical to ensure overall implementation of this plan. In particular, the central agencies under MoAF such as the Territorial Divisions, Parks, RDCs, and RLDCs inter alia will be involved to ensure that the planning and implementation of watershed activities are harmonized with other land uses within the watershed.
In view of area-based planning, the geog level plan becomes the major vehicle for bringing together the different interests of the various sectors (including livestock, agriculture, forestry and others) irrespective of land ownership. The Dzongkhag watershed management committee (DWMC) will ensure coordination and integration between geogs.

Table 6:Terms of reference for committees

| Committee | Members | Roles and responsibilities |
|---|---|---|
| **Watershed Management Committee (WMC)** | Gups, GAOs GAEOs, GLEOs, GFEOs, tshogpas, school principals, CF chairpersons, WUA representatives | 1. Plan and implement watershed management related activities in the Geog.<br>2. Mediate conflicts in implementation of WM plans and activities.<br>3. Ensure reporting of watershed activities of WMD through DzWMC. |
| **Dzongkhag Water Management Committee (DWMC)** | Dzongda, DzFO, DAO, DLO, DzEdu.O, DE, DzEnvi.O, LRO, DPO, CFO, BPC, DoR, WMD | 1. Identify, plan, and implement watershed management activities involving more than one geog<br>2. Administer linkages with the WMD and the RBMC<br>3. Integrate and synchronize watershed related activities into annual geog plans<br>4. Mediate conflicts in implementation of WM plans/activities<br>5. Ensure reporting of watershed activities annually to WMD |

| | | |
|---|---|---|
| **WMD** | | 1. Facilitate periodic watershed and dzongkhag level committee meetings<br>2. Coordinate with relevant agencies and ensure that prioritized watershed activities are integrated into sectoral plans<br>3. Discharge any entrusted tasks related to ToR of the committees from time to time<br>4. Facilitate the provision of technical backstopping on watershed planning and management |

### 6.2 Funding

Implementation of planned watershed activities will be funded from the regular government budget. However, in case this is insufficient or unavailable, the management plan can be used as a basis to solicit funds from hydro-power projects or other donors. As the coordinating agency, the WMD 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.

As for the two degraded sub-watersheds (Lekpachhu/Lekgangchhu and Gangzurchhu) under Gangzur geog, Lhuentse, most of the fund for implementation of identified activities will be supported by WWF Bhutan as a part of their project on Integrated Watershed Management at Nikachhu and Kurichhu sub-basins. The project is focused in the western and eastern park range of Wangchuck Centennial National Park (WCNP).

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 hydropower plants 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.

### 6.3 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 various 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 given in the log frame matrix in Table 6 will assist in the monitoring task.
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.

### 6.4 Revision and amendment of plan

The mandate to revise and amend this plan rests with the WMD. The final impact evaluation will be the basis for revising the plan in the next planning cycle.

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## 8. Annex

### 8.1. Protected areas in the sub-basin

| Sl. No. | Protected Area | Dzongkhag | Geog | Area (Ha) |
|---|---|---|---|---|
| 1 | Wangchuck Centennial National Park | Lhuentse | Kurtoe, Gangzor | 58,453.0 |
| 2 | Bomdeling Wildlife Sanctuary | Lhuentse | Khoma, Minji, | 56,369.0 |
| 3 | Phrumsengla National Park | Lhuentse | Gangzor, Metsho, Jaray | 53,285.0 |
| | Phrumsengla National Park | Monggar | Tsamang, Saleng | |
| 4 | Biological Corridor | Lhuentse | Kurtoe, Gangzor, Menji,Tsenkhar, Jaray | 80,014.0 |
| | Biological Corridor | Monggar | Tsamang | |
| | **Total Area (Ha)** | | | **248,121.0** |

### 8.2. FMUs and CFs in the Kurichhu sub-basin

| Sl.No. | Management areas | Dzongkhag | Geog | Area (Ha) | Watershed ID |
|---|---|---|---|---|---|
| **1** | Lingmethang FMU | Monggar | Saleng | 10,567.67 | 96 & 126 |
| **2** | Rongmanchu FMU | Lhuentse | Minji &Tsenkhar | 6,396.99 | 55 & 66 |
| **3** | Korilla | Monggar | Monggar&Chhali | 4,241.64 | 95 |
| | **Total Area (Ha)** | | | **21206.3** | |

| SI.No | Name of CF | Dzongkhag | Area of CF(Ha) | Watershed ID |
|---|---|---|---|---|
| 1 | NgarPangkurpzur CF | Lhuentse | 47.41 | 40 |
| 2 | Makong CF | | 41.45 | |
| 3 | TonglingKuenphen CF | | 36.57 | |
| 4 | Merculing | | 58.77 | |
| 5 | ZhungkharYongchab CF 1 | | 114.07 | |
| 6 | TabugYargay | | 51.46 | |
| 7 | ZhungkharYongchab CF 2 | | 71.13 | |
| 8 | Zhasela CF | | 61.83 | 55 |
| 9 | Lhapang | | 40.79 | |
| 10 | Jalang CF | | 71.44 | |
| 11 | TshokpelthangLhapang CF | | 4.60 | |
| 12 | Lekcha CF | | 17.10 | 41 |
| 13 | Sisinyelsa CF | | 38.90 | 95 |
| 14 | Chalibadeb CF | | 24.27 | 95&66 |
| 15 | Nganey | | 42.24 | 65 |
| 16 | Gakid | | 56.62 | |
| 17 | Tongthrom CF | | 28.31 | 54 |
| 18 | Masangdaza | Monggar | 90.63 | 96 |
| 19 | Wamakhar | | 123.18 | 95 |
| 20 | Yakpugang | | 503.70 | |
| 21 | Sankama | | 101.77 | 126 |
| 22 | TonglaPhuensumDomangla Block | | 34.87 | |

| | | | | |
|---|---|---|---|---|
| 23 | DungkarGakeyUdari | Monggar | 77.12 | |
| 24 | TonglaPuensumJalukharshu Block | | 55.54 | |
| 25 | TonglaPuensumChangshingzor B | | 5.76 | |
| 26 | DungkarGakeyZetsibe | | 25.56 | |
| 27 | Phajong | | 7.90 | |
| | **Total Area (Ha)** | | **1832.99** | |

### 8.3. FMUs and CFs in the degraded watersheds of the sub-basin

| Sl.No. | Management areas | Dzongkhag | Geog | Area (Ha) | Watershed ID |
|---|---|---|---|---|---|
| 1 | Lingmethang FMU | Monggar | Saleng | 3098.86 | 96 & 126 |
| 3 | Korilla | Monggar | Monggar & Chhali | 4210.99 | 95 |
| | **Total Area (Ha)** | | | **7309.85** | |

| Sl. No | Name of CF | Dzongkhag | Area of CF(Ha) | Sub-watershed | Watershed ID |
|---|---|---|---|---|---|
| | Ngar Pangkurpzur | Lhuentse | 47.41 | Legpagang & Gangzurchhu | |
| | Merculing | | 58.77 | | |
| | Zhungkhar Yongchab CF 1 | | 114.07 | Baegangchhu | 55 |
| | Tabug Yargay | | 51.46 | | |
| | Zhungkhar Yongchab CF 2 | | 71.13 | | |
| | Tshokpelthang Lhapang CF | | 4.6 | | |
| | Masangdaza | Monggar | 90.63 | Tongpalunpa,_Laebari,_Chubar &Wrongri | 96 |
| | Yakpugang | | 503.70 | ChompaI& II Yakpogang Kamang Redaza Wangrongmachhu | 95 |
| | Wamakhar | | 123.18 | | |
| | Sankama | | 101.77 | Sunkari Moitangri Manchuri Tsangpori | 126 |
| | Tongla Phuensum Domangla Block | | 34.87 | | |
| | Dungkar Gakey Udari | | 77.12 | | |
| | Tongla Puensum Jalukharshu Block | | 55.54 | | |
| | Tongla Puensum Changshingzor B | | 5.76 | | |
| | Dungkar Gakey Zetsibe | | 25.56 | | |
| | Total Area (Ha) | | **1365.57** | | |

### 8.4. Stakeholders

| Sl | Main Stakeholder | Roles & responsibilities |
|---|---|---|
| 1 | GT of the respective Geogs | • Preparation of annual work plan based on WSM plan<br>• Implementation of the plan<br>• Monitoring & evaluation |
| 2 | Geog RNR sectors | • Support in preparation of the annual work plan WSM plan<br>• Support & implement WSM plan<br>• Report WSM activities to Dzongkhag RNR Sector Heads |
| 3 | Divisional Forest Office, Monggar | • Regulate access to natural resources in critical watersheds<br>• Assist in establishing private & community forests<br>• Assist in managing the natural grazing land<br>• Assist in riparian protection of the streams |
| 4 | Monggar Dzongkhag RNR Sectors | • Support the GT in preparation of the WSM plan<br>• Support in implementation of the WSM plan<br>• Mobilize funds & other assistances for the WSM plan<br>• Monitoring & evaluation of the overall plan by the Dzongkhag WSM Committee<br>• Report WSM activities to WMD |
| 5 | WMD | • Conduct awareness programs on the importance of WSM<br>• Support in preparation of WSM Plan<br>• Mobilize funds to implement the WSM plan<br>• Investigate possibilities to initiate PES programs<br>• Monitoring & Evaluation<br>• Provide overall guidance |
| 6 | Kurichhu HP | • Provide fund for implementing WSM plans |
| 7 | Communities | • Cooperate with GT in conserving the watersheds |

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