# Contents

# List of Figures



# List of Tables

# Chapter 1 : Introduction and Background

The Water Act of Bhutan, 2011 and the Water Regulation of Bhutan, 2014 both take into account the reality of increasing threats on the quality and quantity of water resources under rapid socio-economic development and the need for stakeholders' coordination in managing Bhutan's water resources. The need to understand the availability of water resources and their changes is imperative for any valid decision making. In theory, Bhutan has abundant water resources, with the highest per capita water availability of 94,500 $m^3$ but the imbalance in terms of spatial and temporal distributions is leading to shortages in local areas.

The major challenges and threats the country faces presently on its water resources are due to unpredictable climate, drying up of water sources, increasing population and urbanization, accelerated glacier melting, accessibility and management issues and stakeholder participation or multi-sectorial coordination issues. According to the National Integrated Water Resources Management Plan (NIWRMP), 2016, developed by NECS with technical assistance from Asian Development Bank, the water data and basin delineation have been updated. Based on this, Bhutan has five major river basins: *Amo Chhu, Wang Chhu, Punatsang Chhu, Mangde Chhu* and *Drangme Chhu* of which *Amo Chhu* and *Drangme Chhu* originate in China. The rivers are mostly fed by rainfall, supplemented by an estimated 2%-12% glacial melt and another 2% from snow melt[1]. Climate change caused by global warming is the biggest threat to the availability of water in the country. As per the climate assessment report of NIWRMP, the temperature is expected to rise with higher increases in the northern parts of the country under RCP 4.5. The rainfall shows an increasing trend with spatial and temporal variations. Increasing temperature is presumed to increase the evapotranspiration rate thereby increasing the crop-water demand, which in turn would reduce the river flow.

A National Water Resources Inventory (NWRI) exercise funded by the Bhutan Trust Fund for Environmental Conservation was carried out in 2013 and 2014 with the objective to assess the water sources and take proper stock of the situation of water availability across the country. The survey methodology and questionnaire were developed after consultation with relevant stakeholders such as the Ministry of Health, Ministry of Agriculture and Forests, Ministry of Economic Affairs, Ministry of Works and Human Settlement and the Royal Society for Protection of Nature.

The main goal of the NWRI was to assess the water sources and gain a proper understanding of the situation of water availability through collection of data and mapping of the water availiability in the country. The NWRI was required to: (i) assess the current status of water resources and uses and; (ii) provide an initial water availability baseline.

[1]Ministry of Water Resources, Government of India, Brahmaputra Basin, 2014. http://www.indiawris.nrsc.gov.in/Publications/BasinReports/Brahamaputra%20Basin.pdf

The data for the current task was collected using Garmin Dakota GPS and Current meters provided by the NECS. Some 35 enumerators were hired to collect the data from the field. The following sections represent the water sources and their flow magnitudes at the national level covering the 20 districts across the country.

The report is a result of the first major initiative in the country to survey all available water sources across Bhutan. While this is a commendable initiative that was successfully completed, there were various issues in the field including technical challenges. Thus, while efforts have been made to provide correct data as far as possible, it may only be used for reference and not for decision-making or for design purposes. Further comprehensive inventory of water resources is recommended to establish a stronger database.

# Chapter 2 : National Water Resources Inventory

## 2.1 NWRI Results

A total of 558 measurements were taken at numerous water sources across the 20 Dzongkhags for this project. Table 2-1 below shows the maximum and minimum water discharges at different measurement points in the twenty Dzongkhags.

From the 558 measured flow values, the maximum discharge was recorded for *Wang Chhu* under Kawang Gewog in Thimphu Dzongkhag, with a discharge of 15,422.40 lps (liters per second) while the minimum discharge recorded was for *Cherang Chhu* under Shumar Gewog in Pemagatshel Dzongkhag with a discharge of 0.03 lps (liters per second) in the month of November. A map of Bhutan showing the National Water Resources Inventory locations are presented in Figure 2-1.

**Table 2-1: Maximum and minimum water discharges recorded in 20 Dzongkhags**

| Sl No. | Dzongkhag | Gewog | Stream name | Discharge lps | | | |
|---|---|---|---|---|---|---|---|
| | | | | Min | Month | Max | Month |
| 1 | Bumthang | Tang | Chakhay | 0.38 | Nov | | |
| | | Menchugang Chhu | Chhoekhor | | | 5145.00 | Sept |
| 2 | Chhukha | Darla | Kalzang ri | 0.45 | Dec | | |
| | | Phuntshogling | Chala Chhu | | | 6196.00 | Aug |
| 3 | Dagana | Drukjeygang | Budi Chhu(mo) female | 10.84 | Oct | | |
| | | Drukjeygang | Daga Chhu | | | 4127.40 | May |
| 4 | Gasa | Khatoed | Gasa hot spring | 4.23 | Sept | | |
| | | Khamaed | Laypey Chhu | | | 2268.00 | Sept |
| 5 | Haa | Luna | Pabi Khola | 55.00 | May | | |
| | | Bji | Yak Chhu | | | 12197.50 | Aug |
| 6 | Lhuentse | Kurtoed | Dungkar Yongba Chhu | 7.56 | Nov | | |
| | | Kurtoed | Chhudigang Chhu | | | 9153.82 | Nov |
| 7 | Mongar | Gongdue | Laizama Chhu | 34.68 | Nov | | |
| | | Saling | Chang Chhu | | | 3816.00 | June |
| 8 | Paro | Dopshar-ri | Ree Chhu | 0.93 | April | | |
| | | Tsento | Yaksa Chhu | | | 8091.15 | Sept |
| 9 | Pemagatshel | Shumar | Cherang Chhu | 0.03 | Nov | | |
| | | Nanong | Tsala ri | | | 2826.25 | June |
| 10 | Punakha | Goenshari | Churolum Chhu | 0.10 | Aug | | |
| | | Kabisa | Jichuluma | | | 4760.00 | Aug |
| 11 | Samdrup Jongkhar | Serthig | Jomo Chhu | 14.70 | Dec | | |
| | | Martshala | Re Changlu | | | 2070.00 | July |
| 12 | Samtse | Tendruk | somju Khola | 1.79 | Dec | | |
| | | Tading | Jiti khola | | | 7225.12 | May |
| 13 | Sarpang | Chhuzaggang | Mosani Khola | 215.73 | Sept | | |
| | | Gakidling | Sisty Khola | | | 4995.96 | June |
| 14 | Thimphu | Kawang | Motithang uper Stream | 0.39 | May | | |
| | | Kawang | Wang Chhu | | | 15422.40 | May |
| 15 | Trashi Yangtse | Tongmizhangsa | Shakposhong Chhu | 2.58 | Nov | | |
| | | Boomdeling | Nagpala Chhu | | | 2190.00 | June |

| Sl No. | Dzongkhag | Gewog | Stream name | Discharge lps | | | |
|---|---|---|---|---|---|---|---|
| | | | | Min | Month | Max | Month |
| 16 | Trashigang | Lumang | Shesukam Chhu | 0.08 | Nov | | |
| | | Sagteng | Morbi Chhu | | | 2327.00 | May |
| 17 | Trongsa | Nubi | Chattsham | 0.08 | Oct | | |
| | | Nubi | Drangne Chhu | | | 5097.00 | Sept |
| 18 | Tsirang | Patshaling | Pau Khola | 26.00 | Oct | | |
| | | Sergithang | Buri Chhu | | | 5472.00 | May |
| 19 | Wangdue Phodrang | Gase Tshogongm | Lawalum Chhu | 0.58 | April | | |
| | | Saephoog | Chazam Chhu/ Nika Chhu | | | 10356.57 | Sept |
| 20 | Zhemgang | Phangkhar | Mangmung kirang Chhu | 118.42 | July | | |
| | | Goshing | Morang Chhu | | | 1570.80 | June |

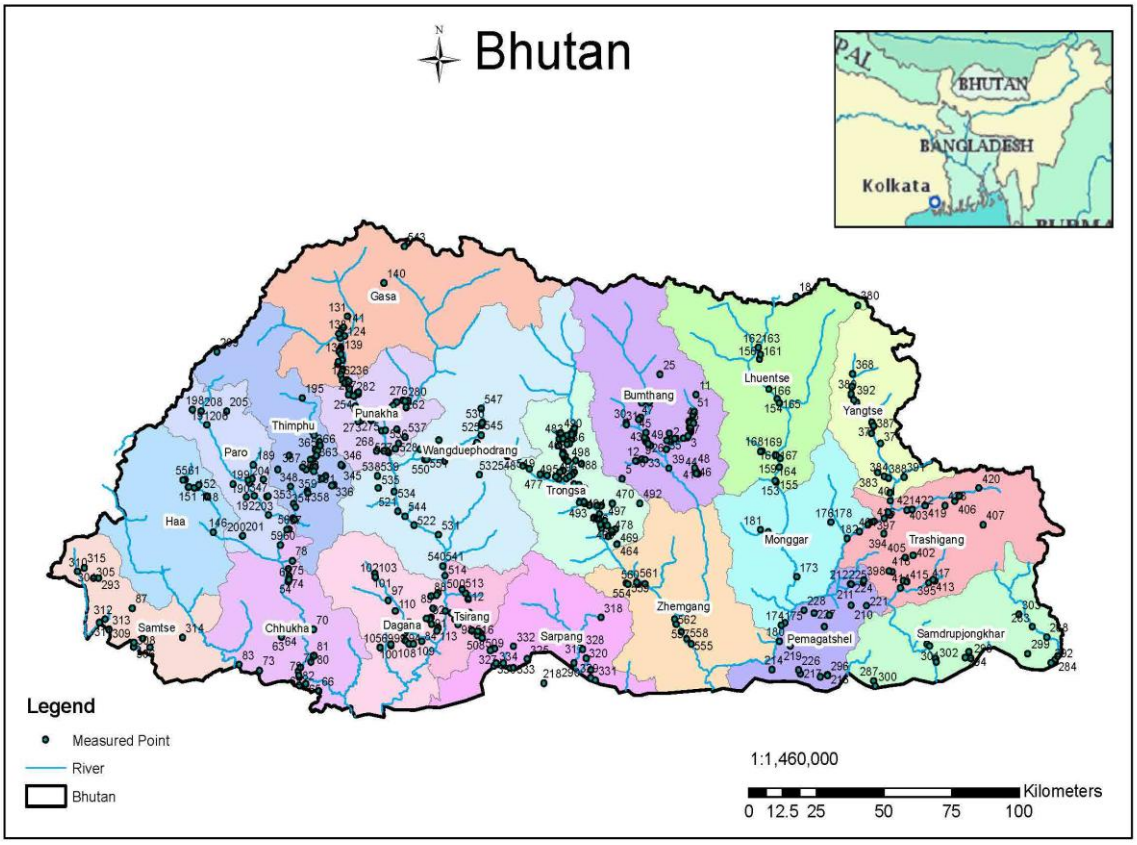


**Figure 2-1: Map of Bhutan showing NWRI sites**

The results of survey for each of the Dzongkhags are presented in the following sections:

### i. Bumthang Dzongkhag

Bumthang Dzongkhag is located in North Central Bhutan. The Dzongkhag has an area of 2708.46 square kilometers comprising 4 Gewogs. It lies at an altitude range of 2400 to 6000 metres above sea level. The population of the Dzongkhag in 2016 was 18,965[2]. A total of 53

[2] National Statistics Bureau, 2017

measurements were taken at various locations during the survey in Bumthang Dzongkhag, spread across the minor and major streams of *Chamkhar Chhu* as shown in Figure 2-2. Almost equal number of measurements was taken in all the 4 Gewogs of Bumthang.

As per the measured flow data, the highest flow was recorded for Menchugang under Chhoekhor Gewog with a flow of 5145.00 lps (liters per second) while the least was recorded for Chakhay in Tang Gewog with a flow of 0.38 lps. This is shown in Table 2-2.

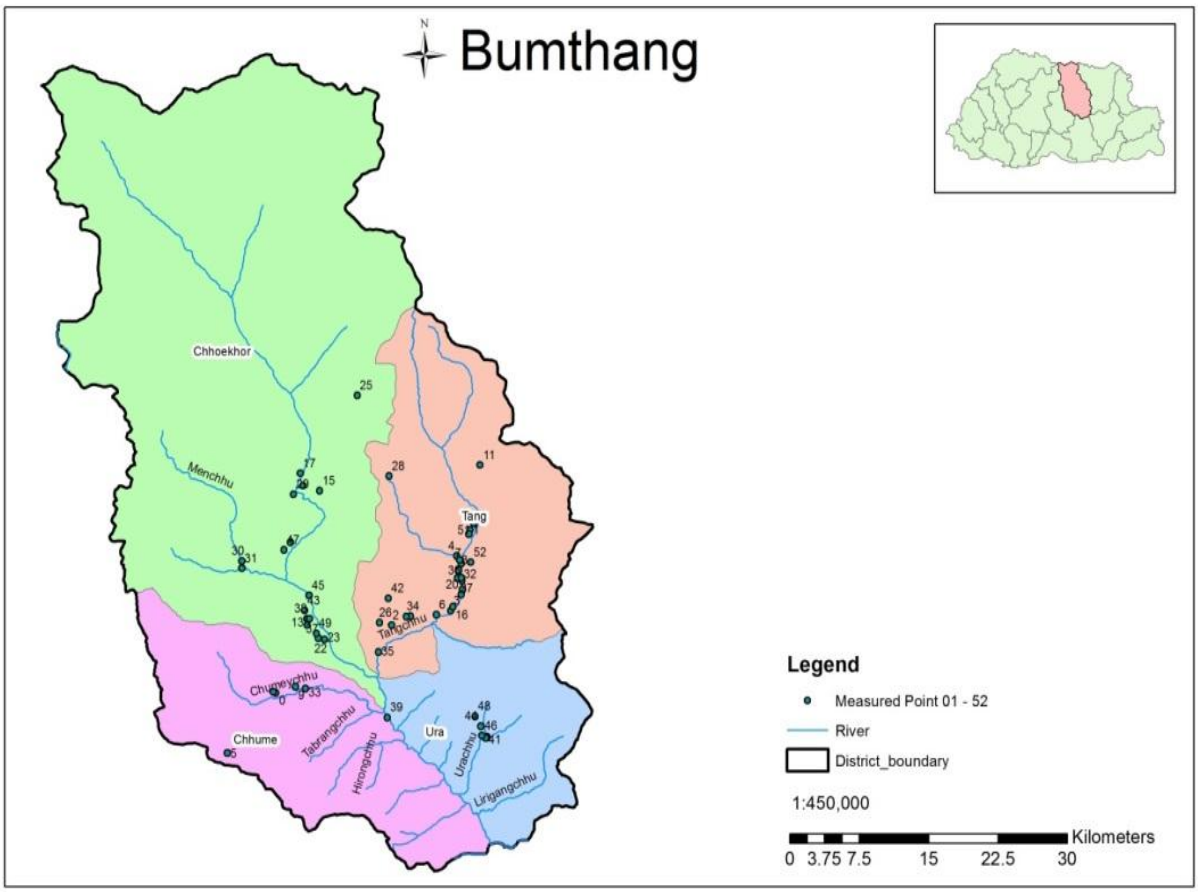


**Figure 2-2: Map of Bumthang showing the locations of NWRI sites**

**Table 2-2: NWRI Data for Bumthang Dzongkhag**

| Gewog | Stream_Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Chhoekhor | Chhudigang Chhu | 27.44331 | 90.66017 | 3735.92 | May |
| Chhoekhor | Chudi Rong Chhu | 27.63494 | 90.72158 | 135.00 | May |
| Chhoekhor | Chudikhork Chhu | 27.70528 | 90.90583 | 346.00 | Sept |
| Chhoekhor | Damphel Chhu | 27.68194 | 90.75000 | 1214.00 | May |
| Chhoekhor | Dhungkhor thang Chhu | 27.69767 | 90.73117 | 58.80 | Sept |
| Chhoekhor | Gorgay Chhu | 27.68639 | 90.73361 | 1549.00 | May |
| Chhoekhor | Jakar Chhu | 27.54781 | 90.74858 | 94.00 | Sept |
| Chhoekhor | Jakar Rong Chhu | 27.54650 | 90.75472 | 213.00 | Sept |
| Chhoekhor | Jambay Rong Chhu | 27.57283 | 90.73508 | 182.00 | Sept |
| Chhoekhor | Jeaypay Chhu | 27.76861 | 90.78639 | 10.43 | Sept |

| Gewog | Stream_Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Chhoekhor | Kitkang Chhu | 27.69528 | 90.81750 | 565.00 | May |
| Chhoekhor | Laybung Chhu | 27.67867 | 90.72450 | 1204.00 | May |
| Chhoekhor | Lusibee Chhu | 27.61803 | 90.67403 | 342.00 | Sept |
| Chhoekhor | Menchugang Chhu | 27.61119 | 90.67422 | 5145.00 | May |
| Chhoekhor | Rong rong Chhu | 27.56550 | 90.73750 | 229.50 | Sept |
| Chhoekhor | Rong Rong Chhu | 27.56561 | 90.73992 | 62.00 | Sept |
| Chhoekhor | Shogap Chhu | 27.58406 | 90.81681 | 307.36 | Sept |
| Chhoekhor | Tabra Om Chhu | 27.57292 | 90.73517 | 97.00 | Sept |
| Chhoekhor | Tamshing Chhu | 27.58658 | 90.73967 | 290.32 | Sept |
| Chhoekhor | Taring Chhu | 27.45917 | 90.90753 | 232.00 | Sept |
| Chhoekhor | Thowaicrock Chhu | 27.62817 | 90.71517 | 157.00 | May |
| Chhoekhor | Wangduecholing Chhu | 27.55214 | 90.74664 | 6.79 | Sept |
| Chhumig | Bethang Chhu | 27.49786 | 90.70744 | 670.00 | May |
| Chhumig | Chorten pang Chhu | 27.50392 | 90.72614 | 9.86 | Sept |
| Chhumig | Chumey Chhu | 27.49881 | 90.70478 | 5012.40 | May |
| Chhumig | Chumey Chhu | 27.55972 | 90.73778 | 3084.35 | May |
| Chhumig | Nayen Chhu | 27.50192 | 90.73628 | 372.30 | Sept |
| Tang | Bumbay Tagpa Chhu | 27.64594 | 90.89603 | 2.69 | Sept |
| Tang | Chakhay | 27.55967 | 90.81964 | 0.38 | Sept |
| Tang | Chamthang | 27.57275 | 90.87722 | 2.67 | Sept |
| Tang | Chhubur Chhu | 27.62272 | 90.88317 | 4042.52 | May |
| Tang | Chisang Chhu | 27.56922 | 90.86325 | 96.00 | Sept |
| Tang | Choekhormani Chhu | 27.61594 | 90.88767 | 3.83 | Sept |
| Tang | Chogkhoe | 27.60964 | 90.88472 | 4.40 | Sept |
| Tang | Chumju Chhu | 27.58781 | 90.88764 | 4.91 | Sept |
| Tang | Dazur Chhu | 27.57625 | 90.87925 | 2454.14 | May |
| Tang | Gangzur Chhu | 27.59206 | 90.88864 | 59.63 | Sept |
| Tang | Gawdong Chhu | 27.56797 | 90.83814 | 1.35 | Sept |
| Tang | Gongjuel | 27.59992 | 90.88833 | 8.62 | Sept |
| Tang | Khorblang Chhu | 27.56197 | 90.80808 | 446.00 | Sept |
| Tang | Kidum Chhu | 27.60258 | 90.88400 | 70.38 | Sept |
| Tang | Nanshong Chhu | 27.60294 | 90.88747 | 2.95 | Sept |
| Tang | Pangzhing Chhu | 27.56758 | 90.83433 | 203.00 | Sept |
| Tang | Phomrong Chhu | 27.53531 | 90.80697 | 59.00 | Sept |
| Tang | Pokhey Chhu | 27.61875 | 90.88586 | 139.26 | Sept |
| Tang | Wongphog Chhu | 27.64258 | 90.89497 | 28.00 | Sept |
| Tang | Zhangma Chhu | 27.65208 | 90.89964 | 12.01 | Sept |
| Tang | Zhay Chhu | 27.61672 | 90.89694 | 2745.93 | May |
| Ura | Shaktar Chhu | 27.47572 | 90.81581 | 133.00 | May |
| Ura | Shingkhar Yalang Chhu | 27.45833 | 90.91239 | 1373.00 | May |
| Ura | Shingkhar Yalang Chhu | 27.45731 | 90.91139 | 472.00 | Sept |
| Ura | Talang Chhu | 27.46783 | 90.90644 | 407.00 | Sept |
| Ura | Tsarwangma Chhu | 27.47678 | 90.90114 | 4.51 | Sept |

### ii. Chhukha Dzongkhag

Chhukha Dzongkhag is located in South-Western Bhutan at an altitude range of 200 to 3500 metres above sea level. It has a total area of 1879.5 square kilometers with 11 Gewogs. The population in 2015 was recorded at 88,342[3]. A total of 30 measurements were taken during the survey in Chhukha Dzongkhag. The sites are spread across the minor and major streams of *Wang Chhu* as shown in Figure 2-3. Equal number of measurements was taken in the 5 Gewogs of Chhukha.

As per the measured flow data, the highest flow was observed in *Chala Chhu* in Phuntsholing Gewog with a flow of 6196.00 lps (liters per second) in the month of August but due to its abnormally high value compared to similar measurements along the stream, it has been considered as a wild value and has been discarded. The least flow was recorded for Kalzangri stream under Darla Gewog with a flow of 0.45 lps (liters per second) in the month of December as shown in Table 2-3.

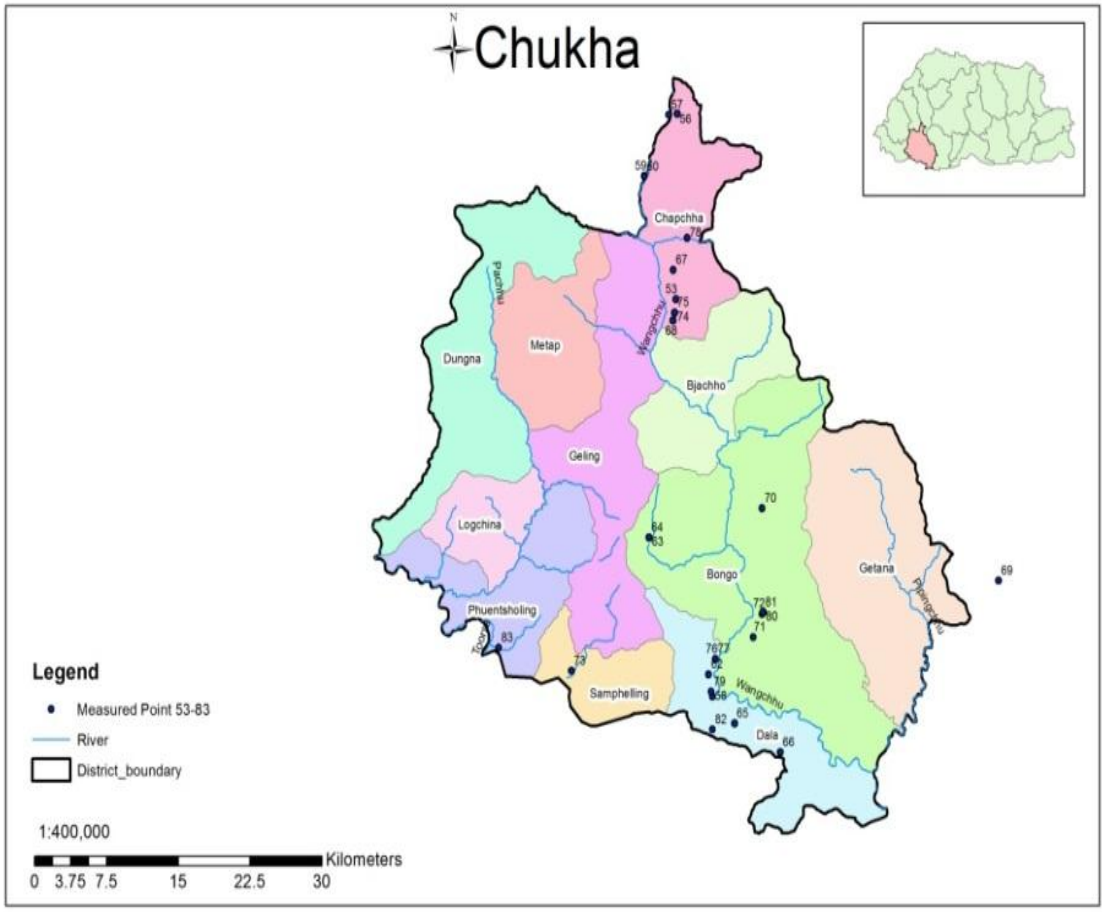


**Figure 2-3: Map of Chhukha Dzongkhag showing the locations of NWRI sites**

[3] National Statistics B, 2016

## Table 2-3: NWRI Data for Chhukha Dzongkhag

| Gewog | Stream_Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Bongo | Tililum Chhu | 26.89197 | 89.63458 | 757.00 | May |
| Bongo | Tililum Chhu | 26.89200 | 89.63386 | 578.00 | May |
| Bongo | Osalum Chhu | 26.97425 | 89.63322 | 214.00 | May |
| Bongo | Otselum Chhu | 26.89092 | 89.63322 | 214.00 | May |
| Bongo | Gedulum Chhu | 26.95100 | 89.52697 | 115.00 | May |
| Bongo | Gedulum Chhu | 26.95117 | 89.52711 | 78.38 | Dec |
| Bongo | Otselum Chhu | 26.87233 | 89.62489 | 20.00 | Dec |
| Chapchha | Tanalung Chhu | 27.18786 | 89.56300 | 2529.60 | May |
| Chapchha | Damchulum | 27.23683 | 89.52264 | 533.20 | May |
| Chapchha | Damchulum | 27.23614 | 89.52275 | 325.00 | May |
| Chapchha | Lobnekha Chhu | 27.16256 | 89.54989 | 223.00 | May |
| Chapchha | Chorolumba | 27.28486 | 89.54544 | 195.00 | May |
| Chapchha | 1st stream after Buna | 27.13939 | 89.55231 | 179.00 | May |
| Chapchha | 2nd stream after Buna | 27.12881 | 89.55100 | 66.00 | Dec |
| Chapchha | Shatogelshsa Chhu | 27.12881 | 89.55127 | 24.10 | Dec |
| Chapchha | Chorolumba | 27.28592 | 89.55333 | 6.90 | Dec |
| Chapchha | Matolumba | 27.12264 | 89.54950 | 3.50 | Dec |
| Darla | Gangu Khola | 26.84283 | 89.58300 | 159.00 | May |
| Darla | Tabge Chhu | 26.85500 | 89.58942 | 158.00 | May |
| Darla | Chubulumba Khola | 26.82550 | 89.58656 | 102.00 | May |
| Darla | Tabge Chhu | 26.85517 | 89.58947 | 96.05 | Dec |
| Darla | Thara Khola | 26.82917 | 89.58542 | 42.00 | Dec |
| Darla | Tsebtsephi | 26.79925 | 89.58658 | 33.00 | Dec |
| Darla | Jhora Chhu | 26.80414 | 89.60719 | 0.50 | Dec |
| Darla | Kalzang ri | 26.78144 | 89.65028 | 0.45 | Dec |
| Phuentholing | Dhoti khola | 26.86394 | 89.38597 | 291.72 | Dec |
| Phuntsholing | Singay Chhu | 27.12881 | 89.55127 | 543.46 | Dec |
| Phuntsholing | Damthang Chhu | 27.43997 | 89.20608 | 355.00 | April |
| Phuntsholing | Pasakha Chhu | 26.84558 | 89.45408 | 190.00 | Dec |
| Samphelling | Nimtola Khola | 26.91692 | 89.85528 | 891.00 | Sept |

### iii. Dagana Dzongkhag

Dagana Dzongkhag is located in Southern Bhutan at an altitude range of 185 to 3800 metres above sea level and has a total area of 1723 square kilometers. It has 14 Gewogs and a population of 20,874 as of 2015[4]. A total of 34 measurements were taken at various locations during the survey in Dagana Dzongkhag spread across the minor and major streams of Punatsangchhu as shown in Figure 2-. All measurement sites were equally distributed in 10 Gewogs of Dagana.

As per the measured flow data, the highest flow was observed for *Daga Chhu* under Drukjeygang Gewog with a flow of 4127.40 lps (liters per second), measured in May while the least was recorded for *Budi Chhu* (mo) in Drukjeygang Gewog with 10.84 lps (liters per second) in the month of April as shown in Table 2-4.

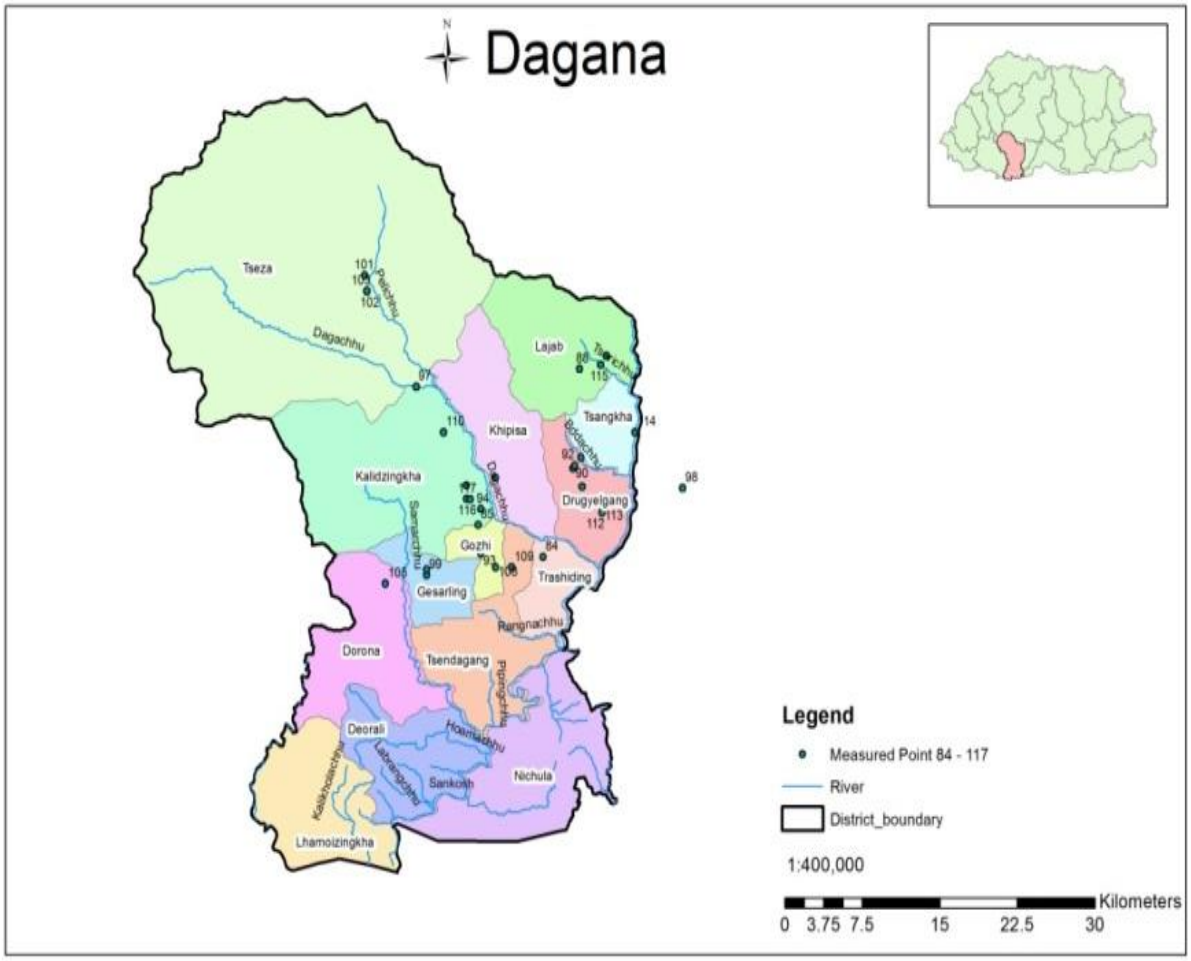


**Figure 2-4: Map of Dagana Dzongkhag showing the locations of NWRI sites**

[4] NSB, 2016

## Table 2-4: NWRI Data for Dagana Dzongkhag

| Gewog | Stream_Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Dorona | Nimtola Chhu | 26.91683 | 89.85533 | 564.30 | Oct |
| Dorona | Nimtola Chhu | 26.91692 | 89.08861 | 891.00 | May |
| Drukjeygang | Budi Chhu | 27.00300 | 90.01864 | 120.61 | Oct |
| Drukjeygang | Budi Chhu | 27.01117 | 90.02561 | 100.95 | Oct |
| Drukjeygang | Budi Chhu (mo) female | 27.00536 | 90.02014 | 10.84 | Oct |
| Drukjeygang | Daga Chhu | 26.98833 | 90.11400 | 4127.40 | May |
| Drukjeygang | Paag Chhu | 26.98931 | 90.02642 | 53.92 | Oct |
| Drukjeygang | Pangna Chhu | 26.92894 | 89.96522 | 169.00 | May |
| Drukjeygang | Tarilum | 26.97008 | 90.04372 | 299.00 | April |
| Drukjeygang | Tarilum | 26.97014 | 90.04381 | 181.30 | Oct |
| Gesarling | Emray Chhu | 26.92325 | 89.89108 | 253.00 | April |
| Gesarling | Emray Chhu | 26.92714 | 89.89111 | 155.90 | Oct |
| Gesarling | Pagna Chhu | 26.92900 | 89.95119 | 70.00 | Oct |
| Gozhi | Baleygang Chhu | 26.96083 | 89.93600 | 113.00 | April |
| Gozhi | Baleygang Chhu | 27.08747 | 90.04764 | 225.25 | Oct |
| Gozhi | Buedulum Chhu | 26.93906 | 89.93831 | 80.00 | April |
| Gozhi | Buedulum Chhu | 26.97261 | 89.93836 | 285.10 | Oct |
| Karna | Lemi Chhu | 26.99014 | 89.92600 | 1889.50 | May |
| Karna | Tayra Chhu | 27.03025 | 90.07244 | 360.00 | April |
| Karna | Zharingay Chhu | 26.98014 | 89.92594 | 483.00 | April |
| Karna | Zharingay Chhu | 26.98003 | 89.92900 | 80.00 | Oct |
| Khebisa | Chora Chhu | 26.99600 | 89.95106 | 235.00 | April |
| Khebisa | Chora Chhu | 26.99603 | 89.95111 | 820.00 | May |
| Lagyab | Banna Chhu | 27.07761 | 90.02425 | 1108.08 | May |
| Lagyab | Tseray Chhu | 27.08069 | 90.04275 | 4017.28 | May |
| Tashiding | Ampikhola | 26.93675 | 89.99256 | 79.00 | Oct |
| Tsangkha | Bandhar Chhu | 27.03969 | 89.03069 | 272.00 | May |
| Tsangkha | Bondhar Chhu | 27.03986 | 90.03069 | 55.76 | Oct |
| Tseza | Daea Chhu | 27.06444 | 89.88194 | 1339.60 | May |
| Tseza | Gaba Chhu | 27.14764 | 89.83733 | 3847.13 | May |
| Tseza | Karey Chhu | 27.13575 | 89.83914 | 189.00 | April |
| Tseza | Karey Chhu | 27.13611 | 89.83906 | 361.05 | Oct |
| Tseza | Tangra Chhu | 27.03025 | 89.90575 | 173.00 | April |
| Tseza | Tangra Chhu | 26.97886 | 90.04764 | 225.25 | Oct |

### iv. Gasa Dzongkhag

Gasa Dzongkhag is located in the extreme north of Bhutan at an altitude range of 1500 to 4500 metres above sea level and has an area of 3081.77 square kilometers with 4 Gewogs. The population in 2017 was recorded as 3,694[5]. A total of 23 measurements, mostly in the Mochhu valley, were taken at various locations during the survey in Gasa Dzongkhag as shown in Figure 2-. The measurement sites are in 2 Gewogs of Khatoed and Khamaed.

As per the measured data, the highest discharge was recorded for *Leypey Chhu* under Khamaed Gewog with a discharge of 2268.00 lps (liters per second) in the month of September while the lowest discharge was recorded for Gasa hot spring in Khatoed Gewog with a flow of 4.23 lps as shown in Table 2-5.

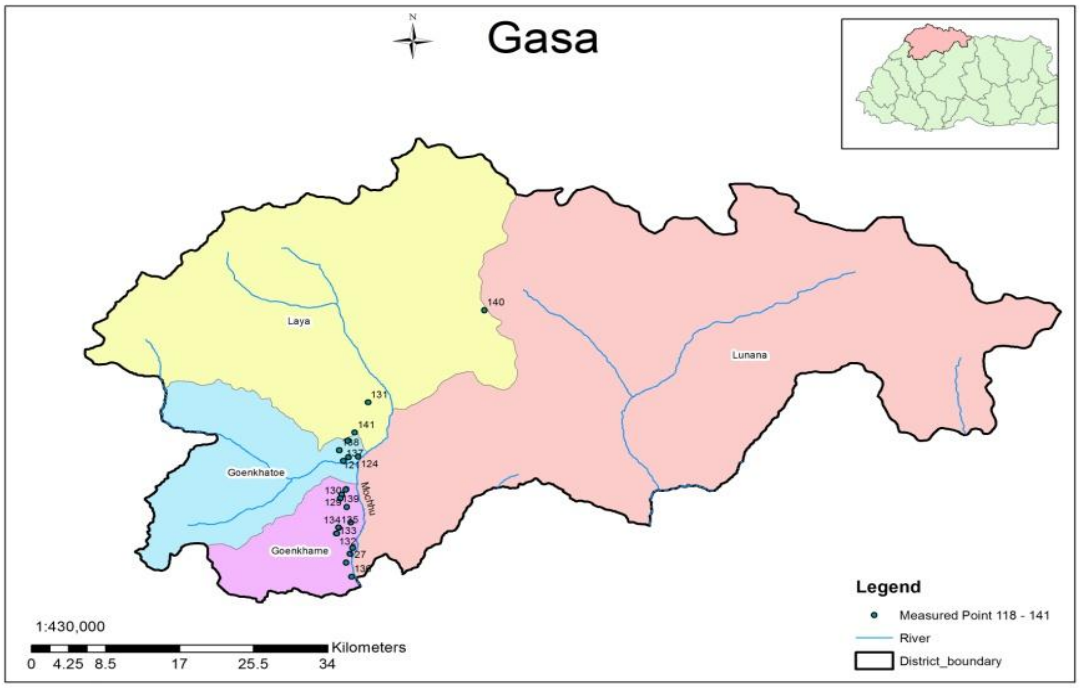


**Figure 2-5: Map of Gasa Dzongkhag showing the locations of NWRI sites.**

**Table 2-5: NWRI Data for Gasa Dzongkhag**

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Khamaed | Churalum | 27.85086 | 89.72414 | 487.00 | April |
| Khamaed | Churalum | 27.85064 | 89.72397 | 389.61 | Sept |
| Khamaed | Dhul Khola | 27.00636 | 90.14025 | 208.00 | May |
| Khamaed | Ganglum Chhu | 27.81306 | 89.72908 | 60.00 | Sept |
| Khamaed | Khiajona Chhu | 27.78450 | 89.73064 | 120.00 | Sept |
| Khamaed | Khimjowom Chhu | 27.77794 | 89.72806 | 180.00 | Sept |

[5] NSB, 2017

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Khamaed | Laypey Chhu | 27.84047 | 89.71800 | 597.00 | April |
| Khamaed | Laypey Chhu | 27.84489 | 89.71967 | 2268.00 | Sept |
| Khamaed | Leypay Chhu | 27.84047 | 89.71800 | 597.00 | April |
| Khamaed | Leypay Chhu | 27.94889 | 89.74667 | 2268.00 | Sept |
| Khamaed | Lungina Chhu | 27.80056 | 89.71389 | 293.00 | April |
| Khamaed | Lungina Chhu | 27.80056 | 89.71442 | 1112.00 | Sept |
| Khamaed | Sebjina Chhu | 27.80731 | 89.71667 | 577.00 | April |
| Khamaed | Sebjina Chhu | 27.80750 | 89.71622 | 745.00 | Sept |
| Khamaed | Thingtha Chhu | 27.75200 | 89.72964 | 121.00 | April |
| Khamaed | Ya lum | 27.83089 | 89.72486 | 72.00 | April |
| Khamaed | Ya lum | 28.05333 | 89.86694 | 109.00 | Sept |
| Khatoed | Chusa Chhu | 27.90583 | 89.72575 | 442.00 | Sept |
| Khatoed | Densana Chhu | 27.88700 | 89.72653 | 121.00 | April |
| Khatoed | Gasa hot spring | 27.88778 | 89.73658 | 4.23 | Sept |
| Khatoed | Tokilumi Chhu | 27.88300 | 89.72136 | 210.00 | April |
| Khatoed | Tokilumi Chhu | 27.89503 | 89.71694 | 588.00 | Sept |
| Khatoed | Zamjena Chhu | 27.91497 | 89.73317 | 2000.00 | Sept |

### v. Haa Dzongkhag

Haa Dzongkhag is located in western Bhutan at an altitude range of 1000 to 5600 metres above sea level and has an area of 1,899.2 square kilometers. It has 6 Gewogs and a total population of 13,499 as of 2015[6]. A total of 11 measurements, spread across the minor and major streams of *Haa Chhu,* were taken at various locations during the survey in Haa Dzongkhag as shown in Figure 2-. The measurement sites are spread across all Gewogs of Haa.

As per the measured flow data, the highest discharge recorded was at *Yak Chu* under Bji Gewog at 12,197.50 lps (liters per second) in August while the least discharge was recorded for Pabi Khola in Luna Gewog with a discharge value of 55.00 lps in the month of May as shown in Table 2-6.

[6] NSB,2016

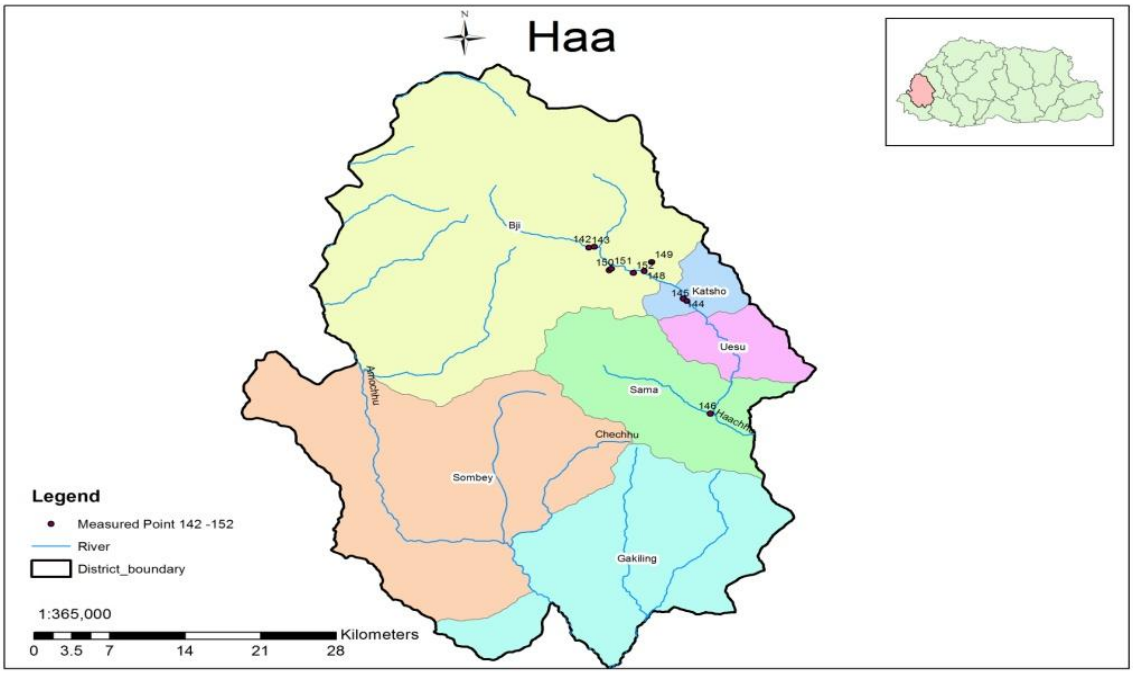


**Figure 2-6: Map of Haa Dzongkhag showing the locations of NWRI sites.**

**Table 2-6: NWRI Data for Haa Dzongkhag**

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Bjee | Chala Chhu | 27.43953 | 89.20428 | 6196.00 | Aug |
| Bjee | Damthang Chhu | 27.43875 | 89.19967 | 948.38 | Aug |
| Bji | Talung Rong Chhu | 27.41583 | 89.24586 | 383.00 | April |
| Bji | Talung Rong Chhu | 27.42461 | 89.25217 | 3748.50 | Aug |
| Bji | Yak Chhu | 27.41669 | 89.21667 | 144.00 | April |
| Bji | YakChhu | 27.41825 | 89.21842 | 12197.50 | Aug |
| Kar-Tshog | Haa Throm Chhu | 27.38889 | 89.27858 | 2563.00 | Aug |
| Kar-Tshog | Haa Throm Chhu | 27.38656 | 89.28139 | 537.00 | Aug |
| Luna | Pabi Khola | 26.97100 | 89.55975 | 55.00 | May |
| Samar | Lang Chhu | 27.27633 | 89.30083 | 323.19 | April |
| Tokay | Khu kaap | 27.41389 | 89.23664 | 390.00 | Aug |

### vi. Lhuentse Dzongkhag

Lhuentse Dzongkhag is located in North-Eastern Bhutan at an altitude range of 600 to 5800 metres above sea level and has a total area of 2854 square kilometers. The Dzongkhag comprises of 8 Gewogs with a total population of 17,618 as of 2016[7]. A total of 17 measurements, spread across the minor and major streams of *Kuri Chhu*, were taken at various locations during the survey in Lhuentse Dzongkhag as shown in Figure 2-. The measurement sites are in 4 Gewogs of Lhuentse.

[7] NSB, 2016

As per the measured data, the highest flow was measured for *Chhudigang Chhu* under Kurtoed Gewog with a flow of 9,153.82 lps (liters per second) in November while the least was recorded for *Dungkar Yonba Chhu* in Kurtoed Gewog with a discharge of 7.56 lps as shown in Table 2-7.

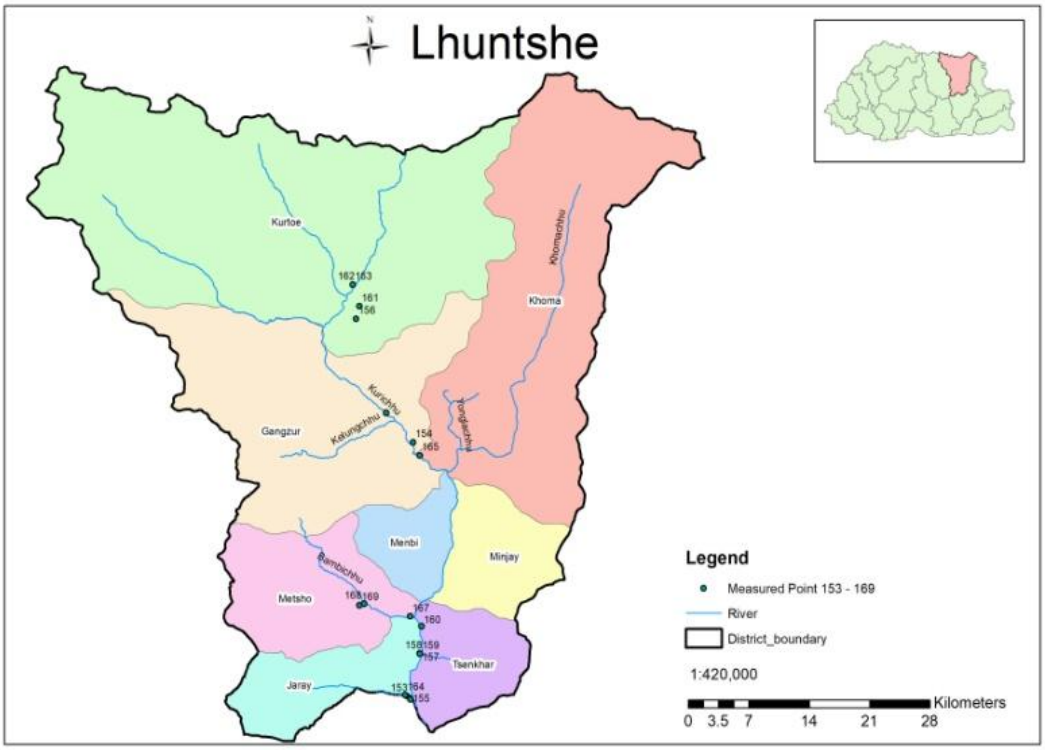


**Figure 2-7: Map of Lhuentse Dzongkhag showing the locations of NWRI sites**

**Table 2-7: NWRI Data for Lhuentse Dzongkhag**

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Gangzur | Chumae rangang Chhu | 27.69269 | 91.17625 | 477.00 | Nov |
| Gangzur | Rong Chhu | 27.85206 | 91.11322 | 100.00 | June |
| Gangzur | Tangkhoe Chhu | 27.67928 | 91.18306 | 576.00 | Nov |
| Gangzur | Thimyule Chhu | 27.72253 | 91.14817 | 823.00 | June |
| Kurtoed | Chhudigang Chhu | 27.43614 | 91.16958 | 9153.82 | Nov |
| Kurtoed | Dungkar Yongba Chhu | 27.81744 | 91.11678 | 7.56 | Nov |
| Kurtoed | Phowgang | 27.83006 | 91.12039 | 1491.32 | Nov |
| Kurtoed | Rong Chhu | 27.85206 | 91.11322 | 100.00 | June |
| Kurtoed | Sungman Chhu | 27.43700 | 91.16811 | 1228.08 | June |
| Maedtsho | Unger Down Stream | 27.51661 | 91.17300 | 3348.60 | June |
| Maedtsho | Unger Upper Stream | 27.52942 | 91.12511 | 2552.00 | June |
| Maedtsho | Wambugang Chhu | 27.52803 | 91.12033 | 1357.00 | June |
| Tsaenkhar | Dorten Chhu | 27.43269 | 91.17331 | 60.00 | Nov |
| Tsaenkhar | Fawan Chhu | 27.47892 | 91.18325 | 454.00 | June |
| Tsaenkhar | Fawan Chhu | 27.47922 | 91.18306 | 2010.00 | Nov |
| Tsaenkhar | Fawan Chhu | 27.47892 | 91.18325 | 454.00 | June |
| Tsaenkhar | Khaba Chhu | 27.50689 | 91.18503 | 648.00 | Nov |

### vii. Mongar Dzongkhag

Mongar Dzongkhag is located in Eastern Bhutan at an altitude range of 400 to 4000 metres above sea level with a total area of 1,940.26 square kilometers. It has 17 Gewogs and a population of 44,259 as of 2015[8]. A total of 16 measurements, spread across the minor and major streams of *Kuri Chhu*, were taken at various locations during the survey in Mongar Dzongkhag as shown in Figure 2-8. The measurement sites are only in the 4 Gewogs of Mongar.

As per the measured data, *Chang Chhu* in Saling Gewog had the highest flow of 3,816.00 lps (liters per second) measured in November while the least discharge was recorded for *Laizama Chhu* in Gongdue Gewog with a discharge of 34.68 lps in June as shown in Table 2-8.

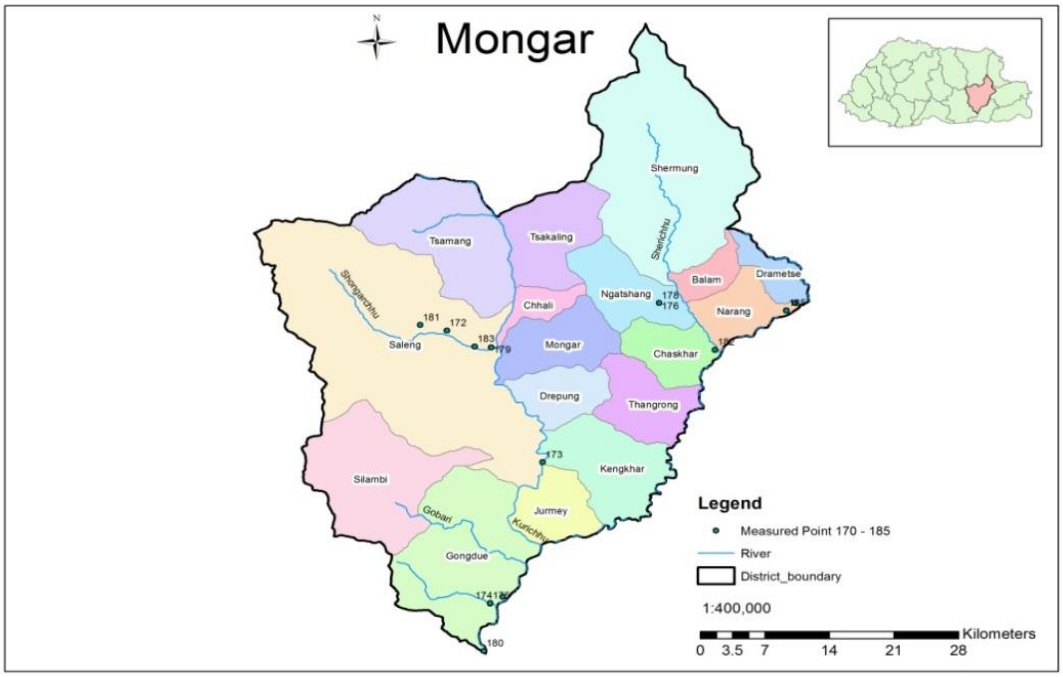


**Figure 2-8: Map of Mongar Dzongkhag showing the locations of NWRI sites.**

**Table 2-8: NWRI Data for Mongar Dzongkhag**

| Gewog | Stream_Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Dramedtse | Healongdang Chhu | 27.30719 | 91.35364 | 305.00 | June |
| Dramedtse | Helongdang Chhu | 27.30725 | 91.48644 | 59.16 | Nov |
| Dramedtse | Helongdang Chhu | 27.30719 | 91.35364 | 305.00 | June |
| Dramedtse | Sheri Chhu | 27.25747 | 91.40822 | 1092.00 | June |
| Dramedtse | Ya young Chhu | 27.29944 | 91.47767 | 182.00 | Nov |
| Gongdue | Bangbari | 26.99367 | 91.20122 | 474.70 | June |
| Gongdue | Garpala Chhu | 26.98669 | 91.18900 | 1530.00 | June |
| Gongdue | Garpola Chhu | 26.98678 | 91.18894 | 1686.82 | June |
| Gongdue | Laizama Chhu | 26.93575 | 91.18272 | 34.68 | June |
| Jurmey | Desung Chhu | 27.13731 | 91.24031 | 205.00 | Nov |
| Jurmey | Tsangpo Chhu | 28.01172 | 91.23828 | 79.00 | Nov |

[8] NSB,2016

| Gewog | Stream_Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Saling | Chang Chhu | 27.45169 | 89.67369 | 3816.00 | June |
| Saling | Changku Chhu | 27.27786 | 91.14653 | 629.00 | June |
| Saling | Kuritomla Chhu | 27.25972 | 91.18986 | 2337.00 | June |
| Saling | Loman Chhu | 27.28381 | 91.12072 | 2014.00 | June |
| Saling | Shongja Chhu | 27.26081 | 91.17386 | 490.14 | June |

### viii. Paro Dzongkhag

Paro Dzongkhag is located in Western Bhutan at an average altitude of 2500 metres above sea level and has a total area of 1,293.2 square kilometers. It has 10 Gewogs and a total population of 43,167 as of 2015[9]. A total of 24 measurements, spread across the minor and major streams of *Paro Chhu*, were taken at various locations during the survey in Paro Dzongkhag as shown in Figure 2-. The measurement sites are in 7 Gewogs of Paro.

As per the measured data, the highest discharge was found for *Do Chhu* at Dopshari Gewog with 171,470.50 lps (liters per second) in the month of September while the least discharge was recorded for Nyephu under Shaba Gewog with a discharge of 0.42 lps as shown in Table 2-9.

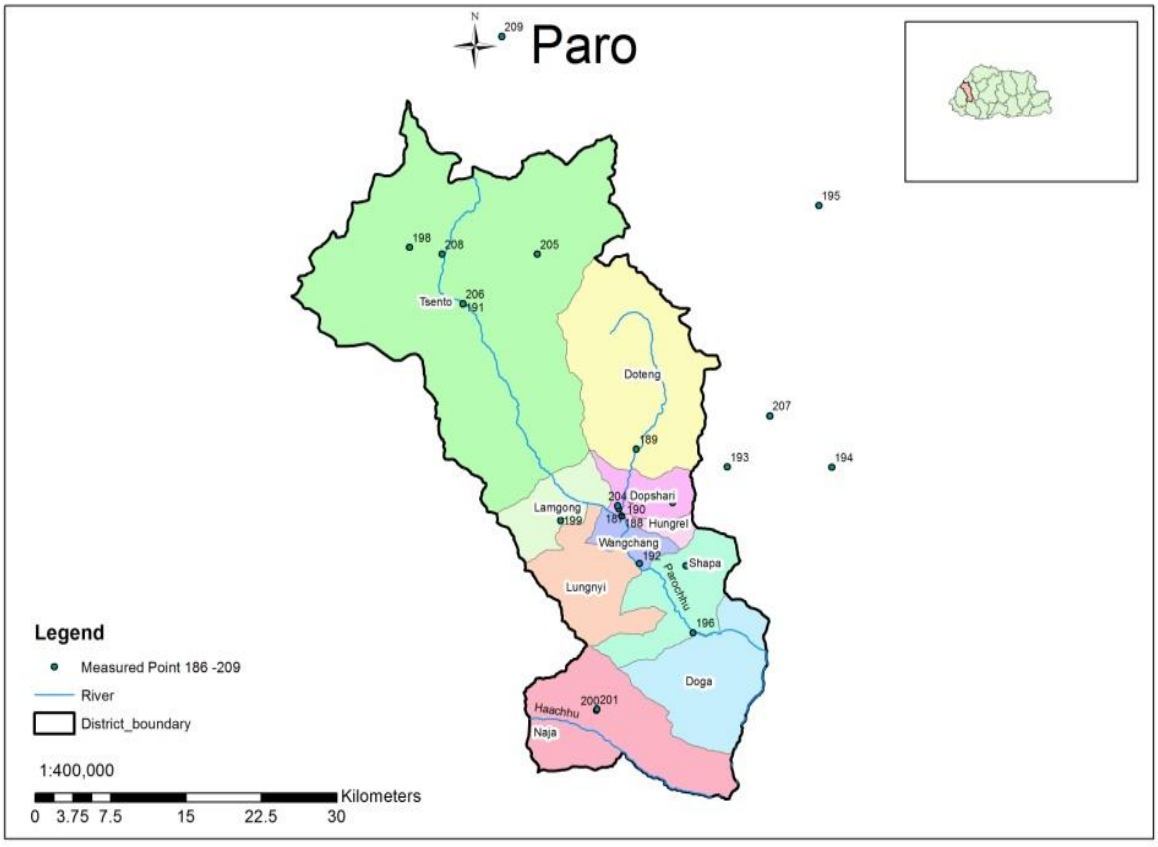


**Figure 2-9: Map of Paro Dzongkhag showing the locations of NWRI sites.**

[9] NSB, 2016

**Table 2-9: NWRI Data for Paro Dzongkhag**

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Dopshar-ri | Do Chhu | 27.43600 | 89.41756 | 17147.5 | Sept |
| Dopshar-ri | Ree Chhu | 27.43872 | 89.41647 | 0.93 | Oct |
| Doteng | Do Chhu | 27.43003 | 89.42008 | 1484.00 | April |
| Doteng | Dogay Pang Chhu | 27.48717 | 89.43319 | 394.00 | April |
| Doteng | Dogay Pang Chhu | 27.44369 | 89.42892 | 1830.00 | Sept |
| Lamgong | Dagopho Chhu | 27.44142 | 89.46581 | 3416.60 | Sept |
| Lamgong | Langong main river/ Dagophhu Chhu | 27.69500 | 89.59639 | 153.00 | Sept |
| Lamgong | Ngobi Rong Chhu | 27.42619 | 89.36564 | 392.50 | Sept |
| Loong-nyi | Gapja rong Chhu | 27.38947 | 89.43611 | 140.00 | Aug |
| Loong-nyi | Gapjarong Chhu | 27.47194 | 89.51472 | 217.00 | Aug |
| Loong-nyi | Wo chhu/Lung Chhu | 27.51556 | 89.55250 | 395.00 | Aug |
| Nagya | Nogo Chhu | 27.26408 | 89.39747 | 205.00 | April |
| Nagya | Nogo Chhu | 27.26514 | 89.39811 | 521.40 | Aug |
| Shaba | Nabisa RongChhu | 27.33042 | 89.48397 | 198.00 | April |
| Shaba | Nabisa Rong Chhu | 27.38750 | 89.47778 | 402.00 | Aug |
| Shaba | Nyephu | 27.38836 | 89.48261 | 0.42 | Oct |
| Shaba | Nyephu | 27.38867 | 89.48328 | 47.78 | Oct |
| Tsento | Dumtay Chhu | 27.61117 | 89.27825 | 4897.70 | Sept |
| Tsento | Naena Chhu | 27.65917 | 89.23044 | 371.10 | April |
| Tsento | Shana Chhu | 27.65344 | 89.34472 | 16.00 | Oct |
| Tsento | Shana Chhu | 27.61108 | 89.27811 | 350.00 | Sept |
| Tsento | Yaksa Chhu | 27.65344 | 89.25947 | 247.00 | April |
| Tsento | Yaksa Chhu | 27.83917 | 89.31278 | 8091.15 | Sept |
| Wangchang | Henshedrag Chhu | 27.47167 | 89.60806 | 32.00 | Oct |

### ix. Pema Gatshel Dzongkhag

Pema Gatshel Dzongkhag, with total area of 1,022 square kilometers, is located in South-Eastern Bhutan at an altitude range of 500 to 3000 metres above sea level. It has 11 Gewogs and a total population of 25,426 as of 2015[10]. A total of 19 measurements, spread across the minor and major streams of Drangme Chhu, were taken at various locations during the survey in Pemagatshel Dzongkhag as shown in Figure 2-. The measurement sites are in 9 Gewogs of Pemagatshel.

As per the measured data, Tsala Ri in Nanong Gewog had the highest flow of 2,826.25 lps (liters per second) measured in June while the least was recorded for *Cherang Chhu* in Shumar Gewog with 0.03 lps measured in November as shown in Table 2-10.

[10] NSB, 2016

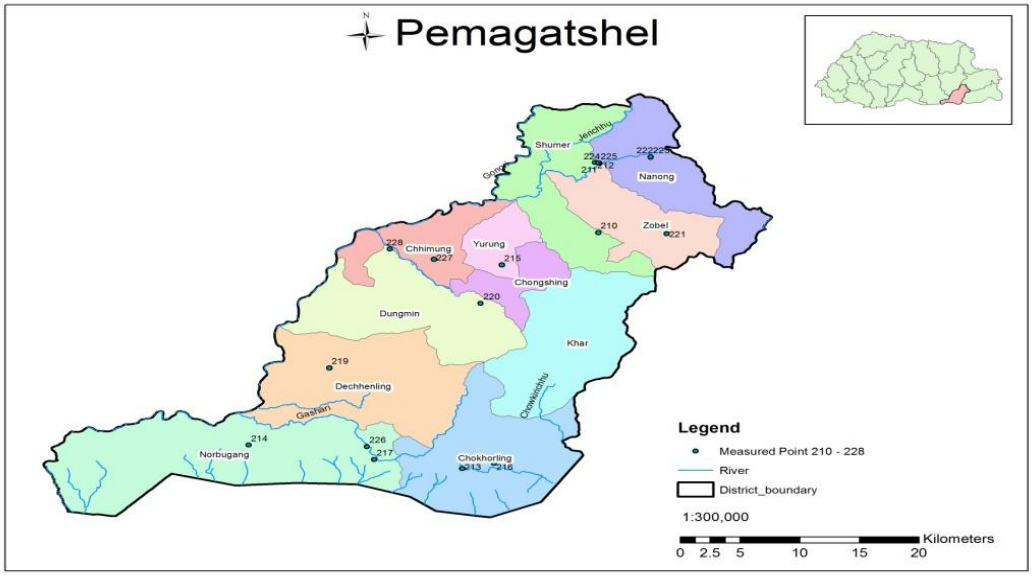


**Figure 2-10: Map of Pema Gatshel Dzongkhag showing the locations of NWRI sites.**

**Table 2-10: NWRI Data for Pema Gatshel Dzongkhag**

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Chhimoong | Tshobari Chhu | 27.02381 | 91.29794 | 0.53 | Nov |
| Chhimoong | Ure Chhu | 27.03336 | 91.26481 | 853.25 | June |
| Chhoekhorling | Lhungkhung mu ree | 26.82667 | 91.31936 | 55.00 | Dec |
| Chhoekhorling | Menchey dopri | 26.83186 | 91.34331 | 257.60 | Dec |
| Chhoekhorling | Pagala drang | 26.80583 | 90.39972 | 2457.30 | June |
| Chhoekhorling | Tshetshegang Chhu | 26.84722 | 91.24756 | 1.49 | Dec |
| Dechhenling | Peling Chhu | 26.92147 | 91.21928 | 31.00 | Dec |
| Dungmaed | Plaitheughi Ri | 26.98225 | 91.33331 | 8.50 | Nov |
| Nanong | Demri upper stream | 27.11419 | 91.42244 | 2465.68 | June |
| Nanong | Shinang gongri | 27.12003 | 91.46142 | 441.76 | Nov |
| Nanong | Shinang gongri | 27.12014 | 91.46139 | 2024.00 | June |
| Nanong | Tsala ri | 27.11442 | 91.42183 | 2826.25 | June |
| Nanong | Tsala ri | 27.11442 | 91.42183 | 71.60 | Nov |
| Norboogang | Lucuri | 26.84864 | 91.15844 | 98.00 | Dec |
| Norboogang | Nganglam Chhu | 26.83511 | 91.25308 | 1323.00 | June |
| Shumar | Cherang Chhu | 27.04897 | 91.42192 | 0.03 | Nov |
| Shumar | Joktang re | 27.11478 | 91.41942 | 91.22 | Nov |
| Yurung | Lungtenri Chhu | 27.01844 | 91.34922 | 20.40 | Nov |
| Zobel | Resena Chhu | 27.04761 | 91.47356 | 112.00 | Nov |

### x. Punakha Dzongkhag

Punakha Dzongkhag is located in Western Bhutan in an altitude range of 1200 to 5400 metres above sea level and has a total area of 1,109.81 Square kilometers. It has 11 Gewogs and a total population of 27,838 as of 2015[11]. Total of 53 measurements were taken at various locations during the survey in Punakha Dzongkhag which are spread across the minor and major streams of *Punatsang Chhu* as shown in Figure 2-. The measurement sites are in 9 Gewogs of Punakha.

As per the measured data, Jichuluma at Kabisa Gewog had the highest discharge of 4,760.00 lps (liters per second) in the month of August while the least discharge was recorded for *Churolum Chhu* at Goenshari Gewog with 0.10 lps, measured in August as shown in Table 2-11.

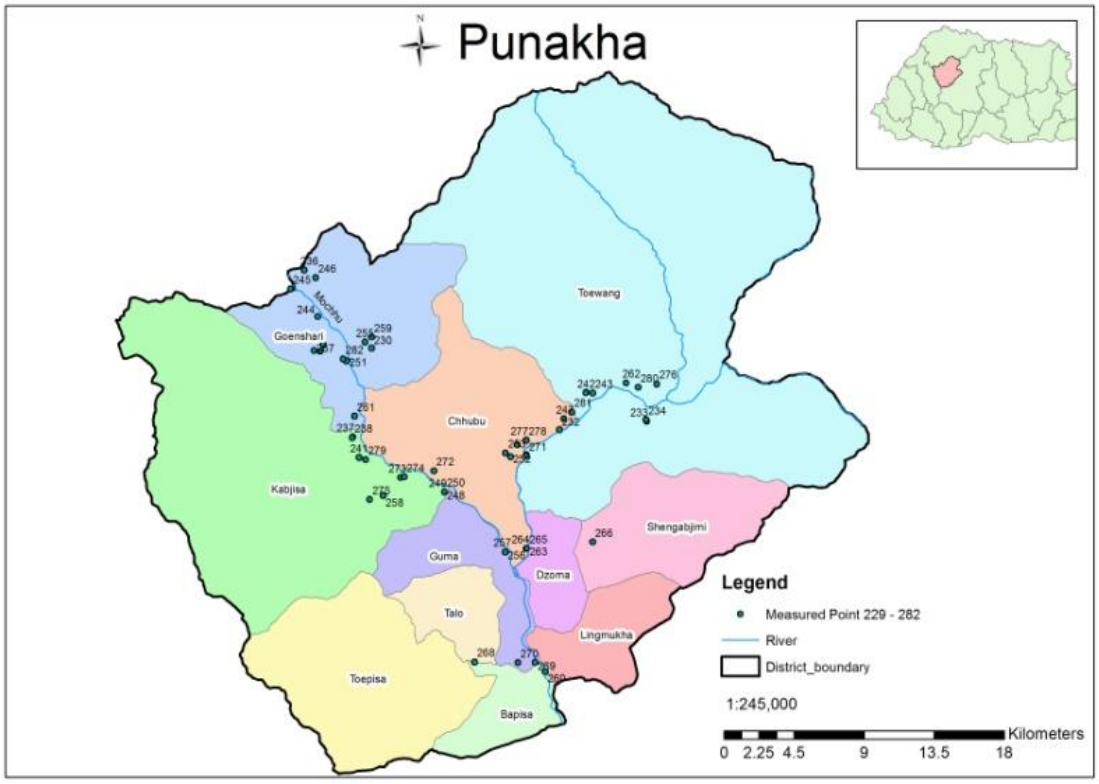


**Figure 2-11 Map of Punakha Dzongkhag showing the locations of NWRI sites.**

**Table 2-11: NWRI Data for Punakha Dzongkhag**

| Gewog | Stream_Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Barp | Never Na | 27.62425 | 89.78986 | 61.20 | Aug |
| Barp | Toebi Rong Chhu | 27.53022 | 89.84272 | 402.60 | Aug |
| Chhuboog | Changsam Chhu | 27.65272 | 89.86728 | 8.12 | Aug |
| Chhuboog | Lori Rong Chhu | 27.64606 | 89.86356 | 77.00 | April |
| Chhuboog | Lori Rong Chhu | 27.64817 | 89.86058 | 34.00 | Aug |

[11] National Statistics Bureau, 2016

| Gewog | Stream_Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Chhuboog | Yebesa Chhu | 27.63811 | 89.81917 | 9.71 | Aug |
| Chhuboog | Zago Rong Chhu | 27.65536 | 89.87258 | 51.00 | April |
| Chhuboog | Zago Rong Chhu | 27.65528 | 89.87253 | 323.40 | Aug |
| Dzomi | Shengana Chhu | 27.59439 | 89.87300 | 320.00 | April |
| Dzomi | Shengana Chhu | 27.59422 | 89.87247 | 21.39 | Aug |
| Goenshari | Charalum | 27.70744 | 89.78319 | 388.00 | Aug |
| Goenshari | Churalum Chhu | 27.70936 | 89.75539 | 37.00 | Aug |
| Goenshari | Churolum Chhu | 27.75147 | 89.74411 | 0.10 | Aug |
| Goenshari | Khebchuza | 27.72517 | 89.75194 | 171.00 | April |
| Goenshari | Khomeylum Chhu | 27.74078 | 89.73633 | 83.00 | April |
| Goenshari | Khomeylum Chhu | 27.74717 | 89.75094 | 37.00 | Aug |
| Goenshari | Limna Chhu | 27.70014 | 89.76869 | 71.00 | Aug |
| Goenshari | Memi Chhu | 27.70567 | 89.75358 | 27.00 | Aug |
| Goenshari | Menchuding Chhu | 27.71075 | 89.77950 | 0.59 | Aug |
| Goenshari | Nitchuluma Chhu | 27.71358 | 89.78308 | 0.12 | Aug |
| Goenshari | Rim Chhu | 27.66894 | 89.77319 | 2778.19 | April |
| Goenshari | Shongchalum Chhu | 27.70586 | 89.75000 | 42.30 | Aug |
| Goenshari | Zorilum | 27.70128 | 89.76667 | 12.32 | Aug |
| Guma | Lakhu Chhu | 27.62600 | 89.82528 | 29.00 | April |
| Guma | Lhakharung Chhu | 27.62600 | 89.82528 | 29.00 | April |
| Guma | Lhakharung Chhu | 27.62636 | 89.82531 | 24.08 | Aug |
| Guma | Nakhalum Chhu | 27.59239 | 89.86044 | 3.33 | Aug |
| Guma | Nakhu | 27.59239 | 89.86044 | 3.33 | Aug |
| Kabisa | Dungkhar Rong Chhu | 27.65719 | 89.77228 | 0.14 | Aug |
| Kabisa | Dungkhar Rong Chu | 27.65689 | 89.77192 | 84.08 | Aug |
| Kabisa | Jichuluma | 27.64561 | 89.77589 | 4760.00 | Aug |
| Kabisa | Zabi | 27.63428 | 89.80000 | 4.42 | Aug |
| Kabisa | Zabi Rong Chhu | 27.63464 | 89.80197 | 622.00 | April |
| Kabisa | Zabi Rong Chhu | 27.62197 | 89.78214 | 24.96 | Aug |
| Kabisa | Zagyemo Chhu | 27.64444 | 89.77975 | 12.46 | Aug |
| Shelnga-Bjemi | Shengana Chhu | 27.59439 | 89.87300 | 320.00 | April |
| Shelnga-Bjemi | Shengana Chhu | 27.59792 | 89.91097 | 2025.00 | Aug |
| Toedwang | Chawa Lum | 27.64722 | 89.87281 | 34.00 | Aug |
| Toedwang | Chawa Rong Chhu | 27.66139 | 89.89167 | 12.80 | Aug |
| Toedwang | Chunem Chhu | 27.66600 | 89.94228 | 92.00 | April |
| Toedwang | Chunem Chhu | 27.66694 | 89.94169 | 23.94 | Aug |
| Toedwang | Gaplumi Chhu | 27.68242 | 89.90731 | 3.17 | Aug |
| Toedwang | Gaplumi Chhu | 27.68219 | 89.90714 | 36.10 | April |
| Toedwang | Jora Rong Chhu | 27.68208 | 89.91100 | 2646.00 | April |
| Toedwang | Jora Rong Chhu | 27.68200 | 89.91097 | 48.52 | Aug |
| Toedwang | Kophulu Chhu | 27.66744 | 89.89428 | 0.71 | Aug |
| Toedwang | Sakomo Chhu | 27.68769 | 89.93031 | 13.98 | Aug |
| Toedwang | Tshokimo Rong Chhu | 27.64658 | 89.87272 | 272.00 | Aug |
| Toedwang | Zachulum | 27.68717 | 89.94806 | 0.37 | Aug |
| Toedwang | zamchu lumi Chhu | 27.68517 | 89.93719 | 0.42 | Aug |
| Toedwang | Zerilumi Chhu | 27.67133 | 89.89883 | 4.20 | Aug |
| Toepaisa | Toebi Rong Chhu | 27.53000 | 89.87778 | 463.00 | April |
| Toepaisa | Toebi Rong Chhu | 27.52981 | 89.86783 | 3701.00 | Aug |

### xi. Samdrup Jongkhar Dzongkhag

Samdrup Jongkhar Dzongkhag is located in South-Eastern Bhutan at an altitude range of 250 to 1900 metres above sea level and has a total area of 1,877.94 square kilometers. It has 11 Gewogs and a population of 35,059 as of 2016[12]. Total of 20 measurements, spread across the minor and major streams, were taken at various locations during the survey in Samdrup Jjongkhar Dzongkhag as shown in Figure 2-.The measurement sites are in 7 Gewogs of Samdrup Jongkhar.

As per the measured data, Re Changlu in Martshala Gewog had the highest discharge of 2,070.00 lps (liters per second) measured in June while the least was observed for *Dungley Pho Chhu* in Dewathang Gewog with a flow of 4.66 lps measured in December as shown in Table 2-12.

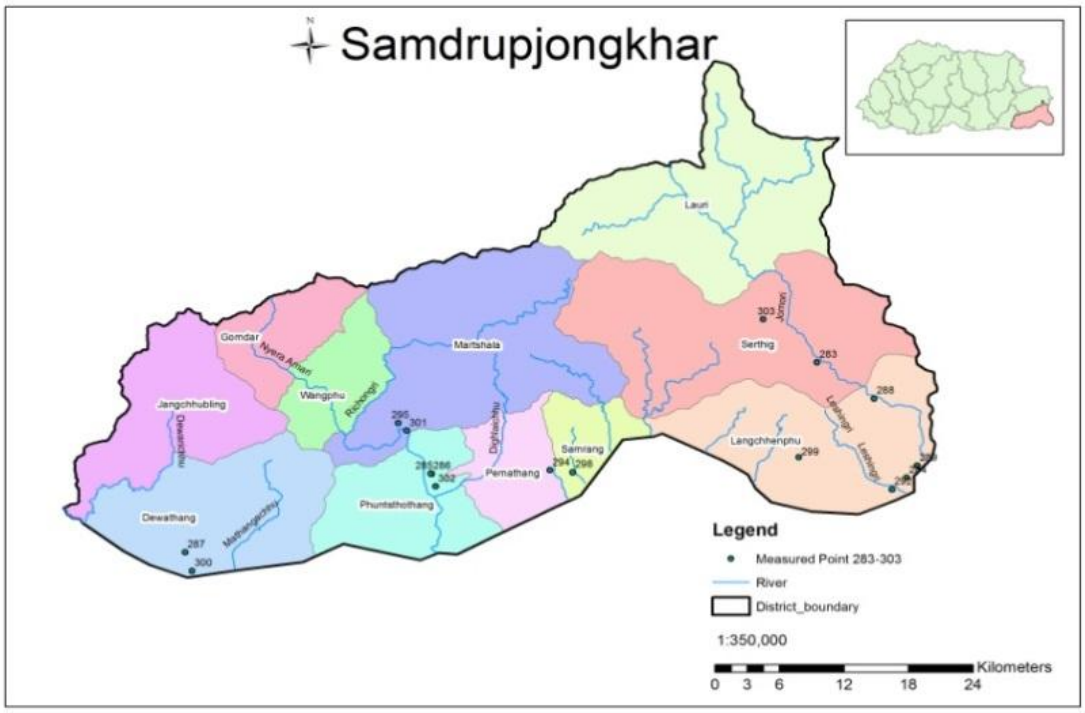


**Figure 2-12 Map of Samdrup Jongkhar Dzongkhag showing the locations of NWRI sites.**

**Table 2-12: NWRI Data for Samdrup Jongkhar Dzongkhag**

| Gewog | Stream_Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Dewathang | Dungley pho Chhu | 27.00739 | 90.14214 | 4.66 | Dec |
| Langchenphug | Augra Khola | 26.87967 | 92.09972 | 231.00 | Nov |
| Langchenphug | Chu Kap | 26.89036 | 92.10850 | 1452.00 | July |
| Langchenphug | Dewla khola | 26.86992 | 90.50022 | 179.35 | Dec |
| Langchenphug | Golanty Khola | 26.86933 | 92.08731 | 1952.00 | July |
| Langchenphug | Sarki khola | 26.89769 | 92.00944 | 14.50 | Dec |
| Martshala | Re Changlu | 26.92828 | 91.67439 | 2070.00 | July |

[12] NSB, 2017

| Gewog | Stream_Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Martshala | Rii changlu | 26.82961 | 91.34256 | 853.49 | June |
| Martshala | Tiki Re | 26.92150 | 91.68156 | 1255.00 | July |
| Pemathang | Newly Khola | 26.88633 | 91.80142 | 777.00 | July |
| Phuentshogthang | Bakuli khola | 26.88319 | 91.70222 | 832.00 | July |
| Phuentshogthang | Bakuli khola | 26.88333 | 91.70156 | 102.00 | Nov |
| Phuentshogthang | Throm Chhu | 26.79686 | 91.50206 | 190.00 | Dec |
| Phuentshogthang | Warang khola | 26.87186 | 91.70556 | 93.00 | Nov |
| Samrang | Samrang khola | 26.90367 | 91.81317 | 368.60 | Dec |
| Samrang | Samrang Khola | 26.88456 | 91.82019 | 1768.00 | July |
| Serthig | Aku Re | 26.98222 | 92.02481 | 1071.00 | July |
| Serthig | Cheti Re | 26.95014 | 92.07244 | 471.00 | July |
| Serthig | Jomo Chhu | 27.13339 | 88.91761 | 14.70 | Nov |
| Serthig | Zamtari Chhu | 27.02039 | 91.97964 | 532.00 | July |

### xii. Samtse Dzongkhag

Samtse Dzongkhag is located in South-Western Bhutan at an altitude range of 200 to 4400 metres above sea level and a total area of 1,309.1 square kilometers. It has 15 Gewogs and a total population of 70,618 as of 2016[13]. A total of 12 measurements were taken at various locations during the survey in Samtse Dzongkhag, spread across the minor and major streams in the Dzongkhag as shown in Figure 2-. The measurement sites are in 6 Gewogs of Samtse.

As per the measured data, Jiti khola at Tading Gewog had the highest flow of 7,225.12 lps (liters per second) in the month of May while the least was observed for Somju Khola with 1.79 lps at Tendruk Gewog measured in the month of December as shown in Table 2-13.

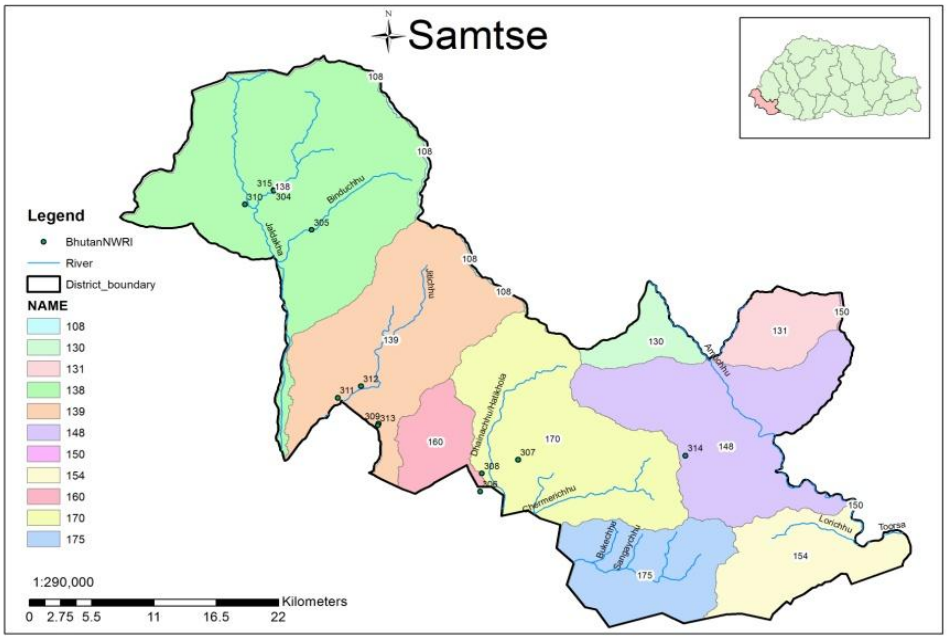


**Figure 2-13: Map of Samtse Dzongkhag showing the locations of NWRI sites.**

[13] NSB, 2017

**Table 2-13: NWRI Data for Samtse Dzongkhag**

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Duenchukha | Kartley khola | 26.94817 | 89.19775 | 25.50 | Dec |
| Norgaygang | Asamsa khola | 27.16603 | 88.87069 | 1691.11 | May |
| Norgaygang | Daina Chhu | 26.91869 | 89.03478 | 1044.23 | May |
| Norgaygang | Dipu Chhu | 26.93346 | 89.03602 | 221.70 | Dec |
| Norgaygang | Jaldrakha upper stream | 27.15431 | 88.84783 | 2516.32 | May |
| Samtse | Juthici khala | 26.97278 | 88.95350 | 671.16 | Dec |
| Sang-Ngag-Chhoeling | Gathriya Khola | 26.97442 | 88.95389 | 628.00 | May |
| Tading | Jiti khola | 26.99564 | 88.92158 | 7225.12 | May |
| Tading | Jiti khola | 27.00511 | 88.94003 | 5521.60 | Dec |
| Tendruk | Bindu Chhu | 27.13336 | 88.90097 | 2410.00 | May |
| Tendruk | Somju Khola | 27.16564 | 88.87086 | 1.79 | Dec |
| Ugyentse | Deepu Khola | 26.94469 | 89.06469 | 1262.00 | May |

### xiii. Sarpang Dzongkhag

Sarpang Dzongkhag is located in Southern Bhutan at an altitude range of 210 to 3600 metrea above sea level and has a total area of 1,655 square kilometers. It has 12 Gewogs with a total population of 45,636 as of 2016[14]. A total of 19 measurements, spread across the minor and major streams, were taken at various locations during the survey in Sarpang Dzongkhag as shown in Figure 2-. The measurement sites are in 7 Gewogs of Sarpang.

As per the measured data, Sisty Khola at Gakidling Gewog had the highest flow of 4,995.96 lps (liters per second), measured in June while the least discharge was observed for Mosani Khola under Chhuzaggang Gewog with 215.73 lps, measured in September as shown in Table 2-14.

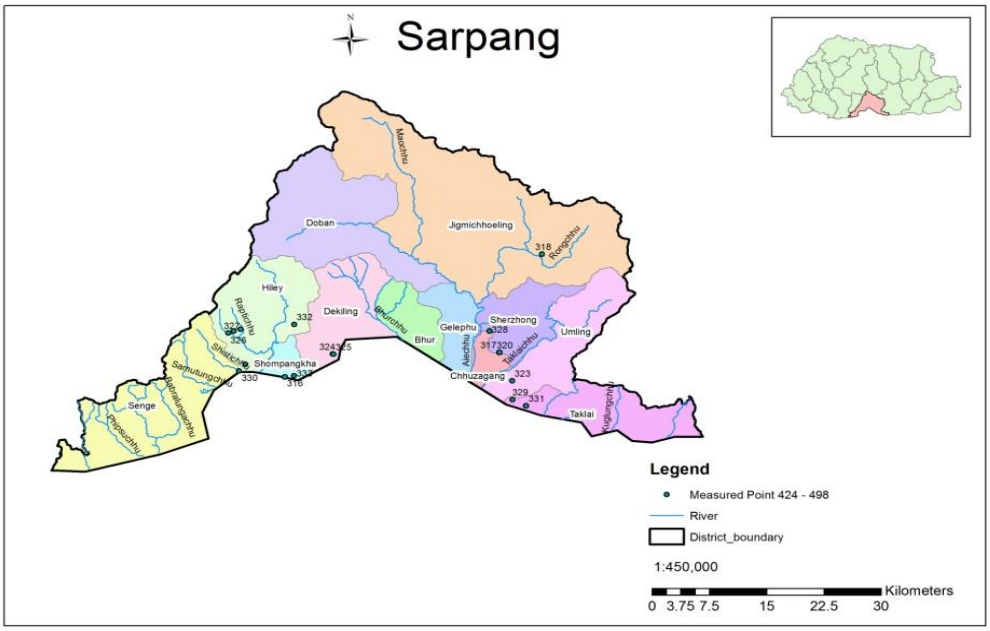


**Figure 2-14: Map of Sarpang Dzongkhag showing the locations of NWRI sites**

[14] NSB, 2017

**Table 2-14: NWRI Data for Sarpang Dzongkhag**

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Chhuzaggang | Jang Khurung Khola | 26.88406 | 90.54025 | 958.80 | July |
| Chhuzaggang | Mosani Khola | 26.91178 | 90.52861 | 215.73 | Sept |
| Dekidling | Lau Khola | 26.88186 | 90.34408 | 3660.01 | July |
| Dekidling | Lau Khola | 26.88156 | 90.34447 | 1712.75 | Sept |
| Dekidling | Tinbadey Khola | 26.86847 | 90.24119 | 254.85 | July |
| Gakidling | Ganday Khola | 26.91192 | 90.22747 | 771.12 | June |
| Gakidling | Kala Khola | 26.91383 | 90.23539 | 560.17 | June |
| Gakidling | Loring Khola | 26.90900 | 90.22075 | 1418.23 | June |
| Gakidling | Loring Khola | 26.90900 | 90.22075 | 2276.64 | Sept |
| Gakidling | Sisty Khola | 26.85997 | 90.23369 | 4995.96 | June |
| Jigme-Chhoeling | Bateni Khola | 26.88406 | 90.54011 | 343.67 | Sept |
| Jigme-Chhoeling | Baytine Khola | 27.01078 | 90.59031 | 542.64 | Sept |
| Shompangkha | Aku Khola | 26.85267 | 90.28733 | 307.53 | Sept |
| Shompangkha | Kami Khola | 26.86867 | 90.26478 | 563.04 | Sept |
| Shompangkha | Thar Khola | 26.92019 | 90.29864 | 540.54 | June |
| Shompangkha | Thar Khola | 26.85378 | 90.29850 | 461.04 | Sept |
| Taraythang | Singay Khola | 26.82322 | 90.55583 | 771.80 | July |
| Taraythang | Sukun Takley Khola | 26.81508 | 90.57161 | 348.84 | July |
| Umling | Langar Khola | 26.84725 | 90.55539 | 1267.03 | July |

### xiv. Thimphu Dzongkhag

Thimphu Dzongkhag is located in Western Bhutan at an average altitude of 2330 metres above sea level and has a total area of 1,795.87 square kilometers. It has 8 Gewogs and a total population of 116,012 as of 2015[15]. A total of 32 measurements, spread across the minor and major streams of *Wang Chhu*, were taken at various locations during the survey in Thimphu Dzongkhag as shown in Figure 2-. The measurement sites are in 7 Gewogs of Thimphu.

As per the measured data, *Wang Chhu* in Kawang Gewog had the highest flow of 15,422.40 lps (liters per second) measured in the month of May while the least discharge was recorded for Upper Motithang Stream in Kawang Gewog with 0.39 lps as shown in Table 2-15.

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[15] NSB, 2016

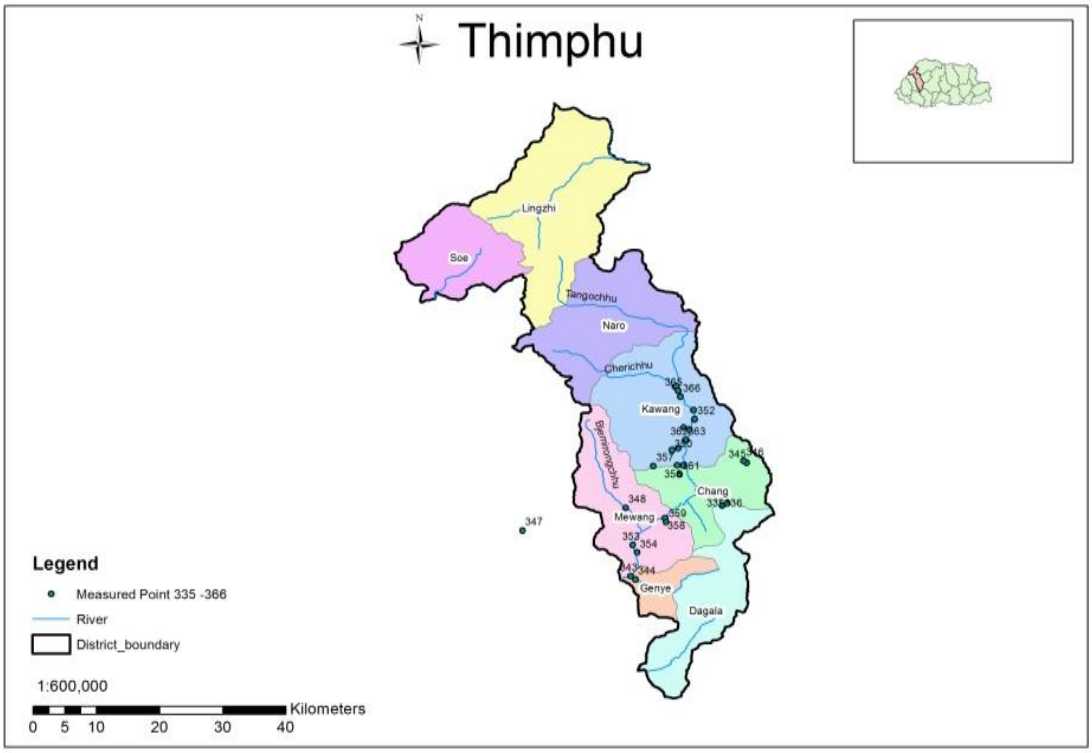


**Figure 2-15: Map of Thimphu Dzongkhag showing the locations of NWRI sites.**

**Table 2-15: NWRI Data for Thimphu Dzongkhag**

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Chang | Dechenphu Chhu | 27.53431 | 89.63992 | 357.00 | May |
| Chang | Dechenphu Chhu | 27.53114 | 89.64764 | 49.00 | Dec |
| Chang | Hongtsho Chhu | 27.48372 | 89.72933 | 273.11 | Dec |
| Chang | Hongtsho Chhu | 27.48631 | 89.72514 | 73.00 | May |
| Chang | Motithang Chhu | 27.47969 | 89.63050 | 109.00 | Dec |
| Chang | Ola Rong Chhu | 27.44347 | 89.66044 | 457.00 | May |
| Chang | R.I.C.B Chhu | 27.46675 | 89.63411 | 76.00 | May |
| Darkarla | Chamgang Chhu | 27.42494 | 89.70167 | 136.10 | Dec |
| Darkarla | Chamgang Chhu | 27.42228 | 89.69442 | 128.00 | Dec |
| Ge-Nyen | Genekha Chhu | 27.32039 | 89.56450 | 1084.60 | May |
| Ge-Nyen | Genekha Chhu | 27.31583 | 89.57097 | 915.00 | Dec |
| Kawang | Chari Chhu | 27.59325 | 89.62850 | 2319.07 | May |
| Kawang | Chari Chhu | 27.59325 | 89.62797 | 1952.00 | May |
| Kawang | Dodhena Chhu | 27.59361 | 89.62900 | 671.50 | May |
| Kawang | Dozam Chhu | 27.55900 | 89.65397 | 546.00 | May |
| Kawang | Jungshina Rong Chhu | 27.50433 | 89.63247 | 127.00 | May |

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Kawang | Jungshina Rong Chhu | 27.50203 | 89.62300 | 98.00 | Dec |
| Kawang | Kabasa Chhu | 27.54594 | 89.65503 | 776.05 | May |
| Kawang | Kabisa Chhu | 27.54639 | 89.65578 | 256.00 | Dec |
| Kawang | Motithang downstream | 27.47967 | 89.63925 | 76.00 | May |
| Kawang | Motithang upper Stream | 27.47897 | 89.59694 | 0.39 | May |
| Kawang | Taba Rong Chhu | 27.51589 | 89.64364 | 97.00 | Dec |
| Kawang | Taba Rong Chhu | 27.51614 | 89.64253 | 92.00 | Dec |
| Kawang | Tago Chhu | 27.58717 | 89.63222 | 48.38 | Dec |
| Kawang | Tango Chhu | 27.58719 | 89.63200 | 50.00 | May |
| Kawang | Wang Chhu | 27.57878 | 89.63494 | 15422.40 | May |
| Maedwang | Jiminang down stream | 27.38614 | 89.41056 | 188.00 | Dec |
| Maedwang | Jiminang upper stream | 27.41869 | 89.55736 | 7897.00 | May |
| Maedwang | Khariphu Rong Chhu | 27.36514 | 89.56747 | 149.00 | Dec |
| Maedwang | Lumnang Chhu | 27.35433 | 89.57389 | 201.00 | May |
| Maedwang | Namseling Chhu | 27.40403 | 89.61328 | 121.95 | Dec |
| Maedwang | Namseling Chhu | 27.39803 | 89.61494 | 425.00 | May |

### xv. Trashigang Dzongkhag

Trashigang Dzongkhag is located in Eastern Bhutan at an average altitude range of 4500 metres above sea level and a total area of 3,006.99 square kilometers. It has 15 Gewogs with a total population of 56,168 as of 2015[16]. Total of 31 measurements, spread across the minor and major streams, were taken at various locations during the survey in Trashigang Dzongkhag as shown in Figure 2-. The measurement sites were in 12 Gewogs of Trashigang.

As per the mesuments at various locations, *Morbhi Chhu* at Sagteng Gewog had the highest flow of 2,327.00 lps (liters per second) measured in November while the least discharge was recorded for *Shesukam Chhu* in Lumang Gewog with 0.08 lps in November as shown in Table 2-16.

[16] NSB, 2016

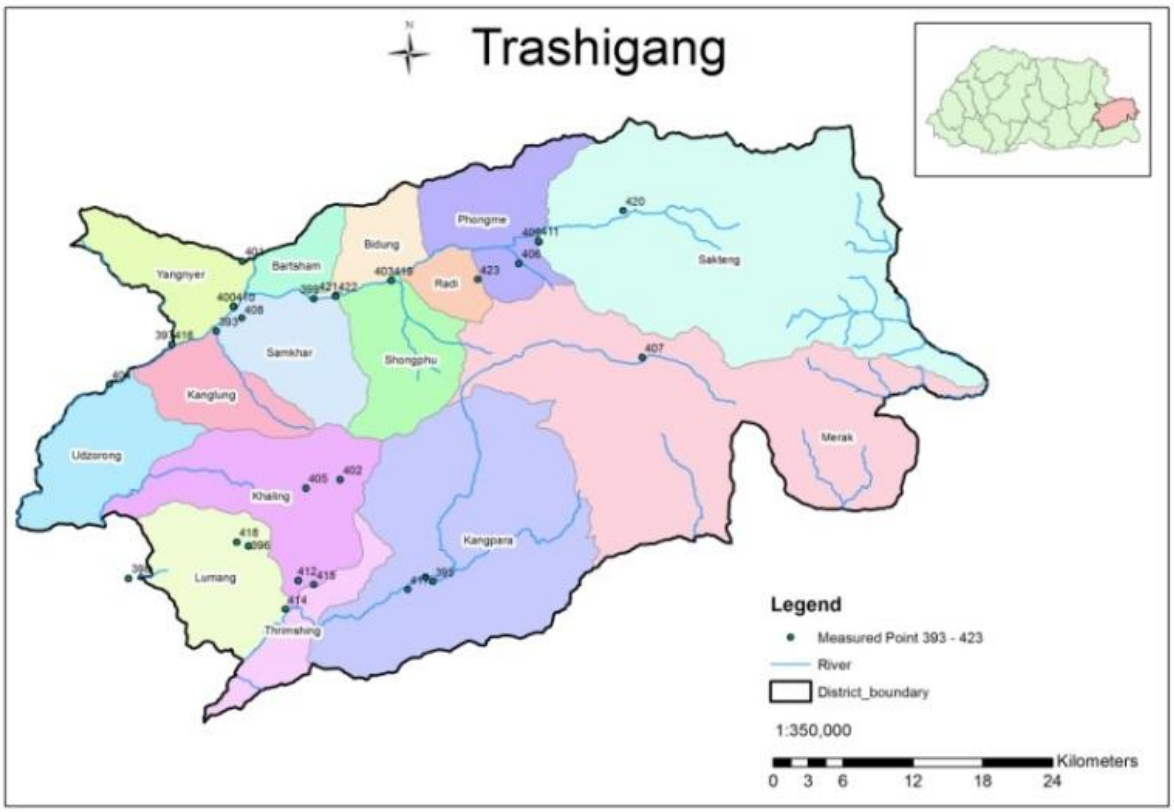


**Figure 2-16: Map of Trashigang Dzongkhag showing the locations of NWRI sites**

**Table 2-16: NWRI Data for Trashigang Dzongkhag**

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Kanglung | Bamri Chhu | 27.32011 | 91.53233 | 639.59 | June |
| Kanglung | Bodidrang | 27.27208 | 91.53072 | 210.33 | Nov |
| Kangpar | Chungdray Chhu | 27.12492 | 91.69939 | 397.65 | Nov |
| Kangpar | Nyera Ama Chhu | 27.12850 | 91.69394 | 1363.14 | June |
| Kangpar | Shelparong Chhu | 27.11886 | 91.68022 | 168.30 | Nov |
| Khaling | Jiri Chhu | 27.20447 | 91.62806 | 2019.60 | June |
| Khaling | Khola Chhu | 27.19792 | 91.60147 | 134.00 | Nov |
| Lumang | Demgang Chhu | 27.15272 | 91.55703 | 13.71 | Nov |
| Lumang | Gangrigang Chhu | 27.12756 | 91.46439 | 415.50 | June |
| Lumang | Shesukam Chhu | 27.15581 | 91.54789 | 0.08 | Nov |
| Merag | Merak Chhu | 27.29958 | 91.86142 | 1588.48 | June |
| Phongmed | Manthong Drang Chhu | 27.37272 | 91.76611 | 637.44 | Nov |
| Phongmed | Yedi Re | 27.36036 | 91.73419 | 863.64 | June |
| Sagteng | Morbi Chhu | 27.38967 | 91.78158 | 2327.00 | June |

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Sagteng | Murbi Chhu | 27.39031 | 91.78125 | 596.70 | June |
| Sagteng | Sona Chhu | 27.41394 | 91.84639 | 709.57 | June |
| Samkhar | Ghodhi Chhu | 27.34528 | 91.60769 | 1.90 | Nov |
| Samkhar | Methidrang Chhu | 27.33022 | 91.55200 | 219.45 | Nov |
| Shongphoog | Khartse Re | 27.35958 | 91.66736 | 1964.50 | June |
| Shongphoog | Shongphu Chhu | 27.35961 | 91.66728 | 2051.00 | June |
| Shongphoog | Thungdi Chhu | 27.34753 | 91.62444 | 881.88 | Nov |
| Shongphoog | Thungdi Chhu | 27.34711 | 91.62439 | 3616.00 | Nov |
| Thrimshing | Numshing | 27.12581 | 91.59542 | 236.00 | Nov |
| Thrimshing | Pangzam Chhu | 27.10339 | 91.58556 | 2106.30 | June |
| Thrimshing | Phongyaung Ri | 27.12258 | 91.60772 | 325.00 | Nov |
| Udzorong | Kheng Re | 27.27850 | 91.44953 | 207.57 | June |
| Yangnyer | Duroong Chhu | 27.30972 | 91.49775 | 673.20 | Nov |
| Yangnyer | Gongdung Chhu | 27.33933 | 91.54575 | 2.32 | Nov |
| Yangnyer | Jamkhar Shang Chhu | 27.37464 | 91.55233 | 501.59 | June |
| Yangnyer | Morongdrang Chhu | 27.33931 | 91.54539 | 61.96 | Nov |
| Yangnyer | Rolong Re | 27.30969 | 91.49772 | 459.00 | June |

### xvi. Trashiyangtse Dzongkhag

Trashiyangtse Dzongkhag is located in North-Eastern Bhutan at an altitude range of 500 to 5401 metres above sea level and has a total area of 1,438.8 square kilometers. It has 8 Gewogs and a population of 20,874 as of 2016[17]. A total of 26 measurements, spread across the minor and major streams of *Kholong Chhu,* were taken at various locations during the survey in Trashiyangtse Dzongkhag as shown in Figure 2-. The measurement sites are in 6 Gewogs of Trashiyangtse.

From the measured data, *Nagpala Chhu* at Boomdeling Gewog had the highest flow of 2,190.00 lps (liters per second) measured in November while the least discharge was observed for *Shakposhong Chhu* in Tongmizhangsa Gewog with 2.58 lps measured in June as shown in Table 2-17.

[17] NSB, 2017

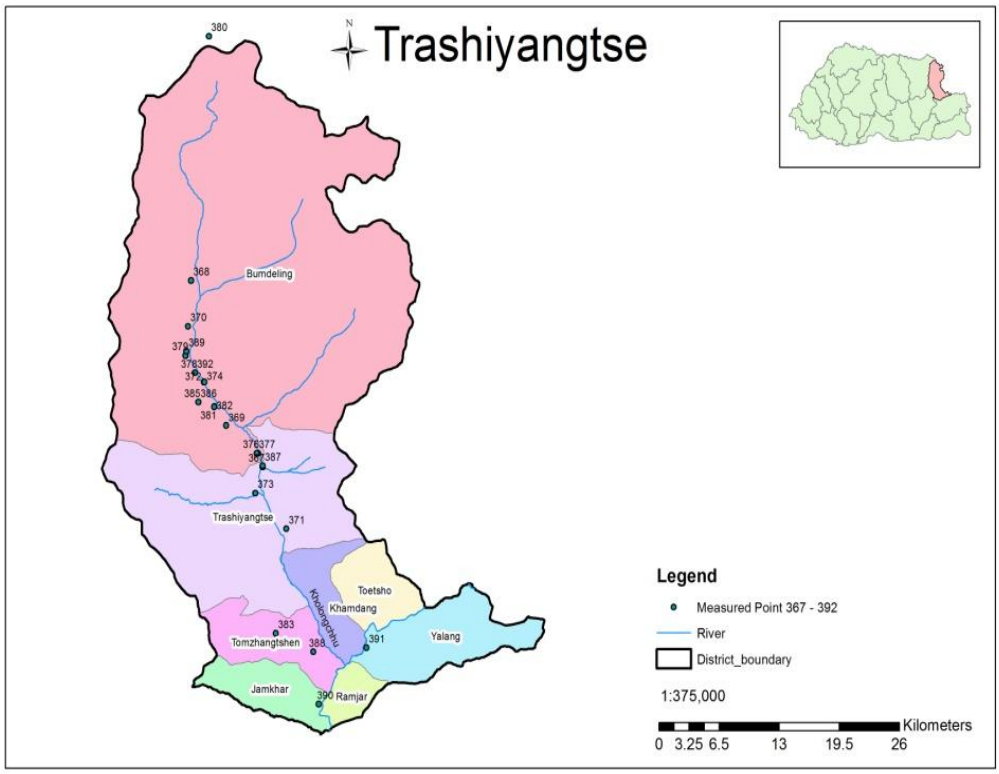


**Figure 2-17: Map of Trashiyangtse Dzongkhag showing the locations of NWRI sites.**

**Table 2-17: NWRI Data for Trashiyangtse Dzongkhag**

| Gewog | Stream Name | Latitude | Longitude | Discharge lps) | Month measured |
|---|---|---|---|---|---|
| Boomdeling | Bhareygang Chhu | 27.77036 | 91.42672 | 627.66 | June |
| Boomdeling | Chhudegang Chhu | 27.64361 | 91.46117 | 135.11 | Nov |
| Boomdeling | Chimikang Chhu | 27.73025 | 91.42403 | 57.12 | Nov |
| Boomdeling | Chutkang chupang | 27.68169 | 91.43947 | 52.99 | Nov |
| Boomdeling | Japang Chhu | 27.68167 | 91.44000 | 213.00 | Nov |
| Boomdeling | Kongkang Chhu | 27.70492 | 91.42175 | 130.05 | Nov |
| Boomdeling | Kuktur Gang Chhu | 27.61914 | 91.49189 | 119.00 | Nov |
| Boomdeling | Kuktur Gang Chhu | 27.61917 | 91.49083 | 745.82 | Nov |
| Boomdeling | Kungkang | 27.70483 | 91.42175 | 139.00 | June |
| Boomdeling | Kungkang | 27.70481 | 91.42153 | 1007.25 | June |
| Boomdeling | Langkhar Chhu (Tarphangdong) | 27.98417 | 91.44417 | 142.00 | Nov |
| Boomdeling | Limbu Chhu | 27.66008 | 91.44964 | 366.79 | June |
| Boomdeling | Lingbu Chhu | 27.66006 | 91.44944 | 701.72 | June |
| Boomdeling | Nagpala Chhu | 27.66386 | 91.43392 | 2190.00 | June |
| Boomdeling | Nakpola Chhu | 27.66386 | 91.43392 | 341.53 | June |
| Boomdeling | Sisikang Chueng | 27.70847 | 91.42219 | 1480.30 | June |
| Boomdeling | Zamadung Chhu | 27.68956 | 91.43058 | 238.27 | June |
| Jamkhar | Tshergom Chhu | 27.39978 | 91.55100 | 164.48 | June |
| Toedtsho | Lungdar Chhu | 27.46169 | 91.50933 | 1647.48 | June |
| Tongmizhangsa | Mannen Chhu | 27.45128 | 91.53175 | 30.69 | Nov |
| Tongmizhangsa | Shakposhong Chhu | 27.44544 | 91.54600 | 2.58 | June |
| Yalang | Yalang Chhu | 27.44917 | 91.59753 | 56.23 | Nov |

| Gewog | Stream Name | Latitude | Longitude | Discharge lps) | Month measured |
|---|---|---|---|---|---|
| Yangtse | Berzam Chhu | 27.60722 | 91.49647 | 1020.80 | June |
| Yangtse | Chumde Chhu | 27.55314 | 91.51967 | 301.27 | Nov |
| Yangtse | Dongdi Chhu | 27.58431 | 91.48931 | 1138.32 | June |
| Yangtse | Serkang Chhu | 27.60819 | 91.49642 | 384.90 | Nov |

### xvii. Trongsa Dzongkhag

Trongsa Dzongkhag is located in Central Bhutan with at an altitude range of 800 to 4800 metres above sea level and has a total area of 1,807 square kilometers. It has 5 Gewogs and a total population of 16,012 as of 2015[18]. A total of 75 measurements, spread across the minor and major streams of *Mangdue Chhu,* were taken at various locations during the survey in Trongsa Dzongkhag as shown in Figure 2-. The measurement sites are in 4 Gewogs of Trongsa.

From the measured data, *Tharkhazam Chhu* in Nubi Gewog had the highest discharge of 6,691.00 lps (liters per second) measured in July while the least discharge was recorded for *Chattsham Chhu* in Nubi Gewog with 0.08 lps measured in November as shown in Table 2-18.

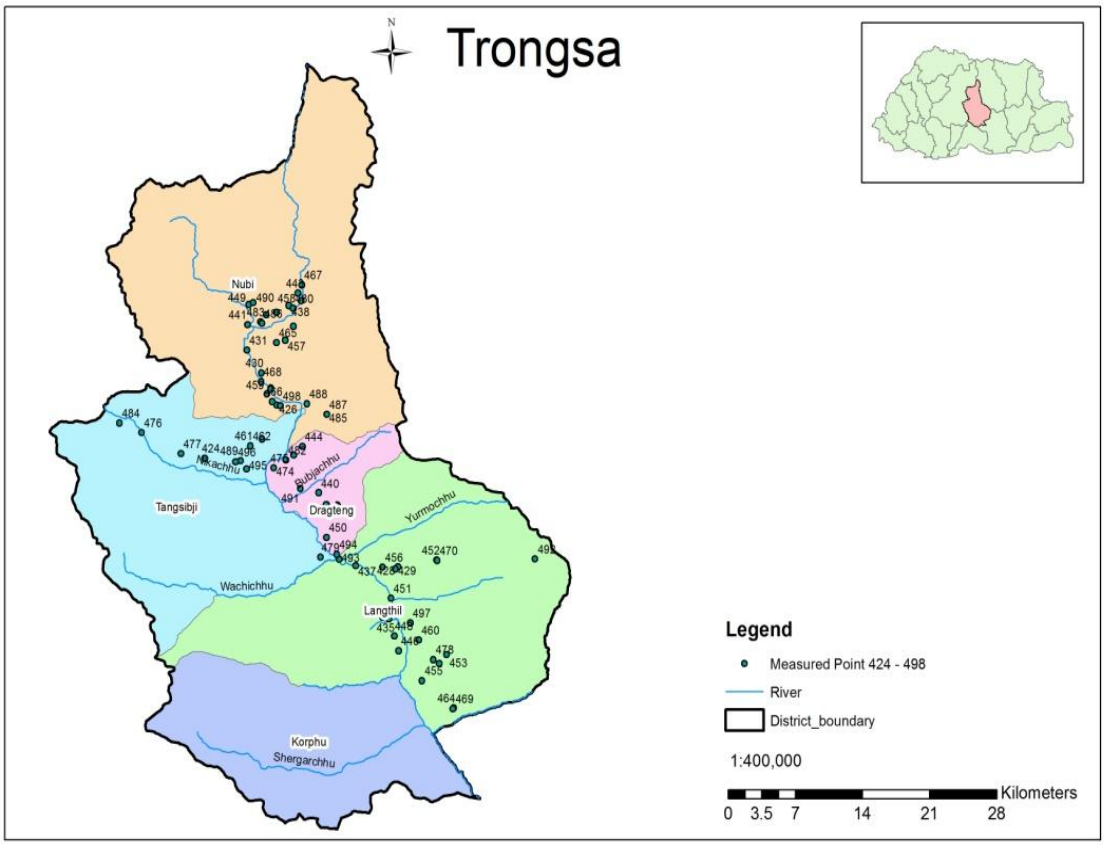


**Figure 2-18: Map of Trongsa Dzongkhag showing the locations of NWRI sites.**

[18] NSB, 2016

Table 2-18: NWRI Data for Trongsa Dzongkhag

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Draagteng | Chorgang | 27.31742 | 90.57647 | 0.20 | Oct |
| Draagteng | Dorjeemo Chhu | 27.42386 | 90.51661 | 145.00 | July |
| Draagteng | Drup Chhu | 27.41325 | 90.52383 | 15.01 | Oct |
| Draagteng | Dzongkhalungma Chhu | 27.46292 | 90.50128 | 652.46 | Sept |
| Draagteng | Jangchub Chhu | 27.45578 | 90.49331 | 137.09 | July |
| Draagteng | Kabsilum Chhu | 27.38542 | 90.52397 | 2.02 | Oct |
| Draagteng | Nargang Chhu 1 | 27.44464 | 90.47456 | 67.32 | Oct |
| Draagteng | Nargang Chhu 1 | 27.41294 | 90.53417 | 95.00 | July |
| Draagteng | Nargang Chhu 2 | 27.41239 | 90.53444 | 137.00 | July |
| Draagteng | Nargang Chhu | 27.44464 | 90.47456 | 67.32 | July |
| Draagteng | Nargang Chhu | 27.44464 | 90.47456 | 67.32 | June |
| Draagteng | Pongpori Chhu | 27.36859 | 90.51832 | 0.37 | Oct |
| Draagteng | Shajukpa Chhu and Tekhang Chhu | 27.41344 | 90.52364 | 30.00 | Oct |
| Draagteng | Taktshelum Chhu | 27.45131 | 90.48592 | 204.00 | Sept |
| Draagteng | Yeshey chhu | 27.42697 | 90.49961 | 0.00 | Oct |
| Langthil | Burang Crok Chhu | 27.36025 | 90.59100 | 197.00 | Oct |
| Langthil | Burgang | 27.35864 | 90.58864 | 437.00 | Sept |
| Langthil | Chirangla | 27.32172 | 90.56583 | 0.77 | Oct |
| Langthil | Chumpaigang Chhu | 27.31625 | 90.58256 | 373.00 | Sept |
| Langthil | Churugang Chhu | 27.36142 | 90.55139 | 138.59 | July |
| Langthil | Jangbi Chhu | 27.28872 | 90.59156 | 1.84 | Oct |
| Langthil | Jawkhay | 27.30139 | 90.58767 | 10.00 | Oct |
| Langthil | Kango Nago Chhu | 27.33358 | 90.58450 | 208.00 | Oct |
| Langthil | Kartey Chhu | 27.36608 | 90.62714 | 56.97 | Oct |
| Langthil | Kartigang Chhu | 27.28542 | 90.63675 | 955.00 | Sept |
| Langthil | Kartigang Chhu | 27.27786 | 90.62950 | 791.70 | July |
| Langthil | Kawtang Chhu | 27.26333 | 90.61361 | 4.61 | Oct |
| Langthil | khamina Chhu | 27.35992 | 90.57664 | 3.57 | Oct |
| Langthil | La Chhu | 27.29794 | 90.61056 | 41.00 | Oct |
| Langthil | Leegang Chhu | 27.24006 | 90.64331 | 9.00 | Oct |
| Langthil | Marjian Chhu | 27.23925 | 90.64256 | 15.00 | Oct |
| Langthil | Mophai Chhu | 27.36586 | 90.62781 | 5.89 | Oct |
| Langthil | Pho Chhu | 27.28131 | 90.62417 | 270.00 | Oct |
| Langthil | Yuksa Chhu | 27.36697 | 90.71964 | 5035.00 | July |
| Langthil | Yurmung Chhu | 27.36678 | 90.53567 | 2976.80 | July |
| Langthil | Yurmung Womrong Chhu | 27.37089 | 90.53378 | 25.00 | Oct |
| Langthil | Zengang Khsok Chhu | 27.31242 | 90.60261 | 10.77 | Oct |
| Nubi | Bongzam Chhu | 27.58744 | 90.50025 | 1368.52 | Sept |
| Nubi | Booktula Chhu | 27.49839 | 90.47717 | 1.07 | Sept |
| Nubi | Bra-Tsham-Bra Chhu | 27.51300 | 90.47172 | 6.98 | Sept |
| Nubi | Chambay Gang Chhu | 27.52592 | 90.46308 | 996.00 | Sept |
| Nubi | charchargang Chhu | 27.54522 | 90.44931 | 1181.00 | Sept |
| Nubi | Chattsham | 27.57550 | 90.46758 | 0.08 | Nov |
| Nubi | Chungna Chhu | 27.56575 | 90.49272 | 37.60 | Sept |

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Nubi | Dophu Chhu | 27.58331 | 90.48872 | 2.23 | Nov |
| Nubi | Dophu Ung Chhu | 27.57769 | 90.47689 | 6.60 | Sept |
| Nubi | Drangne Chhu | 27.56703 | 90.44986 | 5097.00 | June |
| Nubi | Dunkar Chhu | 27.59394 | 90.49706 | 1.10 | Sept |
| Nubi | Kaaba Chhu | 27.58414 | 90.45108 | 2.23 | Sept |
| Nubi | Khangalang Chhu | 27.55383 | 90.48525 | 73.00 | Sept |
| Nubi | Kharkhang | 27.58100 | 90.49294 | 1617.00 | June |
| Nubi | Khensaro Chhu | 27.50769 | 90.46832 | 73.11 | Sept |
| Nubi | Lapbra Chhu | 27.51219 | 90.47189 | 6.16 | Sept |
| Nubi | Lekchung Rok | 27.55164 | 90.47700 | 1.21 | Sept |
| Nubi | Limdhang | 27.50150 | 90.47311 | 16.36 | Sept |
| Nubi | Linga Chhu | 27.60097 | 90.50069 | 183.00 | Sept |
| Nubi | Mangdung Chhu | 27.51839 | 90.46267 | 86.00 | Sept |
| Nubi | Ralang Chhu | 27.58086 | 90.49264 | 3.70 | Sept |
| Nubi | Tamshong | 27.56928 | 90.46208 | 3.50 | Sept |
| Nubi | Telegang Chhu | 27.49053 | 90.52431 | 2080.00 | June |
| Nubi | Tharchen Chhu | 27.56806 | 90.46361 | 3.41 | Sept |
| Nubi | Tharkhazam Chhu | 27.49036 | 90.52431 | 6691.00 | July |
| Nubi | Thruepang Chhu | 27.49953 | 90.50564 | 884.00 | Sept |
| Nubi | Yeba Chhu | 27.58592 | 90.45550 | 538.60 | Sept |
| Nubi | Zomji Brangsa | 27.49767 | 90.48064 | 1.58 | Sept |
| Tangsibji | Bangla Chubalar Chhu | 27.45306 | 90.40967 | 253.00 | Sept |
| Tangsibji | Gongkho Chhu | 27.46936 | 90.46372 | 1167.00 | Sept |
| Tangsibji | La Chhu | 27.46375 | 90.45264 | 209.00 | Sept |
| Tangsibji | La Chhu | 27.46361 | 90.45261 | 115.65 | July |
| Tangsibji | Nyala Drangla | 27.47486 | 90.35061 | 1150.00 | Sept |
| Tangsibji | Pemjee Chhu | 27.45686 | 90.38736 | 318.00 | Sept |
| Tangsibji | Tangruba Chhu(hydropowerchannel) | 27.48303 | 90.32994 | 1103.00 | Sept |
| Tangsibji | Tsheringmo Droup Chhu | 27.45089 | 90.44344 | 3.04 | Sept |
| Tangsibji | Zalam Chhu | 27.44386 | 90.44886 | 74.00 | Sept |
| Tangsibji | Zalam Chhu(Naaginazam) | 27.44994 | 90.43867 | 675.00 | Sept |

### xviii. Tsirang Dzongkhag

Tsirang Dzongkhag is located in Southern Bhutan at an average altitude of 1700 metres above sea level and has a total area of 639 Square kilometers. It has 12 Gewogs with a population of 21,816 as of 2015[19]. Total of 21 measurements, spread across the minor and major streams of *Punatsang Chhu,* were taken at various locations during the survey in Tsirang Dzongkhag as shown in Figure 2-. The measurement sites are in 6 Gewogs of Tsirang.

[19] NSB, 2016

From the measured data, *Buri Chhu* in Sergithang Gewog had the highest flow of 5,472.00 lps (liters per second) measured in the month of October while the minimum discharge was recorded for Pau Khola in Patshaling Gewog with 26.00 lps as shown in Table 2-19.

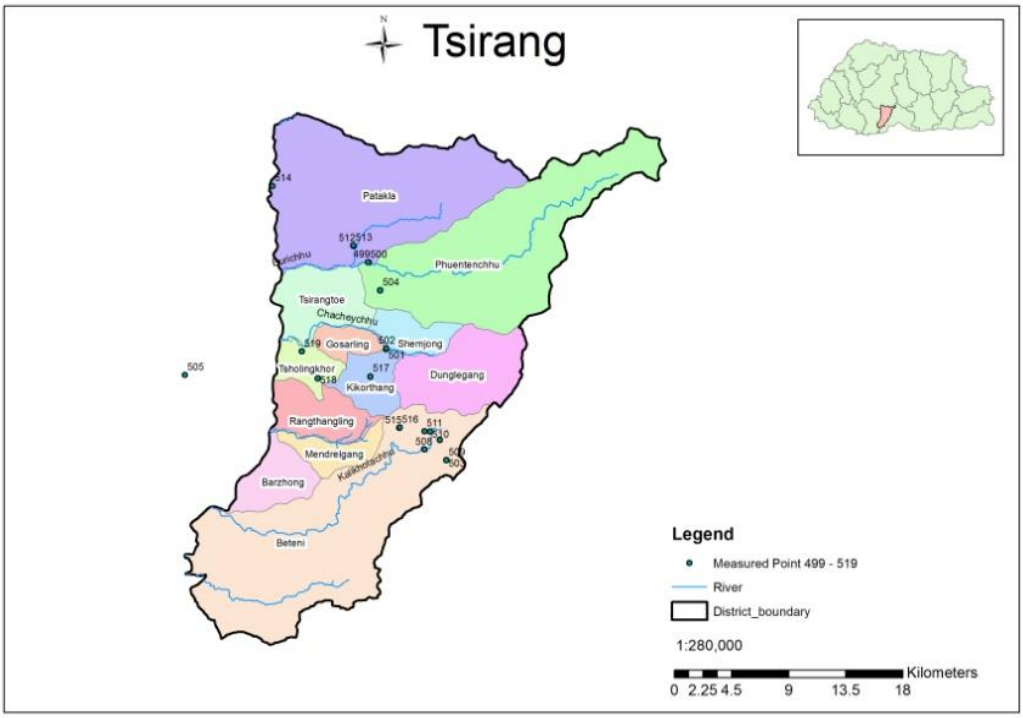


**Figure 2-19: Map of Tsirang Dzongkhag showing the locations of NWRI sites.**

**Table 2-19: NWRI Data for Tsirang Dzongkhag**

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Kilkhorthang | Dungri Khola | 27.00739 | 90.00881 | 312.72 | May |
| Kilkhorthang | Sidha Khola | 27.00639 | 90.14017 | 125.00 | Oct |
| Patshaling | Dara Chhu | 26.94750 | 90.19400 | 107.00 | May |
| Patshaling | Gatey Chhu | 26.96161 | 90.18942 | 109.00 | May |
| Patshaling | Gatey Chhu | 26.96167 | 90.18939 | 77.88 | Oct |
| Patshaling | Kali Khola | 26.95486 | 90.17867 | 182.00 | May |
| Patshaling | Kali Khola | 26.94747 | 90.19394 | 143.36 | Oct |
| Patshaling | Kuchi Khola | 26.96753 | 90.18233 | 66.00 | Oct |
| Patshaling | Kuchi Khola | 26.96781 | 90.17850 | 350.00 | May |
| Patshaling | Pau Khola | 26.96997 | 90.16078 | 26.00 | Oct |
| Patshaling | Pau Khola | 26.97050 | 90.16083 | 276.74 | May |
| Pungtenchhu | Dhanshari Chhu | 27.06700 | 90.14714 | 54.00 | Oct |
| Semjong | Changchey Chhu | 27.02544 | 90.15119 | 203.00 | Oct |
| Semjong | Changchey Chhu | 27.02608 | 90.15142 | 1773.58 | May |
| Sergithang | Buri Chhu | 27.08678 | 90.13889 | 1570.60 | Oct |
| Sergithang | Buri Chhu | 27.08669 | 90.13842 | 5472.00 | May |
| Sergithang | Lara Chhu | 27.09831 | 90.12822 | 335.00 | May |
| Sergithang | Lara Chhu | 27.09853 | 90.12803 | 2506.00 | Oct |
| Sergithang | Nenchenthang Chhu | 27.14050 | 90.07094 | 154.00 | April |
| Tsholingkhar | Tshokhona Chhu | 27.00500 | 90.10294 | 42.00 | Oct |
| Tsholingkhar | Tshokhona Chhu | 27.02400 | 90.09169 | 50.00 | Oct |

### xix. Wangduephodrang Dzongkhag

Wangduephodrang Dzongkhag is located in North-West Bhutan at an altitude range of 800 to 5000 metres above sea level and has a total area of 4,029.03 Square kilometers. It has 15 Gewogs and a population of 37,554 as of 2015[20]. A total of 32 measurements, spread across the minor and major streams of *Punatsang Chhu,* were taken during the survey at various locations in Wangduephodrang Dzongkhag as shown in Figure 2-. The measurements were taken in 10 Gewogs of Wangduephodrang Dzongkhag.

From the measured data, *Chazam Chhu/Nika Chhu* in Sephu Gewog had the highest flow of 10,356.57 lps (liters per second) measured in September while the least discharge was recorded for *Lawalum Chhu* in Gase Tshogongm Gewog with 0.58 lps as shown in Table 2-20.

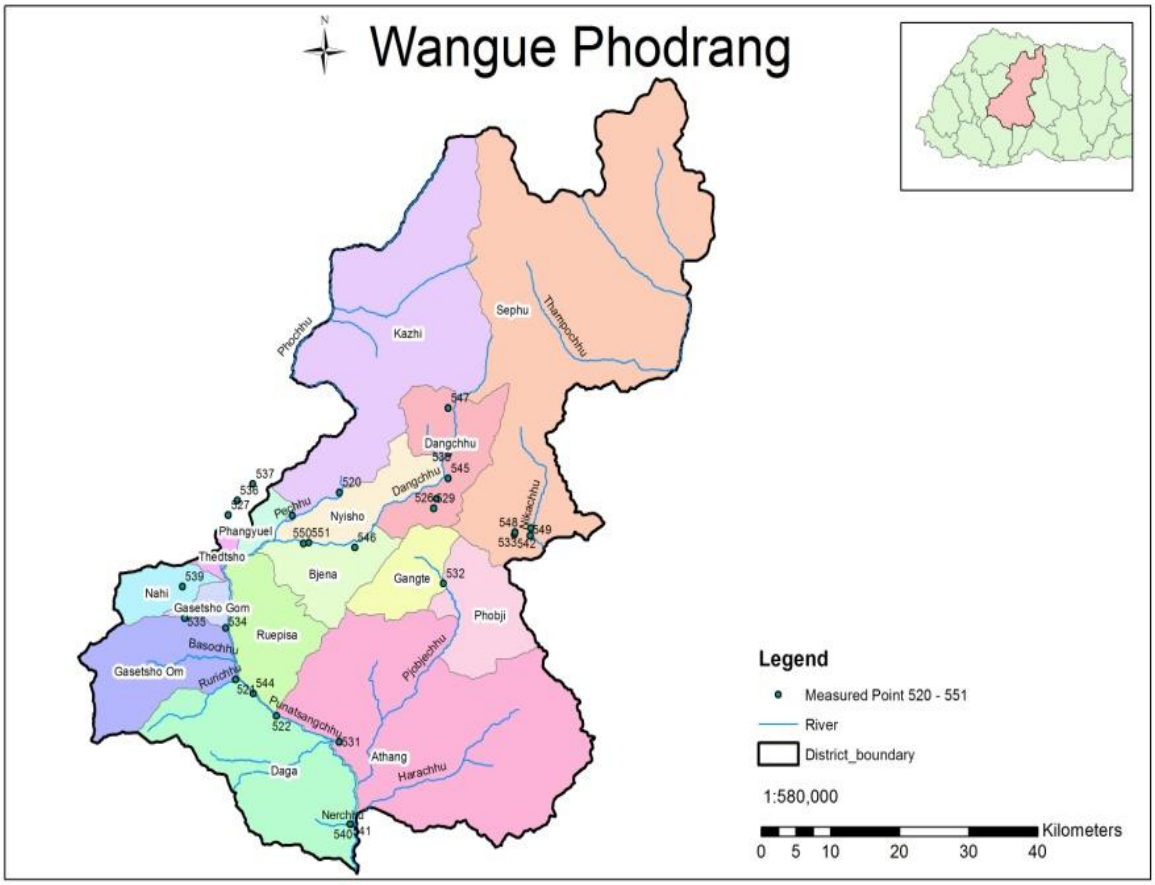


**Figure 2-20: Map of Wangduephodrang Dzongkhag showing the locations of NWRI sites.**

[20] NSB, 2016

**Table 2-20: NWRI Data for Wangduephodrang Dzongkhag**

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Athang | Dee Chhu | 27.26869 | 90.04922 | 3100.00 | Sept |
| Athang | Pangza Chhu | 27.32572 | 89.93747 | 166.00 | April |
| Bjednag | Wokha Chhu | 27.49783 | 90.06978 | 893.00 | Sept |
| Bjednag | Zenkhechongna Chhu | 27.50289 | 90.00289 | 1.64 | April |
| Bjednag | Zhenkey Shong Chhu | 27.50344 | 90.01003 | 197.00 | Sept |
| Dangchhu | Bena Rong Chhu | 27.60864 | 90.19172 | 688.00 | Sept |
| Dangchhu | Chubana Chhu | 27.61917 | 90.19572 | 1639.00 | Sept |
| Dangchhu | Chubashong | 27.55522 | 90.17622 | 312.80 | Sept |
| Dangchhu | Chunatsho Chhu | 27.54414 | 90.17197 | 289.00 | April |
| Dangchhu | Tsamutsho Chhu | 27.57933 | 90.19111 | 190.00 | April |
| Dangchhu | Zame Chhu | 27.66250 | 90.19119 | 1034.88 | Sept |
| Darkar | Bay Chhu | 27.29892 | 89.96756 | 359.00 | April |
| Darkar | Nyera Chhu | 27.17114 | 90.06383 | 820.00 | April |
| Darkar | Nyerey Chhu | 27.17131 | 90.06339 | 1168.75 | Sept |
| Gase Tshogongm | Baso Chhu | 27.34194 | 89.91456 | 95.00 | April |
| Gase Tshogongm | Lawalum Chhu | 27.40283 | 89.90189 | 0.58 | April |
| Gase Tshogongm | Lawalum Chhu | 27.41467 | 89.84847 | 111.00 | Sept |
| Gase Tshowogm | Dang Chhu | 27.61628 | 90.19278 | 369.00 | April |
| Kazhi | Baelangdra Chhu | 27.56286 | 90.04994 | 5263.20 | Sept |
| Kazhi | Chuchina Chhu | 27.53619 | 89.90508 | 164.00 | April |
| Kazhi | Chuchina Chhu | 27.53581 | 89.98842 | 510.00 | Sept |
| Phobji | Gangphel | 27.45522 | 90.18500 | 672.00 | April |
| Ruebisa | Pangda Chhu | 28.16717 | 89.93565 | 2643.00 | Sept |
| Saephoog | Chazam Chhu/Nika Chhu | 27.52081 | 90.29861 | 10356.57 | Sept |
| Saephoog | Jaybi Chhu | 27.51583 | 90.27814 | 762.00 | Sept |
| Saephoog | Palang Chhu | 27.51292 | 90.27719 | 310.00 | Sept |
| Saephoog | Zeeri Chhu | 27.51544 | 90.27803 | 1565.00 | Sept |
| Saephoog | Zeeri Chhu/Rukoobji Chhu | 27.51183 | 90.29747 | 2910.00 | Sept |
| Thedtsho | Limbutey Chhu | 27.55333 | 89.91681 | 240.00 | April |
| Thedtsho | Limbutey Chhu | 27.57297 | 89.93731 | 414.00 | Sept |
| Thedtsho | Nahi Rong Chhu | 27.45172 | 89.84586 | 270.00 | April |
| Thedtsho | Nahi Rong Chhu | 27.45167 | 89.84586 | 1360.00 | Sept |

### xx. Zhemgang Dzongkhag

Zhemgang Dzongkhag is located in South-Central Bhutan at an average altitude of about 990 metres above sea level with a total area of 2,421.74 square kilometers. It has 8 Gewogs with a population of 21,501 as of 2015[21]. Total of 11 measurements, spread across the minor and major streams of *Drangme Chhu,* were taken at various locations during the survey in Zhemgang Dzongkhag as shown in Figure 2-. The measurements were taken in 3 Gewogs of Zhemgang.

[21] NSB, 2016

From the measured data, *Rendigang Chhu* in Goshing Gewog had the highest flow of 3,601.60 lps (liters per second) in July while the minimum flow was recorded for *Mangmung Jirang Chhu* in Phangkhar Gewog with 118.42 lps as shown in Table 2-21.


**Figure 2-21: Map of Zhemgang Dzongkhag showing the locations of NWRI sites**

**Table 2-21: NWRI Data for Zhemgang Dzongkhag**

| Gewog | Stream Name | Latitude | Longitude | Discharge (lps) | Month measured |
|---|---|---|---|---|---|
| Goshing | Gramlang Chhu | 26.92850 | 90.89008 | 550.80 | July |
| Goshing | Morang Chhu | 26.94422 | 90.87483 | 1570.80 | June |
| Phangkhar | Kirang Chhu | 26.96617 | 90.85731 | 220.00 | July |
| Phangkhar | Mangmung kirang Chhu | 26.99019 | 90.83922 | 118.42 | July |
| Phangkhar | Rendigang Chhu | 27.00489 | 90.83472 | 3601.60 | July |
| Trong | Andigang Chhu | 27.11511 | 90.73625 | 178.50 | July |
| Trong | Andigang Chhu | 27.11569 | 90.73633 | 669.37 | Sept |
| Trong | Barpang Chhu | 27.11731 | 90.67361 | 688.35 | Sept |
| Trong | Ngomgang Chhu | 27.11467 | 90.67922 | 123.40 | July |
| Trong | Ngomgang Chhu | 27.11472 | 90.71269 | 167.30 | Sept |
| Trong | Phobye Chhu | 27.12103 | 90.70750 | 164.42 | Sept |

# Chapter 3 : Issues, Challenges and Way Forward

## Issues & Challenges

The issues and challenges confronted with during the task are highlighted below:

- The main issue with the NWRI report was that the exercise could not cover all 186 watersheds delineated by the Watershed Management Division, Department of Forest and Park Services due to geographic conditions and limited resources.
- At the same time, there was difficulty in locating appropriate sites for measurement due to inadequate information available to the Gewog officials.
- There was presence of erroneous data collected; some data for the discharge were omitted and consisted of computational challenges.

## Way Forward

The following points detail the recommendations proposed for improvement of future studies as per the evaluation and analysis of the existing information:

- Train the Gewog officials for data collection and interpretation since they are the right focal persons.
- Carry out a comprehensive water resources inventory, which should include the streams, springs, lakes, ponds and any other water bodies which are major sources of water. Collection of water resources data in the field by Environment Officers and consultants are recommended.
- Continuously assess the water resources, wherever possible, to keep track of water quantity, quality and users.
- Use hydrological modelling and basin delineation with GIS and other tools for analysis of water resources.
- Take into consideration the impacts of climate change on water availability and provide comparisons with present water resources.
- Review water availability and demand based on resident population of a particular area.

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