

Report on Water and Waste Assessment and its potential impact on the high altitude wetland along Druk-Path



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**Bhutan Water Partnership
Thimphu, Bhutan.**



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Executive Summary

Rapid population growth, fast paced economic development, high rate of consumption and urbanization has been a major factor to increased waste generation, specifically solid waste. Further, by 2020 it is envisaged that half of the Bhutanese population will be residing in urban areas. If proper interventions have not put in place, it could have dire consequences to our environment, our health and hygiene.

Efforts with numerous clean up campaigns, awareness and advocacies have been initiated by government agencies, civil society organizations, local communities and international non-governmental organizations. However, these initiatives have not been able to bring any behavioral change among the Bhutanese societies. Hence, solid waste management (and littering) still poses as an acute challenge for Bhutan.

As a legal intervention, the government has put in place the Waste Prevention and Management Act 2009 and Waste Prevention and Management Regulation 2014. The regulatory authority is vested with the National Environment Commission Secretariat (NECS) and is responsible for overseeing and implementing the provisions in the Act and Regulation. Further, the Regulation clearly identifies the roles and responsibilities of different implementing agencies to ensure effective waste management. It is required by the Regulation, that all the implementing agencies report annually on the implementation status to NECS.

In addition, the Ministry of Work and Human Settlements has developed the National Strategy on Integrated Solid Waste Management to manage waste in a regular and affordable manner to safeguard public health, protect the environment and with sustainability approach. Their focus is to ensure that the waste producers become responsible, address the root cause by reducing waste to a minimum, gain control over waste related pollution and establish a well-trained work force.

The National Strategy and Action Plan for Integrated Solid Waste Management emphasizes public participation in waste management as the underlying principle. The following are few of the modalities the garners public participation. Inculcating learning and awareness for the school children by preparing teaching materials on environmental protection and pollution

control, formation of school nature clubs, student initiated recycling programs, sports, youth and scouts association engagement, house-hold level engagement in implementing the “3 Rs” (Reduce, Reuse, and Recycle) and collaborating with interest groups to documenting and updating industrial waste producers and then jointly developing protocols for disposal of such waste.

Therefore, it is safe to say that Bhutan is at a timely juncture in its development path to choose the most environmentally effective waste management system for its ever burgeoning waste issues. What decision Bhutan takes now in terms of waste management will pave the path to ensuring the beauty of the country is maintained as it has reputation of being clean and beautiful.

1. Introduction

The tourism industry in Bhutan contributes more than 9% to GDP, a major earner of hard currency and provides employment (Review Report on Tourism Policy and Strategies, National Council, 12 December 2016). In 2016, 209,570 international tourists visited Bhutan. Majority (88%) of tourists visited Bhutan for cultural purpose and rest are here for nature, adventure, spiritual, and wellness.

Druk path is one of the most popular trekking route in Bhutan for both international and local tourist. Druk Path translates to “Dragon trail” which is also the name of the country in Dzongkha. The trek can be customized from three to five days – depending on which locations you want to visit. As this trek is comparatively easier and at the same time takes trekkers through beautiful natural landscapes and pristine lakes, most tourist opt for this package. In 2016, Druk path used by 1,173 tourists compared to 99 tourists used Bumthang Owl Trek (This is without the local tourists).

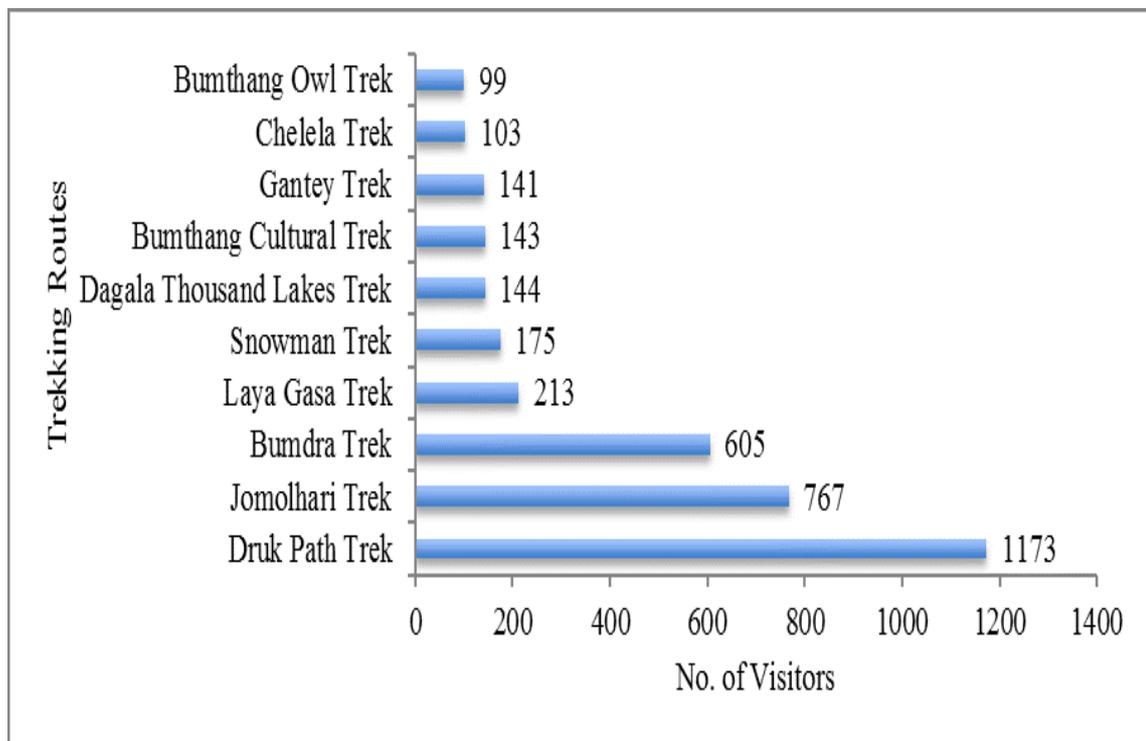


Figure 1: Trekking Routes by Number of Tourist 2016 (source: Annual Report, TCB 2016)

BhWP carried out field tests from 8 to 11 July 2017 by its members. This rapid waste assessment and water resources quality and quantity assessment was initiated to take stock of the scenario (water and waste) and some feedback in form of recommendation.

Day One: Drive from Thimphu to *Damche Gom*, Hiked from *Damche Gom* to *Jele Dzong* for 3 hours. Continued hike to Jangchulakha campsite for 3 hours and further to the Tshokam campsite with additional of one hours walk.

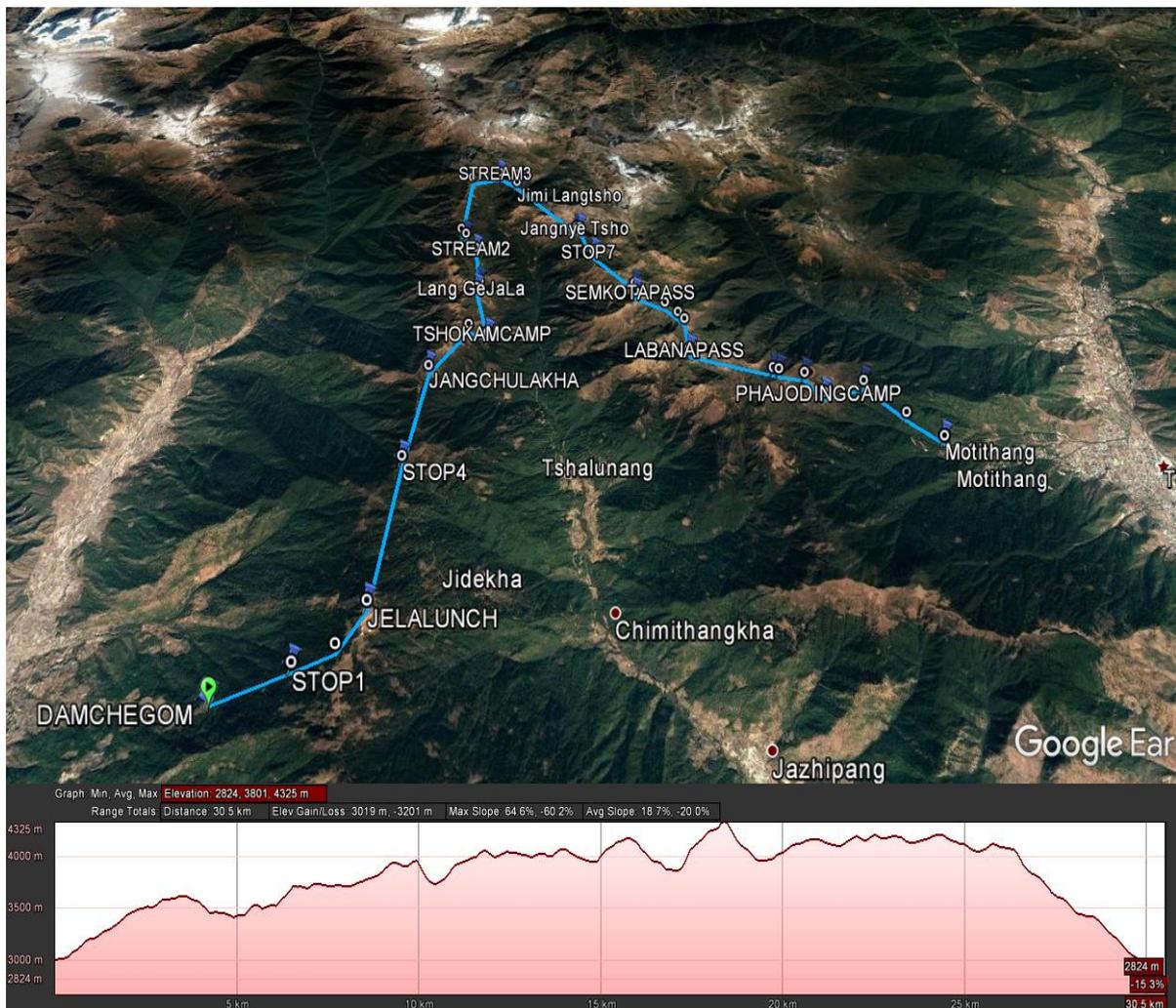


Figure 2: Trekking Route Information of the Assessment



Figure 3: Forest Area along the Trekking Route

The dominant floristic type from *Damchoe Gom* to *Jelela* comprised of *Picea spinulosa* (Spruce), *Pinus wallichiana* (Blue pine) and *Tsuga dumosa* (Hemlock) around *Damchoe Gom* (2900 m a.s.l.). The mixed conifer forest slowly transit to *Abies densa* (Fir) forest before reaching (above 3000 m a.s.l.) *Jelela* (3500 m a.s.l.). The forest near the pass were found mainly composed of *Abies densa* mixed with *Juniperus recurva* (Juniper). The entire forest stretching from Museum to *Jelela* pass forms a part of the sub-basin of *Dochhu*. The stream that originates from the *Jelela* watershed caters to the communities of *Dopshari* and *Humrel Geogs*¹ for drinking and irrigation purposes.

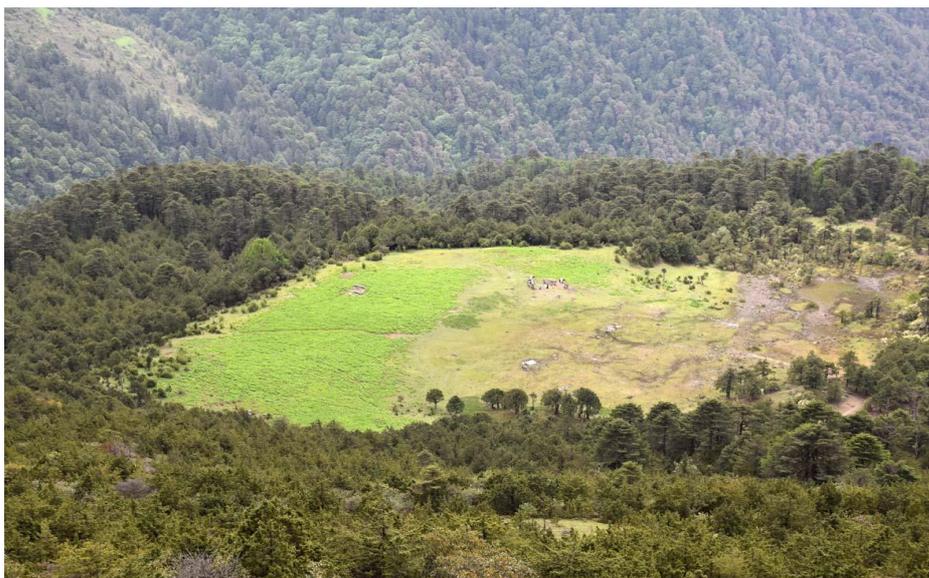


Figure 4: Camping Site at Tso-Kam

¹ Geogs refers to a group of villages in Bhutan

Day Two: Hiked from *Tshokam* almost vertically to a ridge called *Lang ge Gela* with a brake on its way where the team reached to *Jimi Langtsho* after five hours of hiking. Another two hours of hike took the tem to *Ja Nyel Tsho Campe* site. Tsokam camp site (3665 m a.s.l.) was located on the small depression (recharging flat wetland) dominated by *Rumex nepalensis* indicating degradation of wetland mainly brought about by cattle (winter Yak and summer local cattle) grazing and also the site serves as cattle shed. Floristically, the *Tsokam* cattle shed site was surrounded by mainly *Juniperus recurva*, *Abies densa*, *Rhododendron campylocarpum* and *Larix griffithiana*. The photo depicts a typical high altitude coniferous forest. A small spring was observed below Tsokam (seasonal lake) where the herders and trekkers make use of the water for drinking and washing. The team tested the spring water quality using instantaneous measurement kits (pH, turbidity, CO).

Based on the geographical land formation, the Tsokam site is an important collection or recharging site during the monsoon rain (June-September) and probably a perennial spring or stream discharges down below. Thus, the area appears as wetland and an important source of spring water during the lean season.



Figure 5: Camping Site at Bja-Ney

Day Three: The Bja-nye Tso is located at 3845 m.a.s.l. On the third day, we trekked from Bja-nye Tso to Semkota Lake, then to Labana and eventually to Phajoding campsite. Total hike duration was about eight hours.

Day Four: Phajoding to Motithang base. After passing Phadjoding monastery, the trek to Thimphu (Mothitang) is downhill through a forested area of mostly blue pine. The walk, at a leisurely pace, takes about three hours.



Figure 6: Eco-camp at Phajoding

2. Methodology

For this survey, waste consisted of paper, plastics, bottles, cans and cloth that have been disposed improperly. The approach taken for the Waste assessment was through visual observation and physical collection of the waste based on randomly selected assessment area. However, all camping site was selected for the assessment.

The objective of the waste and water assessment is to:

- Collect, sort and record the types and weights of all the Waste gathered from randomly selected area.
- Identify the probable source of waste.
- Determine the water quality and probable inter-relation of waste and water pollution.

The methodology administered for waste assessment will take the following approach:

- Along the trekking path, a transect of 5m above and below road x 25m (horizontal) across will be delineated and the waste, within that dimension will be collected,
- After collection of the waste, it will be weighed,
- The litter will be segregated based on its type, paper, tin, bottle and others.
- The water quality assessment will determine the following parameter;

- PH, Turbidity, DO, volume, and source.

Additionally, the streams and outlets of lakes will be measured and recorded using volumetric calculations and float methods.

The water quality assessment was carried out to determine Temperature, pH, Turbidity, and DO using the Basic Test Kit from World Water Monitoring Day Kit of Earth Echo International². Additionally, the streams and outlets of lakes were identified with the help of handheld GPS, and volumetric measurements carried out using float methods. General observations of the forest ecology, watershed and bio-diversity were also made by the team visually.



Figure 7: Water Quality Testing Kit

3. Limitations of the Methodology

The waste and water quality assessment just provides a snapshot of the situation and is not an in-depth analysis. Thus, this study will not provide any analysis but reflect observation based on information collected on the waste and water quality. Also, it should be noted that prior to this fieldwork, the Tourism Authority of Bhutan had conducted a weeklong clean-up campaign along the Druk path. Nonetheless, our assessment primarily focused on collecting waste within

² <http://www.worldwatermonitoringday.org/>

the camping sites but also collected waste along the route where there were visible signs of littering.

4. Discussion

4.1 Waste Collection and Composition

Waste were collected at six different locations within the altitudinal rage of 3,000 to 4,230 masl³ along the trekking route and mostly within the camping site. The following table provides the details on waste collection location, the type and amount of waste collected.

Table 1: Waste Assessment Worksheet

Location and Altitude	Type of Waste	Weight	Source of waste (assumptive)
1. Alt.3175 msl On the way to Tshokam before reaching Jayla	<ol style="list-style-type: none"> 1. Can 2. Paper 3. Bottles 4. Old Shoes and Cloths 5. Food Wrappers 6. Toilet papers 7. Tarpaulin Sheet 8. Sacks 9. Cartoon Box 10. PET bottle 	5kg	Tourist, Guide, Locals, and porter.
2. Jangchu Lakha Alt. 3,660 masl	<ol style="list-style-type: none"> 1. Cans 2. Bottle 3. Shoes 4. Slippers 5. Cloths 6. Sacks 7. Food package 8. Plastic 	10kg	Local, Yak Herders, tourist, Guide

³ meters above sea level

	<ol style="list-style-type: none"> 9. Diaper 10. Rags 11. Silver foil 12. PET bottle 		
<p>3. Tshokam Alt. 3,700 masl</p>	<ol style="list-style-type: none"> 1. Cans 2. Bottle 3. Shoes 4. Slippers 5. Cloths 6. Sacks 7. Food package 8. Plastic 9. Diaper 10. Rags 11. Silver foil 12. PET bottle 13. Sweets wrappers 14. Used Condom 	12kg	Local, Yak Herders, tourist, Guide
<p>4. Bja-naytsho Alt. 3,825 masl</p>	<ol style="list-style-type: none"> 1. Cans 2. Bottle 3. Shoes 4. Slippers 5. Cloths 6. Sacks 7. Food package 8. Plastic 9. Diaper 10. Rags 11. Silver foil 12. PET bottle 13. Sweets wrappers 14. Hand Warmer 15. Tarpaulin 	14kg	Tourist, Guide, Local, porter

<p>5. Labana Labtsa Alt. 4,230 masl</p>	<ol style="list-style-type: none"> 1. Old Prayer flags 2. Plastics 3. PET bottle 4. Milk Powder package 5. Sweet Wrappers 6. Old Cloths 7. Silver foil 8. Bottle 9. Packed food 	<p>25kg</p>	<p>Tourist, Guide, Locals visiting the lakes, and porter.</p>
<p>6. Phajoding Eco Camp Alt. 3,640 msl</p>	<ol style="list-style-type: none"> 1. Cans 2. Bottle 3. Shoes 4. Slippers 5. Cloths 6. Sacks 7. Food package 		<p>Tourist, Guide, Locals visiting the lakes, and porter.</p>

4.2 Water Quality and Quantity Assessment

During the first day of the hike, there were sign of loggings on either side of the footpath above Damchoe Gom. If not monitored, such activities may encroach further into the upper catchment affecting the recharging capacity of the watershed. It was estimated that around 20 individual trees (Fir and Hemlock) over 80cm DBH were felled within a ca. 20m by 20m opening. The teams' observation was that the forest (*Jelela* watershed) serves as an important water source for the downstream communities and finally joining the Dochhu, which will benefit the Chukha and Tala hydropower generation.

In general, three streams and outlets of two lakes were measured and recorded using volumetric calculations and float methods. The flow at respective locations are shown below.

Table 2: Water bodies, their locations and flows.

Stream	Latitude	Longitude	Elev.	Date	Discharge (l/s)	Landmark
Stream 1	27.51606	89.49706	3994	6/9/2017	0.0314	After Lang Ge Je la Pass
Stream 2	27.52541	89.4952	3992	6/9/2017	0.3619	Plateau
Stream 3	27.54886	89.49904	3930	6/9/2017	1.5022	Before Jimi Langtsho
Jimi Langtsho	27.54563	89.50374	3869	6/9/2017	284.9771	OUTLET
Jan Nygel Tsho	27.53147	89.52021	3920	6/10/2017	23.67953	Outlet



Stream 1



Stream 2



Spring water at Tshokam Camp



Stream 3, just before Jimi Langtsho



Jimi Langtsho (lake)



JaNgyel Tsho (lake)



Semkota Lake



Waste Assessment team



Water Quality testing in process

Table 3: Water Bodies on the trek

Lake	Latitude	Longitude	Elevation
Spring Water at Tshokam	27.50253	89.50013	3740
Jimi Langtsho	27.54563	89.50374	3869
Jan Nygel Tsho	27.53147	89.52021	3920
Semkota Lake	27.51539	89.53343	4141

In addition, the three lakes were tested for PH-level, dissolved oxygen, temperature and turbidity. The following table provides the details:

Table 4: Water testing of the Three Major lakes

Location/Date	Time	Temperature (Celsius)	PH	DO	Turbidity (JTU)	Altitude
1. TsoKam/9/6/17	8:00 am	8 degree	6.5	0	0	3,700 m
2. Jigmelangtsho 9/6/17	4:49 pm	8 degree	7	0	0	3,869 m
2. Bja-Ney Tso 10/6/17	8:00 am	10 degree	7	0	0	3,920 m

5. Recommendation

There are logging activities along the Damchoe Gom route, which is an important watershed area. The team strongly recommended for the conservation of this critical watershed and control illegal felling of trees. However, besides some illegal felling, the forest is still in good condition and may need to protect form further disturbances in future.

There was information that the campsite at Jimi Langtsho, just upstream of the lake is quite often dirty leading to pollution of the lake. While the team was not able to confirm this, it is highly plausible given the situation of the campsite being located upstream of the lake. It is thus recommended that the campsite below the *Jigmi Langtsho* be encouraged to be used. In addition, it may be necessary to clear out the boulders and undulations in that area.

The team also found out that there are several waste bins on the route. However, there is no one to empty or take care of the bins in those remote locations. Thus, BhWP or any relevant agency may have to take up this issue of remote trash bins that are orphaned. Mechanism should be put in place for timely emptying of those bins.

Overall, the waste at the campsites and the route seem to have been generated mostly by the tourism sector as indicated with the type of waste. However, it is worth to note that no water body or wetland seem to be impacted with waste. Some of the key recommendations that the team made are:

- i. Ensure that there is proper check and balance on what trekking groups are carrying in how much they are bringing back at both ends of the trek. It is necessary that there is proper monitoring in place for sustainability.
- ii. Create awareness by putting up signs on both ends of the trek about waste, campfires and regulations.

Annexure:

Annexure I: GPS Point for the Whole Trekking Route.

Latitude	Longitude	Elev	Name	Date	Time	Remarks
27.43312201	89.458677	2907	DAMCHEGOM	6/8/2017	10:28am	Trek Start
27.438111	89.47179501	3264	STOP1	6/8/2017	11:47am	
27.44795001	89.48323203	3615	JELA LUNCH	6/8/2017	2:02pm	
27.49452598	89.48805699	3790	JANGCHULAKHA	6/8/2017	6:15pm	
27.50247002	89.50018401	3751	TSHOKAMCAMP	6/8/2017	7:09pm	Camp Day 1
27.44097099	89.47888903	3484	STOP2	6/8/2017	12:39pm	
27.47459901	89.48540504	3617	STOP4	6/8/2017	4:42 pm	
27.53163803	89.51939601	3970	CAMP2	6/9/2017	8:36pm	Ja Nyel Tsho
27.54606497	89.50352998	3868	CAMPREMDN	6/9/2017	4:43pm	
27.53098299	89.491079	4089	LAP TSA2	6/9/2017	1:55pm	
27.52950601	89.49240804	4003	LUNCH2	6/9/2017	1:31pm	
27.545625	89.50373601	3869	OUTLET	6/9/2017	4:49pm	Jimi Langtsho
27.51428003	89.49653001	4076	PASS1HUMP	6/9/2017	11:33am	Lang Ge Jela La
27.504625	89.49570497	3986	STOP5	6/9/2017	10:36am	
27.54717599	89.49208098	4185	STOP6	6/9/2017	3:17pm	
27.51606496	89.497061	3994	STREAM 1	6/9/2017	12:04pm	
27.52540802	89.49519603	3992	STREAM 2	6/9/2017	12:49pm	
27.54885999	89.49903997	3930	STREAM 3	6/9/2017	4:05pm	
27.50253196	89.50013699	3740	TSHOKAM 2	6/9/2017	7:29am	Spring water source
27.53147098	89.52020796	3920	34	6/10/2017	7:40am	
27.510262	89.54030198	4178	35	6/10/2017	12:21pm	
27.50775003	89.54317303	4194	36	6/10/2017	12:30pm	
27.50775103	89.54317496	4194	37	6/10/2017	12:30pm	
27.49850898	89.54527304	4227	38	6/10/2017	2:23pm	Labana Pass
27.49400496	89.56321701	4090	39	6/10/2017	4:08pm	
27.53159797	89.51942903	3925	CAMP 2B	6/10/2017	7:37am	
27.50602503	89.544562	4143	DRIEDLAKE	6/10/2017	12:38pm	
27.49850797	89.54527002	4226	LABANAPASS	6/10/2017	2:23pm	
27.53146897	89.52017996	3919	LAKE 2	6/10/2017	7:39am	
27.49372602	89.56444404	4093	PHAJOPASS	6/10/2017	4:16pm	

27.51539399	89.53343301	4141	SEMKOTA	6/10/2017	11:31am	
27.51322299	89.53353502	4199	SEMKOTAPASS	6/10/2017	11:48am	
27.52445499	89.523666	4109	STOP 7	6/10/2017	10:12am	
27.49287601	89.56990401	3848	THUJIDBASE	6/10/2017	5:26pm	
27.49099402	89.58238601	3449	CHETEN	6/11/2017	10:38am	
27.488647	89.57331704	3605	PHAJO	6/11/2017	9:17am	
27.48832698	89.57341804	3599	PHAJODING CAMP	6/11/2017	7:23am	
27.48385004	89.59002603	3104	STOP 8	6/11/2017	11:25am	
27.478782	89.59671102	2826	Motithang	6/11/2017	12:08pm	

Reference

1. Review Report on Tourism Policy and Strategies, National Council of Bhutan, 12 December 2016.
2. Bhutan Tourism Monitoring, annual report, Tourism Council of Bhutan, 2016.