

**Cost-Effectiveness of Maternal Health Safety Net Intervention  
in Baglung District of Nepal  
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## **Abstract**

This paper analyzes cost-effectiveness of Maternal Health Safety Net Intervention in Baglung district of Nepal. Maternal health status of Baglung was poor before the intervention and maternal mortality ratio was much higher. The intervention aimed to reduce the maternal death in a cost effective way. The cost of the intervention and reduction in the maternal death are compared with GDP per capita during the intervention period. The numbers of maternal death were used to calculate the DALY. Potential year of life lost due to disability is considered as zero as average mother die at young age. For observing the natural effect in the district another district Sindhupalchok which have similar topography and population structure was selected as control district to the intervention district Baglung.

The paper further analyzes the difference in difference between the Baglung as control with Sindhupalchok as treatment. The intervention is cost-effective at 79 percent net effect at base level. The intervention is found highly cost-effective at the best case scenario compared to cost-effect even at the worst case scenario.

Also, it has significantly improved the maternal health services and the utilization in the district which further enhance the overall quality of the service in the district. This kind of intervention is highly recommended for the other district of Nepal that helps to improve the maternal health status and reduce maternal death in the remote and rural areas of Nepal.

# **1 Introduction**

## **1.1 Background**

Improving maternal mortality was one of eight Millennium Development Goals (MDGs) of the United Nations. The third Sustainable Development Goal (SDG) focuses on the healthy lives of all at all ages including maternal health. The WHO defines maternal death as “the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes”.

Maternal mortality and healthy lives are interrelated since maternal mortality substantially reflects the health status of a nation. Maternal mortality, child and infant mortality, accessibility to health service, poor management are major issues of health care services in Nepal. The maternal health and safe motherhood is one the priority programs of government of Nepal. The goal of the Nepal National Safe Motherhood Program is to improve the maternal and neonatal health through preventive and promotive activities as well as by addressing avoidable factors that causes complications of pregnancy and childbirth. (DoHS Annual Report, 2015) In context of Nepal, as evidences suggested there are three major causes that delays in seeking the maternal care which have critical importance to the emergency obstetric outcome (i) delay in seeking care, (ii) delay in reaching care, and (iii) delay in receiving care. To overcome these delays in seeking maternal care Nepal has adopted three major strategies i) Promoting birth preparedness and complication readiness including awareness raising and improving the availability of funds, transport and blood supplies. ii) Encouraging for institutional delivery and

iii) Expansion of 24-hour emergency obstetric care services (basic and comprehensive) at selected public health facilities in every district. In Nepal, maternal health services have been improved considerably in past few years where more women are getting the safe motherhood services from the public health facilities and skilled birth attendants. In September 2010, the Nepal was awarded for its outstanding leadership, commitment and progress in improving maternal health by the Millennium Development Goals (MDG) Committee in collaboration with the United Nations Office for Partnerships. This decision was driven by the significant reduction in Maternal Mortality Ratio from 539 per hundred thousand live births in 1996 to 281 per hundred thousand live births in 2006 (NDHS, MOHP 2006).

## **1.2 Country Context and Health System**

Nepal is a mountainous land lock country between India and China occupying an area of 147,181 square kilometers and one of the least developed countries in South Asia.

Topographically, Nepal is divided into three distinct ecological zones: mountain, hill, and terai (or plains). (NDHS, 2011) Nepal is a multi-cultural country with a population 28.17 million, 82% of them live in the rural areas where female literacy rate for the age 15-24 years is 80% (WB, 2015). Over 60% of mothers still give birth at home in rural (Engel et al., 2013).

Administratively, Nepal is divided into fourteen zones and 75 districts. Each district has either district health offices (DHO) or district public health offices (DPHO) and district or zonal hospitals which provide the public health and clinical services. Under DHO or DPHO, there are primary health care centers and health post available at the local level in a district. These health facilities may or may not have birthing centers. Those health facilities without birthing centers usually do not provide the delivery services.

### 1.3 District Context and the Intervention

Baglung district lies in the western hilly region of Nepal with the population of around 270 thousand. It's female population of reproductive is around 84 thousand with expected pregnancy of 7400 per year. (Source: District Health Office, Baglung) Till the year 2014 it had low maternal health service availability and access that caused low service coverage and high maternal mortality. Women were not able to get the required services like antenatal visits and proper care during their pregnancy. Lower proportion of women were delivering in the health facilities and under the presence of the skilled and trained birth attendants.



In 2010, Baglung, District Health Office (DHO) in collaboration an international NGO launched maternal health program the Maternal Health Safety Net in the district with an objective to increase the maternal health services utilization and decrease the maternal mortality. The major reason estimated for such lower maternal health services utilization were; lack of sufficient birthing centers in health facilities, lower number of skilled birth attendants, practice of home delivery due to lack of awareness, less services to manage pregnancy related complications. The major strategy adopted were establishing the well-equipped birthing centers in the existing local and district level public health facilities, train health workers

primarily auxiliary nurse midwives, staff nurses as skilled birth attendants, programs for the complication managements. To promote the maternal health services in the existing health infrastructures promotion of safe and clean deliveries, training community health workers, and upgrading existing health posts to meet national standards for birthing centers were done. Similarly, intervention utilized Nepali government's existing Female Community Health Volunteer system, in which each community elects a woman to become trained in basic healthcare and health advocacy to serve the community. They were provided essential trainings on maternal and neonatal healthcare so they can serve the women and infants in their areas. Apart from existing birthing centers few new birthing centers were also established to ensure that women can deliver in a safe facility with a certified Skilled Birth Attendant, drastically improving the chance that a woman and her baby will survive and thrive long past the delivery process. Therefore, for this upgrading the maternal health services in the district more resources were needed and the resources were managed by the district health office and international non-governmental organization (INGO). The program was concluded in the year 2015. Likewise, another district Sindhupalchok was selected where such intervention was not initiated to compare with the intervention district Baglung to observe the natural changes in the maternal health status without similar intervention. Sindhupalchok has similar pattern of topography and similar population size of around 280 thousand with 81 thousand female population of reproductive age and 7357 expected pregnancies (Source: District Health Office Sindhupalchok)

## **1.4 Objective of the Study**

The objective of this paper is to assess the outcomes of maternal health safety net intervention in the Baglung District of Nepal by comparing the pre and post intervention effects. Also, to observe the natural effect on the maternal health status of Baglung by comparing it with control district Sindhupalchok. The assessment is based on the economic analysis of the intervention to explore its cost effectiveness.

## **2 Methods**

We collected data from DHO and from existing district level office of the INGO. The data provided were on different variables and investment in the infrastructure capacity and human resources development. In order to complete this paper, we collected data from WHO and World Bank data bases, Health Management Information System (HMIS), Department of Health Services, Nepal Government, Population Monograph of Nepal (Central Bureau of Statistics). The data were collected for both pre and post Maternal Health Safety Net Intervention (MHSNI). National level age specific maternal mortality is used to prorate the number of maternal deaths in different age profile per year in both intervention and control districts as there were unavailability of the maternal death per year by age in pre and post intervention and control districts. We calculated year of life lost due to maternal death pre and post intervention in the Baglung district and then calculated Potential Year of Life Lost (PYLL) in the same. The Disability Adjusted Life Year (DALY) attributable to the intervention is calculated for Baglung district. Since average pregnancy age in Nepal is around 22 years and we assume that there is no Year of Life Lost due to Disability (YLD) and hence it is considered as zero. Similar method was

applied to calculate the PYLL and the DALY of the control district Sindhupalchok. Project related cost data is taken from the INGO worked in the Baglung district and amortized for the five year the rate of 3 percent interest rate after all taken into present value. Recurrent cost is added to the project cost in to calculate cost effective analysis. Pre intervention cost was regarded as zero since there was no intervention. We also calculated Difference in Difference in order to carry out sensitivity analysis of the intervention. Sindhupalchok district is considered as control for the purposes of calculating difference in difference. The sensitivity analysis is calculated as low at 40 percent, high as 90 percent level against base scenario of 79 percent. Gross Domestic Product (GDP) per capita for the period of the 2010 to 2014 is considered as US\$701 as there is variation of exchange rate during this period. For the calculation of the DALY we have considered following equation:  $DALY = YLL + YLD \dots\dots\dots (1)$

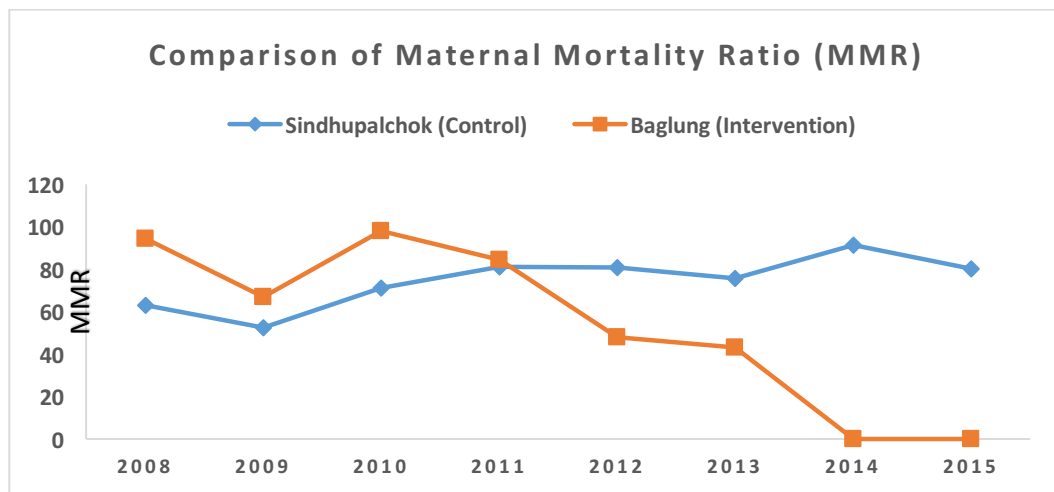
Where, PYLL is year of life lost and YLD is year of healthy life lost as a result of disability (due to maternal death case). Since we are considering no presence of YLD as pregnancy age is younger and considered healthy during the maternity case, then DALY is only depending on year of potential year of life lost (PYLL). However, PYLL is a product of number of death and difference of age at death and life expectancy at that age.

### **3. Results**

The maternal health indicators data from 2008 to the year 2015 were obtained from HMIS Annual Reports. Maternal Mortality Ratio (MMR) in both the intervention district Baglung and control district Sindhupalchok was experienced to be higher and steady before 2011. After the program intervention in Baglung it showed considerable falling in MMR after 2011 when the intervention effects actually show up. In the year 2014 and 2015 no any maternal death

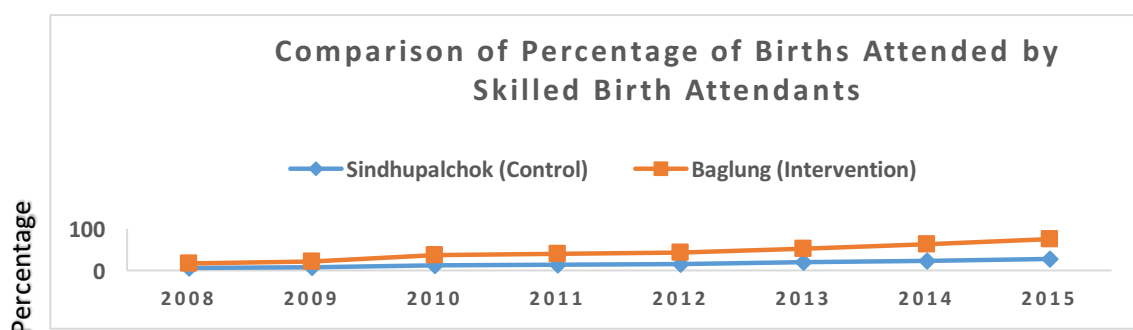


observed in Baglung. On the other hand, in the control district where there was no any intervention the MMR observed to be higher and steady even after 2011 as shown in Figure 1. This reflect the effectiveness of the program in the Baglung district.



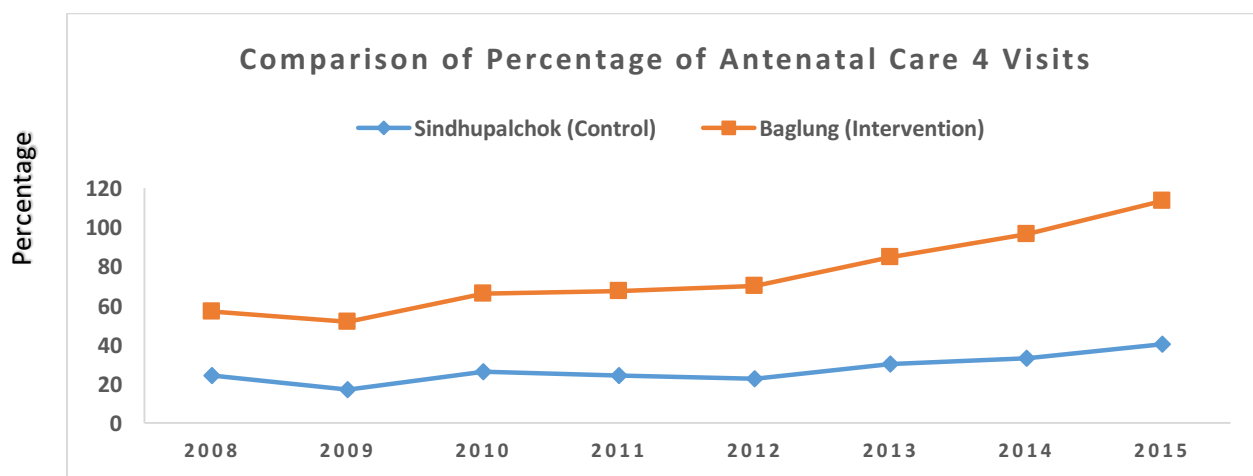
**Figure 1**

Similarly, the percentage of births attended by the Skilled Births Attendants (SBA) in both the intervention and control districts shows gradual increase in past years. But since, 2011 the rate of increase in SBA delivery is higher in the intervention district as compared to the control district as shown in Figure 2.



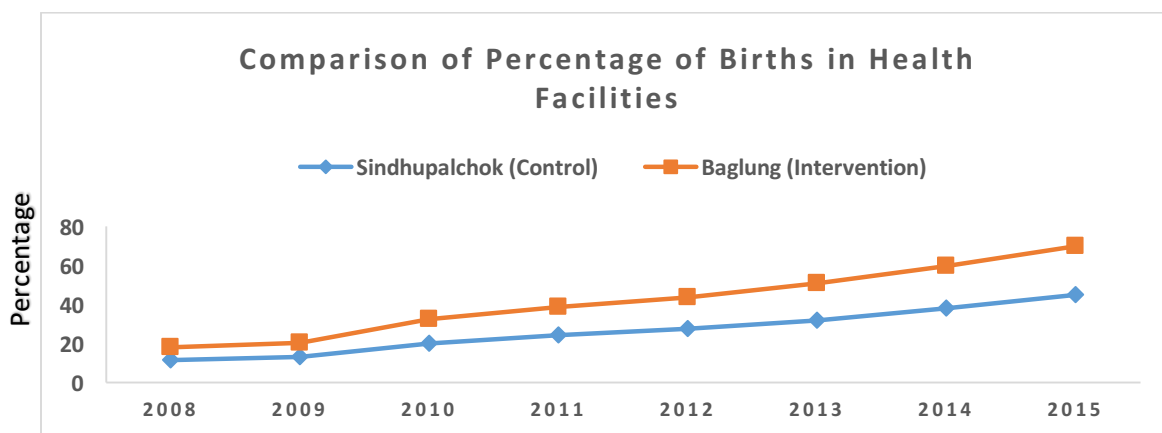
**Figure 2**

When looking into the percentage of antenatal care visits (ANC) it also shows gradual increase in the past years but the rate of increment is more in the intervention district, Baglung as compared to the Sindhupalchok, the control district as shown in the Figure 3



**Figure 3**

As shown in the Figure 4 similar to the above mention indicators of the maternal health service indicators percentage of births that occurred in the health facilities or birthing centers has found to be improved in both intervention and control districts but the rate is observed to be slightly higher in the Baglung district as compared to the Sindhupalchok.



**Figure 4**

Table 1 explains the cost for the Maternal Health Safety Net Intervention (MHSNI) in Baglung district. We consider only cost related to the intervention. Hence we have assumed zero cost for the status- quo. Since recurrent cost is ongoing, we have considered it as US\$5400 per year and also discounted at 3 percent. Other intervention costs are also taken into present value at 3

percent interest rate. Total present value of the cost again amortized for 5 years at the same interest rate of 3 percent. Then the amortized cost per year is used to calculate the cost per year per death averted which is used to calculate the cost-effectiveness analysis.

**Table1: Cost Details of the Maternal Health Safety Net Intervention in Baglung (USD)**

Items	2011	2012	2013	2014	2015	Total
Salaries and Benefits (Central Office and Field team)	40,000	70,000	50,000	40,000	40,000	240,000
Office Expenses (Rent & Utilities)	5,000	8,000	8,000	10,000	2,000	33,000
Baseline Assessment and Need Assessment cost	20,000	-	-	-	-	20,000
Training Expenses	70,000	140,000	20,000	10,000	-	240,000
Birthing Center Upgrade	60,000	120,000	30,000	15,000	-	225,000
Travel Cost	5,000	10,000	15,000	10,000	2,000	42,000
Monitoring and Evaluation	-	-	-	10,000	10,000	20,000
Recurrent Cost Per Year	5,400	5,400	5,400	5,400	5,400	27,000
<b>Total Cost</b>	<b>205,400</b>	<b>353,400</b>	<b>128,400</b>	<b>100,400</b>	<b>59,400</b>	<b>847,000</b>
<i>Present Value at 3% Interest rate</i>	199,417	333,113	117,504	89,204	51,239	790,478
<i>Amortized Value for 5 years</i>	172,605	172,605	172,605	172,605	172,605	863,023
<b>Cost Per Year Per Death Averted</b>	<b>28,767</b>	<b>28,767</b>	<b>28,767</b>	<b>28,767</b>	<b>28,767</b>	<b>143,835</b>

*Source: District Health Office Baglung*

Table 2 reveals the calculation of the Potential Year of Life Lost (PYLL) per year in the Baglung (intervention) and Sindhupalchok (control) district. In order to calculate PYLL per person life averted due to intervention in Baglung district, we have taken age specific life expectancy of women of fertility age 15 - 49 years with 5-year time lag from the HMIS and Central Bureau of

Statistics of Nepal. The number of pre and post intervention maternal deaths were multiplied by the age specific life expectancy or respective age in order to calculate Potential Years of Life Lost (PYLL). As we have total numbers of maternal death in a year and not age specific, we have proportioned to number of national age specific maternal deaths. Finally, we obtained the PYLL per year as there were accumulated data for four year pre and post the intervention period.

**Table 2: Pre and Post PYLL for Baglung (Intervention) and Sindhupalchok (Control)**

Age	Age Specific Life Expectancy	Pre - Intervention				Post – Intervention			
		No. of Death		PYLL		No. of Death		PYLL	
		Baglung	Sindhupalchok	Baglung	Sindhupalchok	Baglung	Sindhupalchok	Baglung	Sindhupalchok
<b>15-19</b>	57.6	4	4	250	226	1	3	56	185
<b>20-24</b>	52.9	7	6	344	311	1	5	78	256
<b>25-29</b>	48.3	5	5	255	230	1	4	57	189
<b>30-34</b>	43.7	4	4	176	159	1	3	40	131
<b>35-39</b>	39.1	4	3	145	131	1	3	33	108
<b>40-44</b>	34.6	3	3	107	97	1	2	24	80
<b>45-49</b>	30.1	4	3	112	101	1	3	25	83
<b>Total</b>		<b>31</b>	<b>28</b>	<b>1390</b>	<b>1255</b>	<b>7</b>	<b>23</b>	<b>314</b>	<b>1031</b>
<b>PYLL Per Year</b>				<b>347</b>	<b>314</b>			<b>78</b>	<b>258</b>

Table 3 shows the DALY averted and cost per DALY averted. Since we have considered year of life lost due to disability caused by maternity as zero there is no component of YLD in given

equation (1) PYLL is equals to DALY. For this we have calculated gross and net effect of the intervention. From the World Bank web site, the GDP per capita for Nepal during the intervention period is considered as US\$701 and this value is compared to DALY averted per death per year. At the gross effect level there is 45 DALY averted per death. After calculating difference in difference, at the net effect level, it is found that 36 DALY averted per death. From table 1 cost per year per death averted is US\$28,767 and once it is divided by the DALY averted per death at net effect level we have got cost per DALY averted as US\$810.

**Table 3: Cost-Effectiveness Analysis**

	<b>Pre- Intervention</b>		<b>Post- Intervention</b>					
	<b>DALY Year</b>	<b>Per</b>	<b>DALY Per Year</b>	<b>Total Change in DALY</b>	<b>Pop<sup>n</sup> (Pregnant Women 15-49)</b>	<b>DALY Averted Per Death</b>	<b>Cost Per Year Per Death Averted</b>	<b>Cost Per DALY Averted</b>
<b>Baglung</b> (Intervention)	347		78	269	7413			
<b>Sindhupalchok</b> (Control)	314		258	56	7357			
<b>Population Ratio</b>					<b>1.007</b>			
<b>Baglung</b> Standardized (Intervention)	347		78	269	7413	45	28767	642
<b>Sindhupalchok</b> Standardized (Control)	314		258	56	7357			
<b>Difference in Difference (Net Effect at 79%)</b>				<b>213</b>		<b>36</b>	<b>28767</b>	<b>810</b>

Table 4 explains sensitivity analysis of the cost and effectiveness of the intervention in Baglung district. Here the DALY per year before and after the intervention period in Baglung was calculated and similar time period DALY was calculated for the Sindhupalchok as well. Later on the DALY of both the intervention and control districts were standardized with the ratio of population of pregnant women of both districts which was found to be 1.007 hence showing no remarkable effect on the overall DALY. The overall DALY averted per death was found to be 45. After difference in difference calculation after deducting the confounding affect the net effect found was 36 DALY averted per death which is 79% of the total DALY averted. The cost per DALY averted is compared with the GDP per-capita of Nepal. At the base scenario of 79 percent effectiveness, it is found US\$ 810 which is cost effective since it is slightly more than one GDP of Nepal. The intervention is found to be cost effective even at the lowest level (40 %) of cost effectiveness which is US\$1578 and is less than three times of the GDP per capita of Nepal (US\$701).

**Table 4: Sensitivity Analysis**

	% of			Cost Per	GDP		
Effectiveness	Effect	DALY	Cost Per	DALY	Per	Decision	Remarks
	Level	Averted	Year	Averted	Capita	(Result)	
							Cost Per DALY Averted <
Low	40	18	28767	1578	701	Cost effective	3xGDP
							Cost Per DALY Averted <
Base	79	36	28767	799	701	Cost effective	2xGDP
High	90	41	28767	701	701	Highly Cost effective	Cost Per DALY Averted < GDP

#### 4. Discussion

The paper shows the impact of Maternal Health Safety Net Intervention (MHSNI) on reduction of maternal death in Baglung (treatment) district compared to Sindhupalchok district from 2011 to 2015. The MHSNI is cost effectiveness even for at the worst case scenario of 40 percent of the effectiveness level of the program. On the other hand, the program substantially has affected the overall maternal health service coverage in the intervention district. When the outcome level indicators of the maternal health services were compared after the intervention initiated in 2011, with the time period before the intervention and again with the control district Sindhupalchok, it showed remarkable improvement in the indicators. This is due the increase in the service availability and the access in the intervention district. The district HMIS of Baglung shows the significant change in the safe motherhood program utilization among the women and more delivery were conducted in the health facilities which are certified as birthing centers. The DHO endorsed this development due to the Maternal Health Safety Net intervention.

There are nearly 78 percent decreases in the DALY per year due to the intervention in the Baglung compared to a decrease of only 18 percent in the control district Sindhupalchok. This shows a big drop in the DALY means that 78 percent of the DALY are averted. From the cost-effectiveness point of view, any intervention with a cost less than three times the GDP per capita during the same period is considered as a cost effective (WHO). The result in the table 4 clearly meets the threshold even at the worst level and hence the intervention in the Baglung district is cost-effective. Even for the worst case scenario, in order to avert one DALY there required a cost of US\$1578. Though the program shows the cost-effectiveness but there have



been certain limitations experienced which includes; there may be other effects of the intervention in the community and specially to the maternal health services than only averting the maternal deaths and DALY which was the basis of calculation of this study. The estimations of other effects of intervention like raise in awareness, improved quality of care etc. were outside of the scope of the study. Also, other associated costs which were made available by government and community and the other hidden costs which is the lower proportion were not included. Further there is economic benefits in the society by averting the death which is also not considered in the study.

## **5. Conclusion**

The intervention is highly cost-effective at the higher effectiveness level of 90 percent and cost-effectiveness at lower level of 40 percent effectiveness. The intervention considerably has averted the maternal deaths and the DALY in the Baglung. Also it has significantly improved the maternal health services and the utilization in the district which further enhance the overall quality of the service in the district. This kind of intervention is highly recommended for the other district of Nepal that helps to improve the maternal health status and reduce maternal death in the remote and rural areas of Nepal.

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