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Expenditure efficiency of Local Government's Basic Service Delivery in Nepal [1]

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Abstract

This study aims to compare the expenditure efficiencies of local government at the district level (DDCs). The study has used data regarding local governance and service delivery of 75 District Development Committees (DDCs) of Nepal from 2011/12 to 2015/16. Data Envelopment Analysis (DEA) has been used for measuring the expenditure efficiency of DDCs. Both input and output oriented models have been employed to measure the expenditure efficiencies. In both input and output oriented models, 29% DMUs are 100 per cent efficient under CRS approach and 25% DMUs are 100 per cent efficient under BCC approach. Moreover, Malmquist productivity index has been used to some selected DDCs in order to complement the findings regarding the expenditure efficiencies. The five years' average Malmquist TFP index of Achham DDC has increased by 17% annually which was the highest performing DDCs. The five years' average Malmquist TFP of 75 DDCs is calculated to be increased by 0.16% annually.

Key words. : Data envelopment analysis (DEA), Malmquist productivity index (MPI), Expenditure efficiency, District Development Committees (DDCs)

1 Introduction

The traditional consensus in the theory of fiscal decentralization is the devolution of expenditure responsibilities and revenue powers from a higher level of government to sub-national level of government are found to improve accountability, responsiveness, and good governance of local government.

The decentralization process in Nepal had pragmatically implemented immediately after the restoration of democracy in 1990 though there was a history of decentralization even in the Rana regime. However, after the promulgation of Local Self Governance Act in 1990, the decentralization process had institutionally started in practice. Unfortunately, due to the political instability in the country, there was no elected representatives in the local governments after mid July 2002 till 2017. Nevertheless, the local governments used to deliver services through the existing mechanism and limited financial resourced at the local level.

The main objective of this paper is to analyze the relative efficiency (expenditure efficiency) of former District Development Committees of Nepal which were the important development institution at the district level. In other word, the objectives of this paper are:

- to identify the most efficient DDCs in Nepal in terms of providing the best possible public local services at the lowest possible cost, and

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- to investigate the empirical determinants of DDCs spending efficiency in order to draw policy conclusions about efficiency and effectiveness in local service delivery in Nepal.

District Development Committees (DDCs) were the important district level government before the restructuring of local bodies in Nepal according to the new constitution of Nepal, 2015. They had important responsibilities with respect to infrastructure development, education, health, social welfare, and maintaining good governance. The Local Body Fiscal Commission had authority and responsibility to assess their service delivery performance based on the key indicators annually. There were 75 DDCs, 3915 Village Development Committees (VDCs) and 217 municipalities before restructuring of local government in 2017. However, after the restructuring of local bodies, now there are 77 District Coordination Committee, 460 rural municipalities and 293 urban municipalities. The most empirical studies have used total current expenditures as municipal inputs (i.e. resources used in the provision of local services). As an output variable, some studies have aggregated various municipal services into a single measure of municipal performance, however, other studies have evaluated one specific local government. The per capita municipal expenditure was used as a measure of municipal inputs and a measure of municipal output, used composite indictor of municipal services such as basic education, cultural services, sanitation, road infrastructure of Portuguese municipalities [18]. The assessment of efficiency of single services delivered by municipalities were done i.e. solid waste and sewage disposal [19], water management [20]; [21]; [22]; urban public transport [23]; [24]; [25]; and [26]. The second stream is related to the overall municipal efficiency score. There are also number of empirical studies i.e. Australia [27]; Belgium [28]; [29]; [30] and [31]. Using one input (total expenditure) and two output variables (total population and total number of hospitals), [13] estimated the efficiency of Turkey municipalities. Through the review of the different literature, the selection of inputs and output variables in the previous studies are presented in Table 1 below.

2 Approaches

The government of Nepal used to assess the performance of local government using minimum condition and performance measurement tool annually and the result of the assessment used to link with the annual grant to be provided to the local government by central government. There was no any robust approach used to assess the performance and efficiency of local government in the past. Therefore, considering Data Envelopment Analysis (DEA) is the robust approach to measure the efficiency, this model is used to assess the expenditure efficiency of local government at the district. The DEA is a non-parametric approach pioneered by [1] and extended by [2]. It is one of the earliest approaches to efficiency measurement, proposed by [3].

The most basic forms of DEA i.e. CCR and BCC models are used to estimate the relative efficiency of 75 DDCs. The CCR score is called global technical efficiency (GTE) and BCC score is called local pure technical efficiency (LPTE) by [4]. The scale efficiency is obtained by the proportion (SE=GTE/LPTE) of these two scores [5].

In one model input oriented analysis is used because it is assumed that the Decision Making Units (DMUs)do have control over inputs. The input-oriented approach applies to a situation in which DMU seeks to deliver the desired output with the minimum input in [6].

Table 1: Selection of inputs and outputs variables in various studies

SN	Author (s)	Method	Sample	Inputs (I) and Outputs (O)	Main findings
1	Athanassopoulus and Triantis, 1998 [32]	DEA, SFA	172 Greek municipalities in 1986	I: Operating costs (expenditure on services, salaries, maintenance and material) O: Actual households, average house areas, heavy industrial use area, tourist areas	Mean efficiency scores range from 0.60 (DEA) to 0.85 (SFA)
2	Aziz KUTLAR et al., 2012 [13]	DEA, and Malmquist index technique	27 Municipalities of Turkey	I (X) : Personal expenses, Goods and services expenses,, current transfer expenses, capital expenses, capital transfer, total expenses (all are controllable) Social security expenses (not controllable) O (Y) : Total population, proportion of 65+ population (65+/city population %), number of pupils, number of beds in tourism establishment, total number of in hospital, number of visitors	There was a decrease in the number of efficient municipalities and level of their efficiencies form years 2006 to 2008.
4	Sampaio de Sousa and Ramos , 1999 [33]	DEA, FDH	3756 Brazilian municipalities in 1991	I : Current spending O: Total resident population, domiciles with access to safe water, domiciles served by garbage collection , illiterate population, enrolment in primary and secondary municipal schools	Smaller municipalities are less efficient in provision of public goods and services than bigger municipalities
5	Afonso and Fernandes, 2008 [18]	DEA	278 Portuguese municipalities in 2001	I : Total per capita expenditure O: Calculation of single municipal performance indicator from several municipal service	Mean efficiency scores range from 0.57 to 0.99 depending on the specification used
6	Borge et al., 2008 [34]	Ratio	362-384 Norwegian municipalities from 2001-2005	: Local government revenue : Constructed measure of aggregate output	Average output 35% below most efficient

Source: Authors' collection, 2018

Technical efficiency is meant the non-existence of any waste of the resources. It is the success of producing the maximum output through utilizing the available inputs in a most efficient way. The technically efficient DMUs are located on the efficient frontier whereas the DMUs below the efficient frontier waste their resources relatively in [7].

The total efficiency scores are calculated by CCR model under the CRS assumption and technical efficiency scores are calculated from BCC model under VRS assumption. The scale efficiency is calculated by the help of the formula created by [3] as follow.

$$Scale\ of\ eficiency = \frac{Totalefficiencyscore(CCR)}{Technicalefficiencyscore(BCC)}$$

If the value of the ratio is one, the DMU is apparently operating at optimal scale. If the ratio is less than one, then the DMU appears to be either too small or too large relative to its optimum size. A DDC is efficient if technical efficiency rate (TE) is =1, but if TE<1, a DDC is considered technically not efficient.

3 Model and used variables

In order to estimate the expenditure efficiency of District Development Committees (DDCs) in Nepal both input and output oriented DEA model is used. The choice of the inputs and output variables followed the criteria of relevance and data availability. This empirical study examines productivity changes in the service delivery of 75 DDCs (k=75). The data consist of one output ($y = 1$, scores of performance measurement) and four inputs ($x = 1, \ldots, 4$). The more specific definition of these variables are given as follow.

The main source of data on expenditure of DDCs collected from Financial Comptroller General Office [8] PM Scores and OSR from Local Body Fiscal Commission [9], population, number of primary schools and number of students enrolled in primary schools from Central Bureau of Statistics [10]. The inputs and output variables are not fully adopted. There is some modification in the input and output variables.

(a) Input variables

Input (X1): The total capital expenditure of five fiscal years 2011/12 to 2015/16,

Input (X2): The total recurrent expenditure of DDCs of five fiscal years 2011/12 to 2015/16,

Input (X3): The total Local Government and Community Development Program (LGCDP) expenditure of five fiscal years 2011/12 to 2015/16,

(b) Output variables

Output (Y1): the performance measurement scores which is measured from 1 to 100 scores of five fiscal years 2011/12 to 2015/16

Output (Y2): the total district-wise population 2011. The annual population growth from 2011/12 to 2015/17 are 1.17%, 1.21%, 1.20%, 1.17% and 1.13 respectively.

Output (Y3): the total own source revenue (OSR) of five fiscal years 2011/12 to 2015/16

Output (Y4): the total number of primary schools in the respective district of five fiscal years 2011/12 to 2015/16

Output (Y5): the total number of students enrolled in primary schools of five fiscal years 2011/12 to 2015/16

The Personal Information Manager (PIM) DEA software is used to compute relative efficiency and Malmquist productivity index of 75 DDCs (DMUs) in Nepal.

4 Mathematical structure of DEA

Data envelopment analysis (DEA) is a mathematical technique based on the linear programming (LP) which is used to measure the relative efficiency of decision making units (DMUs) with multiple inputs and multiple outputs. DEA is one of the several techniques that can be used to calculate a best practice production frontier [11]. The first DEA model was proposed by [1]. (1978) and was later named the CCR model from their acronyms (Charnes–Cooper–Rhodes). Since then, a number of DEA models have been developed and a significantly large number of applications have been reported in the DEA literature [12]. DEA approach is based on the usage of multiple inputs and outputs [3]. The production functions of the economic decision units are measured whether by the best production technique or an efficient production function which represents the best input output relationship. Let's assume that from X_k, K=1,2 …., m inputs of a decision making unit (DMU) y_i, i=1, 2, …., t outputs are produced. With the help of the suitable weights (v_i =1,2…, t: w_k =1, 2, …, m).

$$\frac{\sum_{i=1}^{t} v_i, y_i}{\sum_{k=1}^{m} wk, sk}$$

For every input and output, DEA determines the weights of DMUs. The two constraints exist in determining the weights by linear programming. One of them is the weights have to be positive and the other one is that the ratio of the proportion of outputs to input should not be greater than one (1) for the DMUs included in the model. In the literature, this is known as virtual input-output or virtual weights [13].

5 Malmquist productivity index (MPI)

The productivity refers to the amount of output obtained from given level of inputs in an economy or a sector. In this paper the productivity means the scores of performance measurement of service delivery of DDCs. The Malmquist efficiency index is one of the indexes that consider the change in the production [14]. It is an appropriate tool to measure the efficiency in public sector in which prices are not determined clearly. This index can determine production and cost limits of production technology. The Malmquist index can be calculated as both input and output oriented approaches. A production oriented Malmquist TFV change index M_h^{t+1} can be written as:

$$M_h^{t+1}(X_h^{t+1}, Y_h^{t+1}, X_h^t, Y_h^t) = \left[\frac{D_h^t(X^{t+1}, Y^{t+1}) D_h^{t+1}(X^{t+1}, Y^{t+1})}{D_h^t(X^t, Y^t) D_h^{t+1}(X^t, Y^t)}\right]^{\frac{1}{2}}$$

The equation shows the production element in D_h, t, t+1 period. Technology in t period is reference and t+1 is used. Reference category can be chosen arbitrarily. For the applications concerning the DDCs, inputs as (h=1, 2, … , n). Here input vector is $X_h^t = (X_{1ht}, X_{2ht}, \dots)^t$ and output vector is $Y_h^t = (Y_{1ht}, Y_{2ht}, \dots)^t$. It is because properties of returns to scale of technology in total factor productivity is very important. For estimating the distance functions in Malmquist indexes, constant returns to scale assumption (CRS) is based. Otherwise, results obtained do not represent total factor productivity profits and losses caused by scale effects [13]. If the value of technical change (TEC) is greater than 1 indicates a positive shift or technical progress, a value of TEC is less than 1 means a negative shift or technical regress, and if the value is equal to 1 shows no shift in in technology frontier. The same range of values is valid for the efficiency change component of the Malmquist TFP index [15]. The efficiency change index measures the change in the gap between observed production and maximum potential production between two periods and the technical change index captures the shift of technology between two periods [16].

The Malmquist index of total factor productivity change (TFPCH) is the product of technical efficiency change (EFFCH) and technological change (TECHCH) which is expressed as follows.

$$TFPCH = EFFCH \times TECHCH$$

The Malmquist productivity change index, therefore, can be written as:

$$M0(Y_{t+1}, X_{t+1}, Y_t, X_t) = EFFCH \times TECHCH$$

Technical efficiency change (catch-up) measures the change in efficiency between current (t) and next (t+1) periods, while the technological change (innovation) captures the shift in frontier technology. Productivity decomposition into technical change efficiency catch-up necessitates the use of a contemporaneous version of the data and the time variates of technology in the study periods. The MPI can be expressed in terms of distance function of (E) as equation (1) and (2) using the observation at time t and t+1 [17].

$$MPI_I^T = \frac{E_I^t(x^{t+1}, y^{t+1})}{E_I^t(x^t, y^t)} \tag{1}$$

$$MPI_I^{t+1} = \frac{E_I^{t+1}(x^{t+1}, y^{t+1})}{E_I^{t+1}(x^t, y^t)} \tag{2}$$

where, I denotes the orientation of MPI model. The geometric mean of two MPI in equation (1) and (2) gives the equation (3)

$$MPI_I^G = (MPI_I^t MPI_I^{t+1})^{\frac{1}{2}} = \left[\left(\frac{E_I^t(x^{t+1}, y^{t+1})}{E_I^t(x^t, y^t)}\right)\left(\frac{E_I^{t+1}(x^{t+1}, y^{t+1})}{E_I^{t+1}(x^t, y^t)}\right)\right]^{\frac{1}{2}} \tag{3}$$

The input oriented geometric mean of MPI can be decomposed using the concept of input oriented technical change (TECHCH) and input oriented efficiency change (EFFCH) as given in equation (4)

$$MPI_I^G = (EFFCH_I)(ETCHCH_I^G) = \left(\frac{E_I^{t+1}(x^{t+1}, y^{t+1})}{E_I^t(x^t, y^t)}\right)\left[\left(\frac{E_I^t(x^t, y^t)}{E_I^{t+1}(x^t, y^t)}\right)\left(\frac{E_I^t(x^{t+1}, y^{t+}}{E_I^{t+1}(x^{t+1}, y^{t}}\right.\right. \tag{4}$$

The scale efficiency change (SECH) is given in equation (5)

$$SECH = \left[\frac{E_{vrs}^{t+1}(x^{t+1}, y^{t+1})/E_{crs}^{t+1}(x^{t+1}, y^{t+1})}{E_{vrs}^{t+1}(x^t, y^t)/E_{crs}^{t+1}(x^t, y^t)} \frac{E_{vrs}^t(x^{t+1}, y^{t+1})/E_{crs}^t(x^{t+1}, y^{t+1})}{E_{vrs}^t(x^t, y^t)/E_{crs}^t(x^t, y^t)}\right]^{\frac{1}{2}} \tag{5}$$

And a pure efficiency change (PECH) is given in equation (6)

$$PECG = \frac{E_{vrs}^{t+1}(x^{t+1}, y^{t+1})}{E_{crs}^{t}(x^{t}, y^{t})} \tag{6}$$

6 Results and discussion

The descriptive statistics of input and output variables is briefly presented in Table 2.

Table 2: Destructive statistics of input and output variables

Variables	2011/12		2012/13		2013/14		2014/15		2015/16	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Capital Exp. (Rs.)	22767111	10335756	17059920	8579186	29369994	13747009	31723559	23001682	21489053	1235226
Recurrent Exp. (Rs.)	20610551	5140322	23156572	4924769	23156572	4924769	29293350	6040091	29459352	6933457
LGCDP Exp. (Rs.)	19906628	8206453	22822289	8473099	15442773	6419449	28092784	17178608	22913575	11820523
OSR (Rs.)	20788440	34366008	18240640	24587262	24677427	33195179	27952413	42627920	26796160	41296959
Primary School (No.)	452	186	457	189	463	193	458	188	458	188
Student Enrolment (No.)	63772	39398	61023	39748	58690	39314	57805	39244	56387	39876
PM Scores (No.)	63	11	65	11	57	12	58	13	62	15
Population (No.)	291304	197361	294828	199749	298369	202148	301860	204513	305271	206824

Source: Authors' calculation

a. Input oriented CCR and BCC models The efficiency level of individual DMU is presented in Table 3 below. It is found that of the total 75 DMUs, 29% DMUs are 100 percent efficient under CRS model and remaining 91% DMUs are under efficiency frontier in 2011/12 while only 25%. DMUs are 100 percent efficient under BBC model in the same period.

Table 3: Efficiency level of DDCs

Models	2011/12	2012/13	2013/14	2014/15	2015/16
CCR (CRS)<100	53 (71)	54 (72)	56 (75)	52 (69)	62 (73)
CCR (CRS)=100	22 (29)	21 (28)	19 (25)	23 (31)	13 (27)
BCC (VRS)<100	50 (67)	45 (60)	47 (63)	44 (59)	54 (72)
BCC (VRS)=100	25 (33)	30 (40)	28 (37)	31 (41)	21 (28)
SE (CRS/VRS)<1	18 (24)	21 (28)	20 (27)	15 (20)	16 (21)
SE (CRS/VRS)=1	57 (76)	53 (72)	75 (73)	60 (80)	59 (79)

Note (Figure in parenthesis is percentage)

The efficient DMUs in various fiscal years from 2011/12 to 2015/16 are presented in Table 4.

Table 4: List of 100 per cent efficient DMUs under CRS model

Fiscal year	**DDCs (DMUs)**
Efficient DMUs in 2011/12	Taplejung, Terhathum, Morang, Siraha, Dhanusa, Mahottari, Sarlahi, Dhading, Kathmandu, Bhaktapur, Makawanpur, Bara, Nawalparasi, Rupandehi, Kapilbastu, Gorkha, Manang, Rukum, Dang, Banke, Jajarkot and Kanchanpur (22)
Efficient DMUs in 2012/13	Jhapa, Dhankuta, Morang, Udayapur, Siraha, Dhanusa, Mahottari, Ramechhap, Sindhupalchock, Dhading, Kathmandu, Lalitpur, Bhaktapur, Kavrepalanchock, Bara, Chitwan, Nawalparasi, Rupandeh, Kapilbastu, Arghakhachi, Manang, Kaski, Dolpa, Rukum. Banke, Bardiya, Jajarkot, Dailekh, Kailali and Bajhang (21)
Efficient DMUs in 2013/14	Pachthar, Terhathum, Morang, Mahottari, Sarlahi, Dhading, Bhaktapur, Makawanpur, Bara, Chitwan, Rupandehi, Kapilbastu, Tanahu, Manang, Kalikot, Bardiaya, Kailali, Dedeldhura and Kanchanpur (19)
Efficient DMUs in 2014/15	Pachthar, Shankhuwasava, Dhankuta, Morang, Solukhumbu, Dhanusa, Rasuwa, Dhading, Kathmandu, Bhaktapur, Bara, Nawalparsi, Rupandehi, Tanahu, Gorkha, Kaski, Mugu, Humla, Banke, Jajarkot, Kailali, ,Dadeldhura and Kanchanpur (23)
Efficient DMUs in 2015/16	Jhapa, Terhathum, Dhankuta, Dhanding, Kathmandu, Bhaktapur, Rupandehi, Manang, Kaski, Myagdi, Mustang , Salyan and Kanchanpur (13)

Source: Authors' calculation

The result displays that in 2011/12, under the input-oriented approach the DDCs were, on an average, 85.69 per cent technically efficient in the case of CRS while 86.59 per cent technically efficient in case of VRS and 99 per cent scale efficient (Table 5). In other word, the DDCs could reduce their inputs by 14.31% whilst getting the same level of outputs for CRSTE and 13.41% inputs could be reduced for the same outputs for VRSTE (Table 5). Of the total 75 DDCs, only 22 (29%) percent DDCs were fully (100%) technically efficient in case of CRS while 25 (33%) DDCs were fully (100%) technically efficient under VRS and 57 (76%) DDCs were fully (100%) scale efficient. The Dolpa DDC was 43.24 per cent technically efficient in both CRS and VRS in 2011/12. The five years' average technical efficiency (CRS) is about 85.17% under input oriented approach, and this suggests that there is some room (14.83%) for improvement in terms of converting inputs into outputs. The standard deviation (SD) for the five years' average estimates is 9.43 which was 12.85 in 2011/12 and 17.93 in 2015/16. This is the reflection of the fact that variation in the estimates is reduced when we focus on mean scores. The similar interpretation can be done in remaining years from 2012/13 to 2015/16.

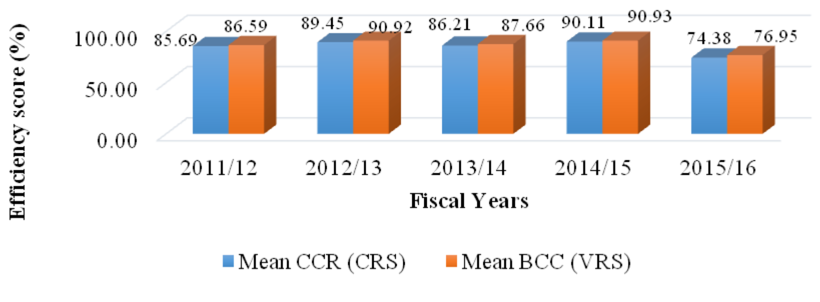
Table 5: Mean efficiency scores estimates of DDCs under input oriented approach

Results	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**2015/16**	**Over all**
Mean CCR (CRS)	85.69 (12.85)	89.45 (11.78)	86.21 (12.98)	90.11 (10.15)	74.38 (17.93)	85.17 (9.43)
Mean BCC (VRS)	86.59 (11.99)	90.92 (11.99)	87.66 (13.44)	90.93 (10.37)	76.95 (19.39)	86.61 (9.75)
Mean CCR /BCC (SE)	0.99 (0.03)	0.98 (0.04)	0.98 (0.03)	0.99 (0.03)	0.97 (0.08)	0.99 (0.03)

Note: Figure in parenthesis is standard deviation

The figure 1 shows that the mean efficiency scores estimate of 75 DDCs under CCR and BCC (technical efficiency) model. The mean efficiency is drastically decreased from 2014/15 to 2015/16 i.e. from 90.93 to 76.95 under VRS model and from 90.11 to 74.38 under CRC model.

Figure 1: Mean expenditure efficiency score under input oriented model



b. Output oriented CCR and BCC models The result indicates that in 2011/12, under the output oriented approach the DDCs were, on an average, 85.69 percent technically efficient in case of CRS and 90.69 per cent technically efficient in case of VRS and 94 per cent scale efficient (Table 6). Of the total 75 DDCs, only 22 (29%) percent DDCs were fully (100%) technically efficient in case of CRS while 25 (33%) DDCs were fully (100%) technically efficient under VRS and 29 (39%) DDCs were fully (100%) scale efficient. The Dolpa DDC was 43.24 per cent technically efficient in both CRS and VRS in 2011/12. The five years' average technical efficiency (VRS) is about 90.45% under output oriented approach, and this suggests that there is some room (9.55%) for improvement in terms of converting inputs into outputs. The standard deviation (SD) for the five years' average estimates is 7.80 which was 9.80 in 2011/12 and 13.44 in 2015/16. this is the reflection of the fact that variation in the estimates is reduced when we focus on average scores. The similar interpretation can be done in remaining years from 2012/13 to 2015/16.

Table 6: Mean efficiency scores estimates of DDCs output oriented approach

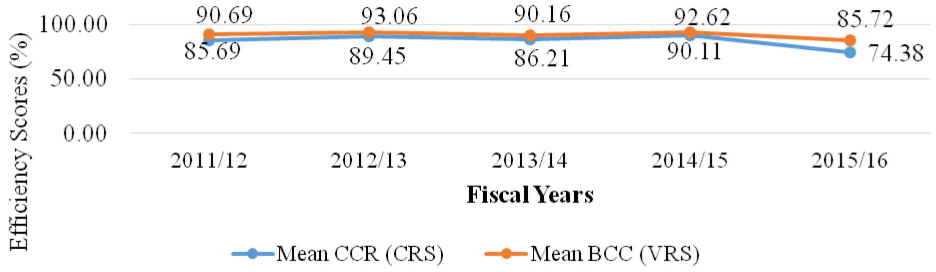
Results	2011/12	2012/13	2013/14	2014/15	2015/16	Over all
Mean CCR (CRS)	85.69 (12.85)	89.45 (11.78)	86.21 (12.98)	90.11 (10.15)	74.38 (17.93)	85.17 (9.43)
Mean BCC (VRS)	90.69 (9.80)	93.06 (9.48)	40.16 (11.89)	92.62 (8.51)	85.52 (13.44)	90.45 (7.80)
Mean CCR /BCC (SE)	0.94 (0.08)	0.96 (0.06)	0.96 (0.06)	0.97 (0.05)	0.86 (0.13)	0.94 (0.06)

Note: Figure in parenthesis is standard deviation
Source: Authors' calculation

The figure 2 shows that the mean efficiency of 75 DDCs under CCR and BCC (technical efficiency) model. The mean efficiency is drastically decreased from 2014/15 to 2015/16.

Malmquist estimation It is a variable which indicates total output growth relative to the rise in financial inputs. The total factor productivity (TFP) is a part of output independent

Figure 2: Mean expenditure efficiency score under output oriented model



of inputs for checking production efficiency [35]. If MPI/TFP is greater than 1 then it means that TFP increases from one time to another time. But if MPI/TFP is less than 1 then it means that TFP decreases from one time to another time. The five years' average Malmquist TFP index of Achham DDC is calculated 17%. In other word, total factor productivity of Achham DDC has increased by 17% annually while the annual Malmquist TFP of Taplejung DDC is deteriorated (1-0.79=0.21) by 21% annually. The five years' average Malmquist TFP of 75 DDCs is calculated to be 0.16% annually (Table 7).

Table 7: Average Malmquist total factor productivity (TFP) index of 75 DDC

Approach	2011/12 to 2012/13	2012/13 to 2013/14	2013/14 to 2014/15	2014/15 to 2015/16	Average
Input oriented (CCR)	1.00 (0.20)	0.92 (0.11)	0.95 (0.15)	1.14 (0.23)	1.0016 (0.05)
Output oriented (CCR)	1.00 (0.20)	0.92 (0.11)	0.95 (0.15)	1.14 (0.23)	1.0016 (0.05)

Note: Figure in parenthesis is standard deviation (SD)

Source: Authors' calculation

7 Conclusion

This paper analyzed and estimated technical efficiency and Malmquist TFP index for a panel dataset of District Development Committees of Nepal. Both the input and output DEA models are used for estimating the efficiency. The efficiencies of the service delivery of 75 DDCs for the period from 2011/12 to 2015/16 has been estimated. The integrated MPI (TFP) values reveals that Taplejung DDC experienced a productivity growth of 82% in the time period 2011/12 to 2012/13. The average productivity growth rates for Taplejung in the other time periods are 95% in 2012/13 to 2013/14, 78% in 2013/14 to 2014/15 and 99% in 2014/15 to 2015/16. The annual average productivity growth rate in the whole time period from 2011/12 to 2015/16 was 89%. The DDCs could reduce their inputs by 14.31% whilst getting the same level of outputs for CRSTE and 13.41% inputs could be reduced for the same outputs for VRSTE. In general, the DDCs having higher OSR (output) and

LGCDP expenditure (input) i.e. Jhapa, Morang, Kathmandu, Dang, Banke and having low population (output) i.e. Manang, Mustang, Humla, Mugu and higher number of students' enrolment (output) i.e. Bara, Parsa and Chitwan etc. are found most efficient. Most importantly it can be concluded that the concentration should be given for the proper utilization of available resource to achieve maximum output.

References

[1] Charnes, A, Cooper, W.W. & Rhodes E.L., (1978). Measuring the efficiency of decision making units. European Journal of Operational Research, 2(6), 429-444

[2] Banker, R.D., Charnes, A. & Cooper, W.W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. Management Science, 30 (9), 1078-1092

[3] Farrell, M (1957). The measurement of productivity efficiency, Journal of the Royal Statistical Society, Series A: General, 120(3), 253-281

[4] Cooper, W.W., Seiford, L.M., & Tone, K. (2007). Data envelopment analysis: A comprehensive Text with models, Applications, references and DEA-Solver software. New York: Springer

[5] Yilmax, Goksen, Onur Dogan and Bilge Ozkarabacak (2015). A data envelopment analysis application for measuring efficiency of University Department, Procedia Economics and Finance, available online at www.sciencedirect.com

[6] Westbuizen, G. van der and B. Dollery (2009). Efficiency measurement of basis service delivery at South African district and local municipalities

[7] Karaduman, Alper (2006). Data envelopment analysis and Malmquist total factor productivity (TFP) Index: An application to Turkish automotive industry

[8] FGCO (2011-2015), Consolidated financial statement, Government of Nepal, Financial Controller General Office (FCGO), Kathmandu, Nepal

[9] LBFC (2011-2015). Analysis report of MCPM assessment of 75 DDCs, the Local Body Fiscal Commission Secretariat, Lalitpur Nepal, 2011

[10] CBS (2011). Statistical year book of Nepal, 2011, Government of Nepal, Central Bureau of Statistics, Kathmandu Nepal

[11] Helfand SM and Levine ES (2004). Farm size and the determinants of productivity efficiency

[12] Ying-Ming Wang & Yi-Xin Lan (2011). Measuring Malmquist productivity index: A new approach based on double frontiers data envelopment analysis, Mathematical and Computer Modelling 54 (2011) 2760–2771

[13] Aziz KUTLAR, Fehim Bakirci and Fatih Yukse (2012). An analysis on the economic effectiveness of municipalities in Turkey. African Journal of Marketing Management Vol. 4(3). p.80-98, March 2012

[14] Malmquist S. (1953). Index number and indifference Curves, Trabajos de Estatistica. 4: 209-242

[15] Tolga Tipi and Erkan Rehber (2006). Measuring technical efficiency and total factor productivity in agriculture: The case of the South Marmara region of Turkey, New Zealand Journal of Agricultural Research, 2006, Vol. 49: 137-145

[16] Nin A, Arndt C, Hertel TW and Preckel PV (2003). Bridging the gap between partial and total factor productivity measures using directional distance functions, American Journal of Agricultural Economics 85 (4): 928-942

[17] Kyong-Rock Lee and Byung-Ihm Leem (nd). Malmquist productivity index using DEA frontier in Stata, the Stata Journal

[18] Afono, Antnio, and Sonia Fernandes (2008). Assessing and explaining the relative efficiency of local government, The journal of socio-economics 37 (2008): 1946-1979

[19] Worthington A.C. & Dollery B.E. (2001). Measuring efficiency in local government: an analysis of New South Wales municipalities' domestic waste management function, Policy Studies Journal 29, 232-250

[20] Byrnes, J.D., Crase, L., Dollery, B.E. and Villano. R. (2010). The relative economic efficacy of urban water utilities in regional New South Wales and Victoria. Resource and Energy Economics, 32, 439-455

[21] Gupta S., Kumarb, S. & Sarangic, G.K. (2012). Measuring the performance of water service providers in urban India: implications for managing water utilities. Water Policy, 14, p. 391-408,

[22] Picazo, T.A.J., Gonzalez, G.F., & Saez, F.F.J. (2009). Accounting for operating environments in measuring water utilities' managerial efficiency, the service Industries Journal, 29, 761-773

[23] Boame, A.K. (2004). The technical efficiency of Canadian urban transit systems, transportation research pat E. 40, 401-416

[24] Fazioli, R., Filippini, M. & Prioni, P. (1993). Cost structure and efficiency of local public transport: the case of Emilia Romagna bus companies, International Journal of Transportation Economics, 20, 305-324

[25] Garcia-Sanchez, I.M. (2009). Technical and scale efficiency in Spanish urban transport: estimating with Date Envelopment Analysis, Advances in Operations Research, 2009, article ID 721279, p. 15.

[26] Walter, M., & Cullmann,A. (2008). Potential gains from mergers in local public transport: an efficiency analysis applied to Germany discussion papers of DIW Berlin 832, DWI Berlin, German institute for Economic Research

[27] Dollery, B., Byrnes, J. & Crase, I. (2008). Australian local government amalgamation: a conceptual analysis of population size and scale economies in municipal service provision. Australian Journal of Regional Studies, 14, 167-175

[28] Geyes, B., & Moesen. W. (2009). Exploring sources of local government technical inefficiency: evidence from Flamish municipalities, Public Finance and Management, 9. p. 1-29.

[29] De Borger, B., Kerstens, K., Moesen, W. & Vanneste, J. (1994). Explaining differences in productivity efficiency: an application to Belgium municipalities, Public Choice, 80, 339-358 in the Brazilian cener-west. Agricultural Economics 31 (2-3): 241-249

[30] Kalb, A., Gey, B., & Heinemann, F. (2012). Value for money? German local government efficiency in a comparative perspective: Applied Economics, 44, 201-218

[31] Balaguer-Coll M. T. & Prior-Jimenez (2009). Short- and long term evaluation of efficiency and quality: an application to Spanish municipalities, Applied Economics, 41, 2991-3002

[32] Athanassopoulos, A., and K. Triantis (1998), Assessing aggregate cost efficiency and the related policy implications for Greek local municipalities, Infor 36(3), 66-83

[33] Sampaio De Sousa, M., and F.S. Ramos (1999), Measuring public expenditure efficiency in Brazilian municipalities: a non-parametric approach, in Data Envelopment Analysis in service sector, ed. by G. Westermann, Wiesbaden: DUV, Gabler, pp. 237-267

[34] Borge, L.E., T. Falch, and P. Tovmo (2008), Public sector efficiency: the roles of political and budgetary institutions, fiscal capacity and democratic participation. Public choice 136 (3-4), 475-495

[35] Afono, A., Ayadi, M. & Ramzi, S. (2013). Assessing productivity performance of basic and secondary education in Tunisia: A Malmquist analysis. Working papers department of Economics 19, ISEG-School of Economics and Management, 5(1) 104-128