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The Impact of Malnutrition and Lack of Access to Clean Water on Productivity

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Abstract

This study aims to examine the importance of access to clean water and malnutrition in determining total factor productivity (TFP) for seventeen representative developing countries by employing data for 1995-2015 period. Among common, fixed and random effects models, fixed effects model is chosen as a best candidate model through using appropriate selection criteria. The study finds that both lack of access to clean water and malnutrition have significant, robust and negative impact on TFP whereas trade openness (transfer of knowledge)positively affect TFP. Neoclassical view about no impact of sectoral changes on productivity is evident for the selected sampled countries. Trade openness, and information and communication technologies positively influence the TFP. The findings confirm the importance of availability of proper nutrition and clean water to the population at large to ensure sustainable economic growth and development. The study recommends the policy makers of developing countries to prioritize their efforts to ensure universal access to safe drinking water and nutrition with a time bound approach.

Keywords: Total Factor Productivity, Lack of access to clean water, Malnutrition, Common effects, Fixed effects model.

1. Introduction

How important is the role of opportunity to clean water and malnutrition in determining total factor productivity (TFP)?This is an important and relatively unexplored area of research specifically in the developing countries. Literature is more focused on different health measures like life expectancy to explore the role of health in determining TFP and economic growth irrespective of exploring its impact through productivity. Further, due

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to lack of availability of any consolidated measure for health, it is important to pinpoint the basic reason behind poor health. There is an increased attention by the international policy makers (as reflected through MDGs and SDGs) to ensure the universal availability of clean water and nutrition. However, this has not been a part of academic research to explore the impact of these factors on productivity. In this perspective, it is highly significant to understand the role of lack of access to clean water and malnutrition in determining productivity. This study is unique in a way to assess the significance of basic factors behind bad health on TFP for the selected developing countries. Given the significance of human capital in the growth process, exploring the role of healthy human capital seems to be an important contribution in the literature and have important implications for the policy makers.

The role of human capital, as an important factor of growth, cannot be ignored therefore enhancing its quality should be prioritize by the public policy makers. According to Benhabib and Spiegel (1994) and Mankiw et al. (1992), human capital has positive external or spillover effects on growth and development process of any country. Therefore, investigating the factors that enhance the quality of human capital is a significantly important task for research and development. Many leading economists, like Solow (1956), Romer (1986), Lucas (1988),explained that availability of quality human capital can better contribute in the growth process whereas its quality primarily depends on quality of education and knowledge. However, the role of health cannot be ignored because a physically and mentally healthy worker with quality education can contribute more toward productivity and economic growth. A healthy worker is more productive and likely to be less absent from work (Cole and Neumayer, 2006).Disability and poor health results in reduction of income which is more evident in developing countries than developed countries. Thus, health is a prerequisite to economic development of any country.

Bad health of population at large is a major hurdle for developing countries toward achievement of productivity and economic growth. The role of health in determining economic growth through affecting total factor productivity is explored by various studies during the last two decades, like Knowles and Owen (1995), Bloom et al. (1999), Gallup and Sachs (2000), Mayer (2001), Bhargava et al. (2001), Webber (2002) and Alvi and Ahmed (2014) along with others. But these studies adopted life expectancy as an indicator of health which captures mortality only and not the morbidity. WHO (2002) identified that "even though life expectancy has been most commonly used by economists but it does not capture all the aspects of the individual's current health that may affect productive capacity". Cole and Neumayer (2006) adopted the Malnutrition and lack of access to clean water as indicators of poor health. They used data for the period 1965-1995comprising 52 developing and developed countries (jointly).

This study is distinguished from the previous studies as follows; firstly, it takes most recent data set from 1995 to 2015, secondly, this study focuses on developing countries only because lack of access to clean water and malnutrition is a problem for the people who are living in developing countries. Therefore, developing countries which are far lagging behind the achievement of sustainable Development goals require an emergent attention to fulfill the national and international obligation.

Another distinguishing feature is investigating the role of innovation and creation of knowledge (measured by information and communication technologies, transfer of knowledge or technology (measured by trade openness) and structural transformation (share of agricultural output to GDP) in affecting TFP. The developing countries included in the sample represent roughly half of the world's population and these countries have big influence in the world affairs. Lack of access to clean water and malnutrition affect the economic growth via TFP is our central argument. Thus, we intend to empirically examine the impact of lack of access to clean water and malnutrition, as indicators of poor health and represents the quality of human capital, on TFP and we shall estimate TFP by using the parsimonious production function.

According to the United Nations Food and Agriculture Organization (2014-2016) report, about 795 million individuals are suffering chronic malnutrition in the 2014 that represents 11 percent of the global population. However, the situation is even worse in developing countries where 14.9 percent of the population is undernourished. The world statistics (2014-2016) shows that it is increasing in absolute numbers after 2007 instead of decreasing. Malnutrition causes short height, thin body, poor energy level, swollen legs, abdomen and it results in permanent problems with mental and physical development. The prevalence of malnutrition or the households having insufficient food intake is also an issue to be treated as it is seriously causing damages to the productivity and accordingly to the growth of any economy. Decreased proportion of malnutrition population leads to better economic growth(Webber, 2002). According to Arcand (2001) identified that

0.23-4.7 percent shortfall in GDP per capita in the worldwide is due to inadequate nutrition.

Waterborne diseases due to lack of access to clean water are the great risk for the world in the 21st century. Most of the population in the developing countries has no access to clean water. According to World Bank (2014) report, 2.5 billion population of the world has no access to the sanitation facilities which is 37% of the world population while 11% of the world population is unable to access clean water. Due to lack of access to clean water and sanitation, people are suffering from many serious kind of waterborne diseases like; Diarrhea, typhoid fever, cholera, schistosomiasis, Dengue, Malaria and Hepatitis. According to WHO (2014), diarrheal disease is the primary cause of deaths of almost 1.8 million human population every year (WHO, 2014). According to estimates of Cole and Neumayer (2006), the impact of lack of clean water on world productivity is -0.09 while it is higher for African region, that is, - 0.17.

This remaining study is organized as; theoretical model is described in section-2, section-3 is data methodology, Section 4 is the results and discussion and section 5 describe the concluding remarks of the study.

2. Theoretical Model

To examine the impact of malnutrition and lack of access to clean water on TFP by using the panel data of 17 developing countries (List of country's names is given in Table 3), we adopted the most widely and acceptable production function for the calculation of TFP, namely the Cobb-Douglas production function. This same approach has also been used by Miller and Upadhyay (2000) and Cole and Neumayer (2006).

The Cobb-Douglas production function is represented as

$$Y = AK^{\alpha} H^{\beta} L^{\gamma}, \quad 0 < \alpha < 1, \quad 0 < \beta < 1, 0 < \gamma < 1 \quad (1)$$

Y represents production which is measured as real GDP, K represents stock of total physical capital, L is the total labor force and H indicates stock of human capital. TFP is measured as A. No restriction is imposed on the sum of parameters (α +β+γ) allowingthe possibility of decreasing or increasing return to scale therefore the sum of α, β and γ can be equal to, less than or greater than 1.

Equation (1) can be transformed for production per worker through dividing both sides of equation by "L"

$$\frac{Y}{L} = \frac{AK^{\alpha} H^{\beta} L^{\gamma}}{L}$$

)

$$\frac{Y}{L} = \frac{A}{L}\left(\frac{K}{L}\right)^{\alpha}\left(\frac{H}{L}\right)^{\beta}(L)^{\gamma}(L)^{\beta}(L)^{\alpha}$$

$$\frac{Y}{L} = A\left(\frac{K}{L}\right)^{\alpha}\left(\frac{H}{L}\right)^{\beta}(L)^{\alpha+\beta+\gamma-1}$$

Thus, the production function become

$$y = A(k)^{\alpha}(h)^{\beta}(L)^{\alpha+\beta+\gamma-1}$$

In equation (5), y is a measure of per worker real GDP, k is per worker real stock of physical capital and h is per worker human capital. Rewrite the equation (5) in logarithm form, it become as following:

$$lny = lnA + \alpha lnk + \beta lnh + (\alpha + \beta + \gamma - 1)lnL \quad (6)$$

As this study is comprised on panel data so the equation (7) is written in panel form

$$lny_{it} = \phi_i + \alpha lnk_{it} + \beta lnh_{it} + (\alpha + \beta + \gamma - 1)lnL_{it} + \varepsilon_{it} \quad (7)$$

The subscript "i" is meant for country and "t" is time subscript. The TFP is ($\phi_i + \varepsilon_{it}$) which is equal to lnA in equation (6). Thus TFP is calculated as follows:

$$tfp_{it} = (\phi_i + \varepsilon_{it}) = lnA \quad (8)$$

Model II:

The driven TFP, as in equation (8), is dependent variable whereas the impact of malnutrition, lack of access to clean water and other control variables on TFP will be estimated. Health indicators, that is, malnutrition and lack of access to safe drinking water, represent the quality of human capital. Improvement in health indicators positively influence TFP. According to Isaksson (2001), technological innovations in developed countries readily transfer to developing countries therefore trade can be viewed as a significant tool to transfer knowledge. Miller and Upadhayay (2000), Cole and Neumayer (2006) and Alvi and Ahmed (2014)have used trade openness to check its impact on TFP. Theoretically, trade openness has positive impact on TFP.

Because panel comprises of developing economies therefore investigating the impact of structure transformation on TFP seems to be significantly important. We measure structural transformation through share of agriculture output to GDP. Economies in transition shift their focus from primary to secondary sector, that is, they are in the process of structural transformation and in fourth or fifth stage of Rostow's five stages. There are two prevailing views about the impact of structural transformation on productivity and growth. First, neoclassical view which states that structural changes have no impact on productivity and growth. Second view belong to world bank economist, like Rostow (1971), Baumol (1989). Therefore, it requires inclusion of agriculture share to GDP as a determinant of TFP. Therefore, share of agriculture to GDP may or may not influence TFP.

Creation of knowledge cannot be measured however its intensity can be accessed through different proxies, for example, R&D expenditures and patents. However, the most recent measure used is information and communication technologies (ICT) as witnessed in the literature, for example Jorgenson and Stiroh (2000), Isaksson (2006), Van Ark et al. (2008) along with others.

The discussion on the role of ICT was simulated during the late 1980s and 1990s after the expression of concern by Robert Solow which is termed as productivity paradox. However, the visibility of the role of ICT is witnessed after 1995. It affects productivity both directly and indirectly. First, ICT being part of goods produced in the economy have direct effect on growth and productivity. Second, because ICT play significant role in generation and transmission of information, and in reducing market failures relevant to information asymmetries, therefore ICT also affect productivity of ICT user sectors. Therefore, role of ICT in determining productivity of any country is included as control variable in the model.

So, the equation of Model II, in logarithmic form, becomes as followings.

$$lntfp_{it} = \eta_i + \theta_1 lnmalnut_{it} + \theta_2 lnlsw + \theta_3 lntrad_{it} + \theta_4 lnagri_{it} + \theta_5 lnict_{it} + \varepsilon_{it} \quad (9)$$

Where “malnut” is the malnutrition “*lsw*” is the lack of access to clean water and sanitation, “*trad”* is the trade openness and*“ agri”* is the agriculture share to GDP, *ict* is the information and communication technologies. The model is transformed into log-log form for retrieving the elasticities so that sensitiveness of TFP to independent variables can be estimated.

3. DATA AND METHODOLOGY

Selection of appropriate measures to estimate the model through compatible econometric method is highly important to meet the objective(s) and for making useful policy guidelines. The data is selected for the period 1995-2015 from World Development Indicators (2015) for all the countries and for all the variables.

Real GDP per worker is calculated by dividing the GDP (in US Dollars) at constant prices with total labor force. Due to non-availability of data on capital stock per worker, we used the following procedure to calculate it.

$$K_0 = \frac{GFK_0}{\delta + g_{GFK}}$$

Where, K_0 represents stock of capital, δ denoted depreciation rate which is taken as 5%, growth rate of gross fixed capital is represented by g_{GFK} and Gross Fixed Capital Formation is represented by GFK_0. After calculating K_0, data for the entire period is calculated by using the following formula.

$$K_t = K_{t-1} - \delta K_{t-1} + GFK_t = (1-\delta)K_{t-1} + GFK_t \qquad (11)$$

Finally, K_t is divided by labor force to get the data series for capital stock per worker.

This study used lack of access to clean water and malnutrition, representing quality of human capital, as determinants of TFP. However, in the production function, quality of human capital will be measured through average years of schooling. Two different measures of quality of human capital, health indicators and education, will help us to understand the significance of healthy educated human capital in the growth process of developing counties. The other determinants of TFP used in the model are trade openness and agriculture share to GDP.

This study also used information and communication technologies (ICT) development as a control variable. Following Vu (2011) and Sassi and Goaied (2013), ICT is proxied by most relevant indicators which are mobile broadband, mobile cellular, fixed telephone and fixed internet lines subscriptions per 100 inhabitants.

Baltagi (2008) lists the many advantages of panel data. In order to understand the role of lack of access to clean water and malnutrition in determining the economic growth of a panel of developing countries, we relied on widely accepted models which are common effects, fixed effects and random effects models. These models advocate various panel data studies (Cole and Neumayer, 2006; Miller and Upadhyay, 2000; Bloom et al., 2004 and Alvi and Ahmed, 2014).

Common effects model assumes coefficients as constant across countries and time wherein it follows OLS estimation procedure. The OLS equation, for the 1st step and 2nd step approaches, are as follows

$$lny_{it} = \phi_i + \alpha lnk_{it} + \beta lnh_{it} + (\alpha + \beta + \gamma - 1)lnL_{it} + \varepsilon_{it} \quad (12)$$

and

$$lntfp_{it} = \eta_i + \theta_1 lnmalnut_{it} + \theta_2 lnlsw + \theta_3 lntrad_{it} + \theta_4 lnagri_{it} + \theta_5 lnict_{it} + \varepsilon_{it} \quad (13)$$

In the above equation, i is the identifier for cross-sections and *t* denotes the time.

The Fixed Effects model is well behaved in a way that it captures the cross-country differences. For this purpose, this study used the dummy variable for each country because each country has the different level of output per worker and TFP. Thus, we can write equations for Fixed Effects model as

$$lny_{it} = \phi_1 + \phi_2 D_2 + \phi_3 D_3 \ldots + \phi_{17} D_{16} + \alpha lnk_{it} + \beta lnh_{it} + (\alpha + \beta + \gamma - 1)lnL_{it} + \varepsilon_{it} \quad (14)$$

and

$$lntfp_{it} = \eta_1 + \eta_2 D_2 + \eta_3 D_3 \ldots + \eta_{17} D_{16} + \theta_1 lnmalnut_{it} + \theta_2 lnlsw + \theta_3 lntrad_{it} + \theta_4 lnagri_{it} + \theta_5 lnict_{it} + \varepsilon_{it} \quad (15)$$

Where D_i represents the dummy variable for country i. For 17 countries, 16 dummy variables are included to avoid dummy-variable trap. 16 dummy variables along with the intercept will serve the purpose to capture the cross-country differences for all 17 countries included in the sample.

However, it may always be true that the cross-country differences are captured through separate intercepts. For this case, we need to include an error term along with common intercept. This approach is suggested by the proponents of random effects model or the error correction model. It has the feature to identify intercept separately for each country, that is intercept is of random nature with fixed mean and a random componentu_{it} having mean zero and varianceσ^2. It suggests that all the seventeen countries included in the model have a common mean whereas the difference is captured through including u_{it} as error term.

Thus the 1st and 2nd step model can be written as

$$lny_{it} = \phi_1 + \alpha lnk_{it} + \beta lnh_{it} + (\alpha + \beta + \gamma - 1)lnL_{it} + \varepsilon_{it} + u_{it} \quad (16)$$

and

$$lntfp_{it} = \eta_1 + \theta_1 lnmalnut_{it} + \theta_2 lnlsw + \theta_3 lntrad_{it} + \theta_4 lnagri_{it} + \theta_5 lnict_{it} + \varepsilon_{it} + u_{it} \quad (17)$$

Where ϕ_1 and η_1 are mean value of intercept respectively.

We used a formal restricted F test of two models, in which we test which model is more appropriate, either the Common Effects or Fixed Effects. The test is as following

$$F = \frac{(RSS_R - RSS_{UR})/m}{RSS_{UR}/(n-k)} \quad (18$$

Where; RSS_R and RSS_{UR} are restricted and unrestricted residual sum of square respectively. m captures the total number of restrictions, n and k denote number of observations and parameters.

It is important to understand the critical nature of regression models having error component such as the individual effect of each country is a part of residual and it may not be the case that $E(\varepsilon_{it}/X_{it})$=0.

This means the correlation between independent variable and error component is possible (Hausman 1978 and Baltagi, 2008). Therefore, Hausman test is employed to select the appropriate model between Random Effects and Fixed Effects models.

4. **Results and Discussion**

To avoid the problem of spurious relationship, panel stationary test is applied to check the stationarity of variables, that is, we need to check the level of stationarity or order of integration so that we can transform the variables accordingly. According to Levin, Lin and Chu(2002), the individual unit root tests have limited power against alternative hypothesis. Therefore, they proposed a test for panel unit root but the test is restrictive in the sense that it requires ρ_i to be homogeneous across all i's but that may not necessarily be the case. Maddala (1999)has rightly pointed out that the alternative hypothesis has problem of convergence in growth for all the countries at same rate. Im, Pesran and Shin (2003) proposed a test for panel unit root which allows for a heterogeneous coefficient and it is based on the idea to average test statistic of individual unit root having properties of serial correlation as different across the cross-sections. So, this study has applied IPS unit root test which gives more accurate results comparable to LLC. Table 1 shows the results of IPS test which indicates that all variables are stationary at first difference.

Table. 1	Unit root test	
Variable	**IPS Statistics**	**Level of Stationary**
Output	-7.66609*	I(1)
Capital Stock	-4.45451*	I (1)
Human Capital	-6.43463*	I(1)
Labor Force	-5.44629*	I(1)
Trade Openness	-2.52442**	I(1)
Agriculture Share to GDP	-7.94226*	I(1)
Malnutrition	-4.44412*	I(1)
Lack of access to clean water	-6.8892*	I(1)
Information and Communication Technology (ICT)	-3.0001**	I(1)

Note: *, ** and *** shows significance at 99%, 95% and 90% confidence interval

4.1 Production Function

The Common, Random and Fixed Effects are employed to estimate the production function. The restricted F-test and Huasman test for model specification have indicated that fixed effects model is most suitable. Accordingly, Table-2 shows the estimated results of Fixed Effects model. It is revealed that all the factors of production including human capital have significant impact on production wherein elasticities showing the impact of k and h have magnitude of 0.41 (α) and 0.16 (β) respectively. The coefficient of lnL (α+β+γ-1), which shows the impact of labor on production as 0.003 which resultantly emerges into value of γ ($= 0.03 - \alpha - \beta - 1$) as 0.413, showing how elastic is production with respect to labor. The signs of all three parameters are in line with theory, that is, all the variables have positive contribution in production.

Table-2 Cobb- Douglas Production Function	
Variable (dependent: Lny)	
Lnk	0.43*
	(11.44)
Lnh	0.16*
	(3.24)
LnL	0.003*
	(3.81)
N	340
R-Square	0.61
Hausman Test	P-value 0.006

Note: *, ** and *** shows significance at 99%, 95% and 90% confidence interval

The model treats the production function as flexible (constant, increasing or decreasing returns to scale) therefore sum of values of α,β and γ can be less than, equal to or greater than 1. The results show the nature of production function as constant returns to scale because $\alpha + \beta + \gamma = 1.03$ which is not significantly different from 1.

TFP ($\phi_i + \varepsilon_{it} = lnA = tfp_{it}$) for all the countries is calculated through using the above estimated production function, based on equation (7). The ranking of countries is based on the value of TFP which is shown in Table-3. The ranking of countries enable us to differentiate among countries based on TFP. It is obvious to believe that there are some factors or indicators which influence TFP and these factors are primarily related to social and economic development conditions in the respective countries. These factors may be comprised of different indicators like health, trade or industrial development. Now we explain and discuss the estimation of those determinants which affect economics growth or development via TFP.

Table 3. Countries Ranked by Average TFP

Country	**TFP**
Mexico	7.68
Brazil	7.54
South Africa	7.33
Malaysia	7.13
Egypt	7.01
Iran	6.94
China	6.91
Peru	6.84
Tunisia	6.81
Thailand	6.77
India	6.75
Indonesia	6.73
Philippine	6.67
Pakistan	6.54
Paraguay	6.34
Bangladesh	6.32
Sri-lanka	6.21

4.2 Determinant of Total Factor Productivity

To check the impact of lack of access to clean water and malnutrition on TFP, we estimated equation (9).Malnutrition (malnut) and lack of access to clean water (lsw) are health indicator describing quality of human capital whereas the three other determinants, trade openness (trad) describing creation and transfer of knowledge, agriculture share to GDP (agri) describing structural transformation and ICT. We estimated the common effects, fixed effects and random effects models and check their validity through appropriate diagnostic tests discussed in the previous section. These tests have indicated that fixed effects model is most appropriate.

Table. 4 Determinants of Total Factor Productivity

Independent Variable	Fixed Effects
Malnutrition	-0.17*
Lack of access to clean water	-0.20**
Trade Openness	0.08**
Agriculture share to GDP	-0.02
Information & Communication Tech	0.24*
C	-0.05*
N	340
Adj. R-square	0.94
Hausman Test	P-Value 0.002

Note: *, ** and *** shows significance at 99%, 95% and 90% confidence interval

Health is an important determinant of TFP. The laborer is reasonably more productive if his health condition is good whereas the basic underlying reasons for bad health are the unavailability of healthy drinking water and the inadequate nutrition. Thus, bad health contributes negatively to TFP. The results in Table-4 show that malnutrition has significant negative impact on TFP which is equal to -0.17 which is identified as one percent increase in proportion of undernourished population cause to decrease TFP by 0.17 percent. The coefficient of malnutrition is significant at 99% level of confidence. Our results are supported by findings of Cole and Neumayer (2006); in which they found that impact of malnutrition on TFP is negative and significance.

Our second indicator of health is waterborne diseases. We took lack of access to clean water as a proxy of water borne diseases where "lsw" depicts the percentage of population which has no access to clean water. The results indicate that the coefficient of lack of clean water (lsw) is significant at 95% confidence interval. Lack of access to clean water is responsible for reducing TFP by 20% which mean if there is 1 percent increase a percentage population have no access to clean water, it causes reduction of 0.20 percent in TFP of the economy as a whole. The result is supported by the findings of Cole and Neumayer (2006) in which they estimated that lack of access to clean water has reduced world TFP. On the other hand, trade openness has positive impact on TFP. 1% increase in trade openness causes to increase TFP by 0.08 percent. Trade openness, proxy of transfer of knowledge, enhances transfer of technology and leads to increase in TFP. The results are in-line with Isaksson (2001) and Harrison (1996)along with others.

The coefficient of agriculture share to GDP is negative, but insignificant. The result is in line with the neoclassical preposition, that is, sectoral composition is not important for productivity and growth of an economy. The coefficient of information and communication technologies is 0.24 and significant at the 99% confidence interval which is indicating that if there is one percent increase in information and communication technologies it causes to increase the TFP by 0.24 percent. The results are in line with Vu (2011) and Sassi and Goaied (2013). The value of adjusted R-square is reasonably high depicting that 94 percent of the variations in TFP are explained by the model.

5. Conclusion

The adoption of two indicators of health, that is, lack of access to clean water and malnutrition, as determinants of TFP for selected developing countries is the key significance of this study. Both lack of access to clean water and malnutrition are found to have negative significant impact on TFP. However, lack of access to clean water is more influential than malnutrition. It demonstrates that lack of access to clean water and malnutrition are key factors of productivity and economic growth.

Unhealthy human capital due to non-availability of adequate nutrition and clean drinking water results in low economic growth. So, health of the labor force and the population at large is necessary to achieved sustained level of economic growth and health is at least as important as any other determinant of economic growth. Structural transformation has no impact on productivity (Neoclassical preposition holds). Further to health indicators, trade openness and ICT are important determinants of productivity.

As a matter of successful public policy, it is important to consider health as the top priority so that sustainable social and economic development can be ensured because health not only is an indicator of social development but also influence the production through affecting productivity of labor. It requires the allocation of resources toward fulfillment of clean water and appropriate nutrition to the poor segment of the society. It is also a prerequisite to ensure the optimal utilization of physical capital.

In fact, mother of the diseases is lack of availability of clean water and malnutrition which have fatal effects and create low productive total labor. Increase in productivity of labor has reciprocal effect in a way that it ensures high economic growth of a country and economic growth results in improving the ability of labor to ensure living standard, as wages are increased due to increase in productivity and economic growth. The importance of innovation, creation and transfer of knowledge cannot be ignored to enhance TFP in developing countries.

The current study highlights the importance of nutrition and the access of the population to clean water that call for healthy fiscal policy both at federal and regional levels. The respective governments of developing countries must allocate enough funds and formulate an appropriate policy framework with a time bound approach wherein the implementation of policies must be worked out strictly. This approach in the long run will ensure a healthy society and sustained economic growth. Lack of access to clean water and inadequate nutrition are the basic ingredients of all the diseases which results in increase in dependency ratio along with other multi-dimensional effects.

These two indicators (lack of access to clean water and malnutrition) are also included in the sustainable development goals wherein developing countries are far lacking behind the developed countries. In future, micro-level research should be conducted that may highlight the availability of adequate nutrition and access to clean water at regional level and its impact on income level of labor force. Opportunity index and the timeframe is needed to estimate. That study will be helpful to guide the policy makers to workout plan at regional level to ensure a healthy society which will also help the countries to achieve sustainable development goals within stipulated timeframe. The study is a call to the public policy makers of developing countries to prioritize the policies to ensure universal access to clean water and nutrition which require allocation and utilization of funds optimally.

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