



Relationships among energy consumption, pollution emission, and economic growth in Nepal



Umesh Bastola*, Pratikshya Sapkota

School of Economic Sciences, Washington State University, PO Box 646210, Pullman, WA 99164, USA

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ABSTRACT

Solving the existing energy crisis, alleviating poverty, and mitigating the potential impacts of climate change have garnered significant attention of policy makers in Nepal. In this context, this paper examines the causal relationships among energy consumption, pollution emission, and economic growth for Nepal employing time series econometric methodology. Both Johansen cointegration and ARDL (Autoregressive Distributed Lag) bounds tests suggest presence of two cointegrating vectors, one when energy consumption and the other when carbon emissions are used as dependent variables. The Granger causality tests suggest presence of long-run bidirectional causality running from energy consumption to carbon emission and vice-versa and a unidirectional causality running from economic growth to both carbon emissions and energy consumption. These findings imply that policies that boost energy consumption may not spur economic growth, rather are more likely to exert adverse effects on the environment. On the other hand, energy conservation and carbon emission reduction policies would not impede the long-run economic growth. Policies that focus on alternative energy may be an approach in favor of mitigating climate change impacts while protecting environmental health and without a cost to the country's long-run economic growth.

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1. Introduction

Nepal is one of the least developed countries in the world with per capita annual GDP (gross domestic product) of \$1279 in terms of PPP (purchasing power parity, constant 2005 international dollars) in 2012 and more than 55% of total population living below a poverty line of \$2 (in PPP terms)/day [1]. Nepal is a non-industrialized predominantly agricultural country with about two-thirds of the total population engaged in agriculture. Nepal has not shown substantial growth rate in national income since many years, and has remained as one of the economically deprived nations in the world. Although there is no substantial development towards industrialization, data reveal that CO₂(carbon dioxide) emission, an indicator of both economic growth and environmental degradation, as well as energy consumption are increasing over time in Nepal.

CO₂ emission in Nepal is contributed by various sources. Residential buildings and commercial and public services,

manufacturing industries and construction, and transportation are the major sources of CO₂ emissions, with average shares of 34%, 31%, and 27% of total fuel combustion during 2000–2008, respectively (Fig. 1). With escalating urbanization and increased use of transportation, the figures are expected to rise in future.

Nepal is one of the lowest per capita energy consuming countries in the world. In 2009, Nepal's per capita primary energy consumption was 2.8 million btu, the lowest among the South Asian nations, while the world average being 70.7 million btu [2]. Nevertheless, energy sector in Nepal has a substantial influence in the economy and thus has garnered much attention of the policy makers. For instance, petroleum products are the major imported commodities in terms of value, which is greater than the total value of all the commodities exported by the country [3]. Increasing domestic demand for the petroleum products and its soaring international market price indicate more depletion of the country's foreign currency reserves. Such a high import of fossil fuels, together with poor performance of the export sector, has created a serious concern on trade deficit in the country, which may have important implications for the country's economic growth. At the same time, inadequate energy supply may also affect the growth of the economy.

* Corresponding author. Tel.: +1 (971) 801 2035.

E-mail addresses: umesh.bastola@email.wsu.edu (U. Bastola), p.sapkotabastola@email.wsu.edu (P. Sapkota).

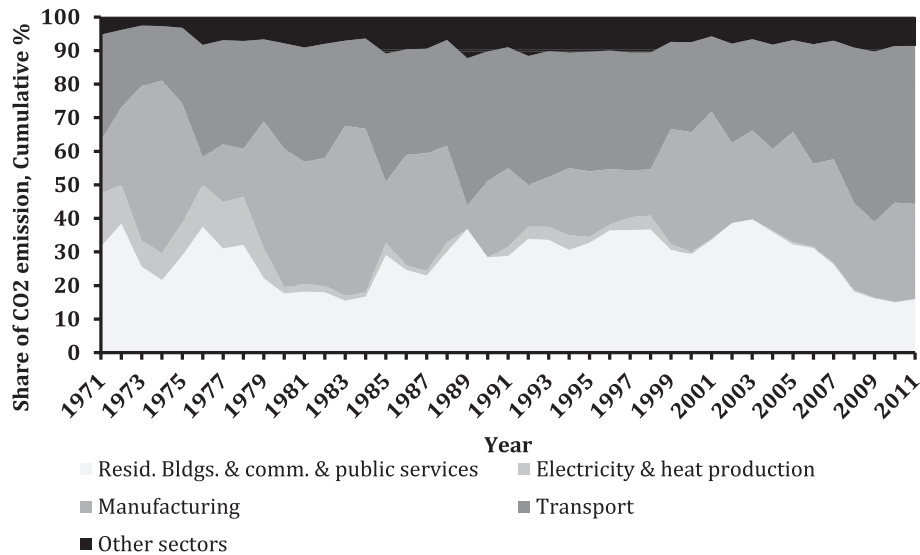


Fig. 1. Sources of CO₂ emissions in Nepal. (Source: World Development Indicators, 2012).

Nepal's first policy statements in energy sector appeared in the Fifth Five-year Plan (1975–80) where the government emphasized the need to increase the supply of renewable energy including the hydropower and reduce heavy dependence on traditional sources and petroleum imports. Other policies and acts were sequentially formulated for the development of the energy sector and include Hydropower Development Policies 1992 and 2001, Water Resource Act 1992, Electricity Act 1992, Forest Sector Policies and Forest Act 1993, Water Resources Strategy 2002, National Water Plan 2005, Rural Energy Policy 2006, National Electricity Crisis Resolution Action Plan 2008, and Ten Years Hydropower Development Plan 2009, among others. In essence, these acts, plans, and policies have emphasized meeting household as well as industrial demand for energy on a sustainable basis through scientific management of the resources. The focus is on making the country less reliant on the imported energy and encouraging alternative energy sources. In the recent years, Nepal has been seriously hit by energy deficiency and the country is striving to solve the problem of power outages that extend even up to 16 h a day, which compelled the government to declare a national power emergency [4].

Issues for environmental protection in Nepal have been addressed since the Sixth Five-Year-Plan (1980–85), however, the legislations for controlling pollution emissions started after enactment of the Environmental Protection Act 1996, Environment Protection Regulation, 1997, and Ozone Depleting Substances Consumption Rules, 2001. The government has institutionalized the requirement of EIA (Environmental Impact Assessment) of any developmental project and has implemented the standards pertaining to the industrial effluents air quality, however, the outcomes of these efforts have not been achieved in a satisfactory manner [5].

Energy use, pollution emissions, and economic growth of a country are all interconnected. The consequences of over or under-utilization of energy may extend to climate change, national income, and sustainable development. Despite low emission of greenhouse gases, Nepal, due to her unique geography, is highly vulnerable to climate change. In fact, Nepal is the fourth most climate vulnerable country in the world and hazards such as floods, droughts, and landslides pose enormous costs to the Nepalese economy [6]. Impacts of climate change are already occurring in the Greater Himalayas [7–9] through the loss of ice and snow as well as rapid reduction in the volume of Himalayan glaciers. Hence,

realizing the potential impacts of climate change, the Government of Nepal has approved a new policy on climate change that aims to “improve livelihoods by mitigating and adapting to the adverse impacts of climate change, adopting a low-carbon emissions socio-economic development path, and supporting and collaborating in the spirits of country's commitments to national and international agreements related to climate change” [10].

The above discussion leads us to our research questions: Does energy consumption in Nepal spur economic growth? What is long-run causal relationship among energy consumption, environmental pollution, and economic growth? What energy and climate policies can contribute to sustainable growth of the Nepalese economy? Therefore, the overall goal of this paper is to probe the relationships among environmental pollution, economic growth, and energy consumption in Nepal. Specifically, we test the existence of long-run and causal relationships among the variables in a multivariate framework employing a variety of time series econometric testing strategies, including a recently developed ARDL bound testing approach for cointegration which has a better small sample merit and can produce robust results in a short data span [11]. Findings from this study would provide a better understanding for policy makers and researchers regarding energy, environment, and growth relationships in Nepal.

The remainder of the paper is structured as follows: Section 2 provides an overview of literature on energy consumption, pollution emission, and economic growth. Section 3 presents the research methodology followed by the empirical results in Section 4. Section 5 provides discussion on the results. Section 6 concludes the study by outlining policy implications of the findings.

2. A brief review of literature

Despite an extensive literature on energy consumption, economic growth, and pollution emissions, empirical evidence on the causality relationship seems to be divergent. The lack of consensus may be attributed to the differences in developmental stages of the various countries, policies implemented, institutional arrangement, data used, and the methodologies employed [12–14].

Studies investigating the relationship between economic growth and environmental pollution emerged after Grossman and Krueger's [15] path breaking study of the environmental impacts of North American Free Trade Agreement. Grossman and Krueger [15]

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