Clean Energy Policy, Planning and Management: Gearing up the Rapid Economic Growth and Sustainable Development in Nepal

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Abstract

Sustainability agenda has been gaining extensive concentration as one of the major development paradigm in modern era. Rapid economic growth, social development, sustainability and poverty reduction have been considered as crucial discourse under that paradigm. With the world-wide wave of economic development and improved traditional living standard of people, consumption of fuel has also increased significantly. Exponential growth in use of fossil fuel and its impacts compelled to search for alternative energy sources. Green energy is that source of energy that is naturally restocked. Nepal is rich enough country for renewable energy sources even though, could not accelerate growth and development agenda. Appropriate policy, planning, and management of green energy would help to give a big push to break development hazards and would contribute for takeoff for sustainable development and poverty reduction strategies. This paper attempts how green energy policy, planning and management would contribute for gearing up for sustainable development and poverty reduction in Nepal. It is an endeavor to scrutinize and understand the green energy utilization, proper management and exploring the capacity of the Nepalese economy. Findings of the study conclude that, instead of fossil energy, renewable energy utilization contributes for transferring poor livelihood and its sustainability.

Keywords: Green Energy, Economic Development, Sustainability

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BACKGROUND

Energy is the most obligatory factor for human society. Without energy human life and society cannot be imagined. Primitive Stone Age has transformed and developed into modern civilized society only after the invention of energy (fire) (Wikipedia). The pioneering of fire and its control by early humans was a turning point in the behavioral and cultural aspect of human civilization. As an important source of warmth, protection, improvement on hunting and a method for cooking food; fire made revolutionary achievement. These progressions had lead for cultural innovations and human behavior. Additionally, invention of fire allowed the expansion of human activity to proceed into civilized human society. Therefore, energy is one of the most important and indispensable components of socio-economic development of the society.

Nepal is a least developed south Asian country situated in between world's two giant economies India and China. More than 80 percent of population in Nepal resides in rural communities. Out of total population, 84.9 percent people have access to electricity and large proportion of the rural population does not have access to electricity through national electricity grid (UNTAD, 2017). Nepal has no own sources for petroleum products such as petrol, diesel, Kerosene, Liquefied Petroleum Gas (LPG), or coal, and its energy sector is dominated by the traditional energy sources like firewood, crop residues, and animal dung in rural area and imported fossil fuel in urban area mainly for domestic use. Biogas is also in use in some rural area but not significantly. Due to the socio-economic impact of remittance income, migration, and urbanization; the energy demand is rapidly increasing and only imported fossil fuel is heavily used. As a result, the

continuous increase of petroleum imports has an always adverse impact on the economy. Nepal is starved for energy for the last few decades because domestic energy mostly depends on imported fossil fuel and natural gas. Similarly due to mismanagement and insufficient hydroelectricity and other alternative energy generation, Nepal faced 18 hours daily load shedding. However, when Mr. Kulman Ghising appointed as the chief executive of the Nepal Electricity Authority, it has been smooth and steady supply of electricity in Nepal. The present government has its high motivation on hydroelectricity generation, yet the other alternative clean energy generation has not been prioritized due to lack of appropriate plan, policy and management.

OBJECTIVES OF THE STUDY

The board objective of the study is to assess the substitution of fossil fuel by domestic green energy. It is an endeavor to make the economy self-dependent in domestic energy by utilizing huge renewable energy sources. The specific objectives are to:

1. Make an in-depth study of the framework under which the urgency of policy, planning and management of the green energy for rapid economic growth and development in Nepal.
2. Address the problems that the country has been facing arising from over dependency on imported fossil fuel such as terrifying economic burden and energy insecurity.
3. Understand the need of domestic energy and environment friendly green energy for sustainability of the development of the country.
4. Access to capture the broad attention of the world for the increasing challenges on environmental threats.

5. Access the outcome to draw lessons for the further research.

LITERATURE REVIEW

At present era, entire global economy is heavily reliant on fossil fuels and emission of greenhouse gas has creating serious problems to our original climate system. Climate change, snow melting and outburst, monsoon disorder, acid rain, drought, etc. are the noticeable impacts on every continent. According to the UNDP under its action "The Sustainable Development Goals (SDGs)", expresses a serious concern to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. SDGs are a universal appeal of action which requires the partnership of governments, private sector, civil society and citizens to ensure a better planet for future generations. Of course, there have been new initiations to encourage alternative clean energy sources in every continent.

According to UNDP, among SDGs, a goal of ensuring easy access to affordable electricity by 2030 means investing in clean energy sources such as hydroelectricity, solar, wind and biogas. Development of infrastructure and upgrading technology in order to ensure an easy excess of clean energy in all least developed and developing countries is a fundamental goal that can encourage for rapid and sustainable growth and thereby help the environmental preservation.

Nepal's energy sector is enormously dominated by the traditional solid biomass and imported fossil fuel. Fundamentally, an effective clean energy plan and policy is urgent in Nepal in order to get rid of from at least excessive economic burden arising from petroleum import and energy insecurity. Moreover, environmental issue is the global issue and should be addressed individually and jointly from global level. Rijal, (2018) suggests that the substitution of fossil fuel by domestically produced clean energy is urgent to reduce Nepal's increasing trade deficit. Nepal's Balance of Payment (BoP) has started recording negative due to excessive import of petroleum products. Similarly, Rijal has assessed the excessive use of fossil fuel is one of the major sources of climate change and environmental vulnerability. He suggests that, Nepal has to set a target to use at least 50 percent of electric public vehicles by 2030.

Development and promotion of renewable energy sources would be one of the indispensable tools to overcome all the obstacles of Nepal's rapid economic growth and sustainable development agendas arising from energy problem. *"Energy over dependency, excessive economic burden arising from petroleum imports, and energy insecurity, are the major binding constraint to Nepal's economic growth. If we can generate more electricity, we could revive the manufacturing sector. This could absorb youths who want to move away from subsistence agriculture, reducing outflow of workers to various labor destinations,"* (Wagle, 2017).

The empirical evidence of the study of Ranjit (2017) reveals that, around two billion populations of developing countries suffered from indoor air pollution arising from smoke emission in their homes from burning firewood, crop residue or animal dung in poorly ventilated cook ovens. Indoor air pollution in underdeveloped countries has become the fourth largest health risk. As a result, nearly two million people die every year. This death record has very closely linked with the traditional cooking and heating practice of households and indoor air pollution. Moreover, use of firewood and smoke emission also contributes for environmental degradation. Therefore, renewable clean energy is the ultimate remedy for this problem of largest health risk and environmental loss. When renewable clean energy sources are used, use of smoke emitting source of fuel such as firewood, crop residue and animal dung goes down and also the demand for fossil fuels is reduced. Unlike fossil fuels, renewable sources of energy such as hydroelectricity, solar power, biogas, and wind power do not emit greenhouse gases.

Shrestha, (2012) have evaluated that energy crisis is one of the major problems in Nepal. Excessive reliance on imported fossil fuel has repeatedly created energy crisis, insecurity and thereby affected both economic and social development. Shrestha further emphasizes that the ultimate and sustainable solution of energy crisis in Nepal

could be the proper utilization of domestically owned alternative renewable clean energy resources.

According to UNDP report, Launched as a pilot project in five remote hill districts in 1996, it is now widely recognized as a successful model for rural development benefiting more than one million people. The REDP's development benefits include: (i) Average increase of US\$121 (8 percent) in annual household incomes due to electricity access; (ii) 40 new businesses created per district following the installation of a micro hydropower system, compared with only 4 established prior to electricity access; (iii) A reduction of average annual household spending rates on energy to US\$19, compared to US\$41 spent by non-electrified households; (iv) Average of 11 health workers per 100,000 people in electrified areas, compared to 2 health workers per 1,000 people in non-electrified areas; and (v) Electrified households spent twice as much on education than non-electrified households.

METHODOLOGICAL APPROACH

The study largely depends on descriptive analysis. Number of micro level studies and survey had been conducted to understand the need and urgency of substitution of imported fossil fuel by domestic renewable green energy. Different set of structured questionnaire had been prepared for personal interview with the stakeholders. Focus group discussion was conducted with academicians, experts, government officials, environmental activists, renewable energy engineers, and electric vehicle users and sellers. Convenient sampling had been carried out with the intention of interviewing with households, vehicle users, electric vehicle sellers and environmental activists from Kathmandu valley, Sindhupalchok, Kavreplanchok and Nuwakot for data collection. Most of the questions were designed on five points Likert Scale measurement such as Strongly Agree = 1, Agree = 2, Don't Know 3, Disagree = 4 and Strongly Disagree = 5. Few questions were designed with the options "Yes" or "No". Secondary data have been collected from Nepal Oil Corporation (NOC), Department of Customs (DoC), Central Bureau of Statistics (CBS) and Nepal Rastra Bank (NRB). Descriptive statistical tools and judgmental analysis were used to analyze the data.

DESCRIPTIVE ANALYSIS

It is extremely important to understand the need and urgency of substitution of imported fossil fuel in terms of, at least, to be serious about terrible economic burden, energy insecurity and environmental point of view. In order to achieve predetermined objectives of the paper, a descriptive analysis over primary and secondary data had been employed.

Why Green Energy is Important in Nepal? Driving Forces

With the gradual economic achievement and higher living standard, demand for energy sources also increase. Since Nepal has no own source of energy, its larger extent of energy demand is met by imported fossil fuel. Nepal is heavily dependent on fossil fuel such as Petrol, Diesel, Kerosene and LPG. Nepal government spends tremendously huge amount of money on import of petroleum products. According to Department of Customs (DoC), Nepal's fuel imports surged by a massive 39.2 percent in first eight months of the current fiscal year compared to same period of Fiscal Year 2016/17. Data compiled by the DoC shows that the country imported petroleum products worth Rs 116.3 billion in the first eight months of FY2017/18, compared to Rs 83.5 billion in the same period of previous fiscal year. Still Nepal suffers from energy insecurity time and again. Excessive economic burden arising from exponential rate of petroleum products import and terrible trade deficit is a serious issue from economic point of view. Domestic air pollution arising from traditional means of cooking in rural area is becoming serious health environmental risks. Moreover, energy insecurity and environmental degradation have been appearing as the major obstacles in development and poverty reduction

strategies. Therefore, the substitution of fossil fuel by domestic green energy is extremely necessary for at least three reasons. It is very serious and urgent to address excessive economic burden arising from tremendous trade deficit with major trading nations India and China. Moreover, green energy is important for environmental and energy security point of view.

Fig. 1: Use of Fossil Energy and Consequences

DUE TO EXCESSIVE ECONOMIC BURDEN

During 2016-17, Nepal imported 407 million liters of gasoline (petrol), 1.32 billion liters of diesel, 19 million liters of kerosene, 184 million liters of aviation fuel, 36 thousand liters of furnace oil and a large amount of LPG (Nepal Oil Corporation, 2018). In the current years, the expenditure made on imported fossil fuel is far more than the revenue that Nepal generates from export of all commodities (Rijal, 2018). Current macroeconomic data of nine months reveals that import of petroleum products amounts to NPR 116.8 billion (NRB, 2018). Similarly according to NRB, current gross exports earning amounts to NPR 73.05 billion, gross import expenditure amounts to NPR 990.11 billion and trade deficit equals to NPR -917.06 billion. The current year data shows that, the expenditure on the import of fossil fuel exceeds far over the total revenue that Nepal generates from total exports. The following figure illustrates increasing gap between expenditure on the import of fossil fuel and the value of gross merchandise exports:

Fig. 2: Use of Fossil Energy and Consequences

Source: NRB 2018

Above figure divulges that import of carbon-emitting fossil fuel is significantly. After fiscal year 2010/11, single import of petroleum products is far more than the gross value of overall merchandise exports. This shows that Nepal's trade deficit is terribly increasing due to single component carbon-emitting petroleum products. This is the most shocking economic burden to the economy. Therefore, there is no way rather than to substitute imported fossil fuel by domestically produced green energy such as hydroelectricity, solar power, biogas wind energy, etc. This is the best way to make the economy self-reliant.

DUE TO OVER DEPENDENCY AND ENERGY INSECURITY

Nepal is heavily dependent on India for petroleum import. Due to difficult topographical structure, import from China is not feasible as from India. As a result, fuel import solely from India is compulsion. Sometimes, either due to some political intrigue or some natural factors Nepal has encountered with fuel crises. Nepal suffers from energy crisis a lot due to transit blockade by India. In past, India restricted import of petroleum products in Nepal for several times. From Neharu to Modi led government, Nepal suffered from transit blockade of petroleum products. The Narendra Modi-led government imposed an unofficial and undeclared economic blockade, which began on 23 September 2015, is an economic and humanitarian crisis which has severely affected Nepal and its economy (Republica Daily). The Indian government of Prime Minister Narendra Modi has expressed its displeasure at Nepal's constitution, a position made clear in a series of statements issued by Ministry of External Affairs (MEA) in New Delhi (Ojha, 2015). In 1989, the Rajiv Gandhi-led government imposed a thirteen months economic blockade against Nepal because of a dispute over transit treaties and its uneasiness over Nepal's growing closeness with China (Bhattari, 2015). In September 1962, India prevented all goods from crossing into Nepal at Raxaul, the Indian side of the Birgunj checkpoint, in an attempt to bully Nepal because of political tensions regarding trade treaties (Rana 1971:649).

An economic and humanitarian crisis resulting from India's blockade has severely affected Nepal and its economy. Due to the scarcity of petroleum, many of the hospitals were out of oxygen and other essential live-saving medicines. Even ambulances and fire-brigades also did not operate due to the shortage of petroleum. There was no cooking gas, no fuel for vehicles, no essential daily goods, no distribution of humanitarian supplies, no factories/industries running, no print media working, and lives were about to freeze. Prices of daily essential commodities have skyrocketed across the country. Public frustration, emotion and anger are escalating over New Delhi's perceived interference in Nepal's internal affairs (Pathak, 2015).

Whatever the reason, there are still hurdles where trade can be blocked or severely restricted by India. Barrier can easily be placed upon Nepal by its neighboring country India. People in Nepal, not only sometimes but frequently can suffer from fuel crisis. There is a compulsion that households to keep extra cooking gas cylinders and vehicle owners to keep stock of petrol/diesel because they don't have confident over smooth fuel supply. Therefore, the key for achieving and sustaining sovereignty is having self-reliance in development of self-owned green energy resources. The huge potentiality in green power in Nepal can play a key role in achieving energy security.

DUE TO ENVIRONMENTAL THREATS AND CHALLENGES

Air pollution and health problems are the major headache for sustainable development agenda. According to World Health Organization (WHO) six major air pollutants include particle pollution, ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. Long and short term exposure to air suspended toxicants has a different toxicological impact on human including respiratory and cardiovascular diseases, neuropsychiatric complications, the eyes irritation, skin diseases, and long-term chronic diseases such as cancer (Ghorani-Azam and et al.). Health issue is now an important agenda even at the international level and concern for the health of poor people is becoming a central issue in sustainable development goals. Nepal is undergoing economic development, urbanization, changing living standard, population growth, and with subsequent industrialization and growth in private and public vehicles leading to increase in air pollution. As a result, large populations in urban area are exposed to high concentrations of air pollution. These exposures, attached with increasing economic burden have led to substantial health from air pollution and many people still live in poverty. Hence, the health agenda and socioeconomic position are likely to be important in sustainable development strategy in Nepal.

The conclusion resulting from focus group discussion revealed that burning of these fuels produces a significant amount of Green House gases (GHGs), and transportation sector contributes to the highest level of GHG emissions. Current air pollution and global warming phenomenon is has been creating chronic impacts in the public health and livelihood of people not only in the underdeveloped countries like Nepal but also in the industrialized world. According to WHO health report 2014, 11.00 percent of the world population has suffered from COPD, 16.00 percent have suffered from lung cancer and 20.00 percent have suffered from heart diseases. Developed industrialized countries contribute to the major segment of GHGs emissions, which are the major precursors of global warming. Significant effects have been noticed in agriculture, water resources, natural resources among others in the form of drought, wildfires, hurricanes, ice and snow storms along with other issues (KC, 2018).

Green Power for Prosperity

Nepal's economic and social development is being hampered by its inadequate energy supply. The country does not have its own reserves of gas, coal or oil. A ray of hope towards economic prosperity, remedy for poverty reduction and energy security in Nepal is nothing other than priority in renewable green energy.

HYDROELECTRICITY POWER

Huge source of hydropower, potential of producing hydroelectricity - 83,000 Mega Watt (MW) electricity as said by Hari Man Singh 50 years ago, alone can be sufficient base for the prosperity of the nation. Besides; biogas, solar energy, wind energy, etc. are also the important and potential source of green energy in Nepal. Out of total potentiality of 83,000 MW hydroelectricity power, economically and technically feasible capacity is only 43,000MW due to topographical features in Nepal. Despite this high potentiality in hydroelectricity, Nepal has produced only 920 MW which is just around 1.2 percent of total capacity (NEA, 2017).

Altogether 6000 rivers including rivulets and tributaries about 45,000 Kilometer lengths mostly originating from snowy mountains and Siwalik region have munificent potential of producing 83,000 MW hydroelectricity. Koshi, Gandaki and Karnali are main river systems and Trishuli, Bagnati, Rapti, Babai, Seti, Mahakali, etc. are other important rivers in Nepal. The following diagram exhibits hydropower capacity from different river systems in Nepal.

Hydro Electricity Potentiality of Different River System

Source: Hydro Potentiality of Nepal, Ministry of Finance

The above pie diagram shows the total hydroelectricity potentiality of different river system in Nepal. The largest hydroelectricity potential river system is Karnali river system alone occupies around 49 percent of total potentiality.

SOLAR ENERGY

Solar power is one of the best clean energy sources. Solar radiation generates solar energy through solar energy devices. Solar radiation is

the best option and cost effective energy resources of this world from 21st century onwards (Adhikari and et al., 2013). Like hydroelectricity, Nepal has enormous potential for solar energy also. The country is located at favorable latitude that receives ample amounts of solar radiation and from solar energy alone, around 2,920 GWh of energy per year can be generated with utilization of just 0.01% of the total land area of Nepal (AEPD).

Regmi and Adhikary have analyzed meteorological data such as solar radiation (1975-1984, and 2002-2010) and sunshine duration (1968-2004) to study temporal characteristics of solar energy and investigate solar energy potential in Kathmandu valley. They concluded that, Pre-monsoon and post monsoon seasons have higher mean monthly sunshine duration (about 8 hours/day) than summer (about 5 hours/day) and winter (about 7 hours/day) seasons over Kathmandu. Pre-monsoon and monsoon seasons receive solar energy of about 190 Wm⁻² and 170 Wm⁻² respectively. The winter season receives the least amount of solar radiation (135 Wm⁻²). According to them, approximately 220 MW of solar electricity can be produced in Kathmandu that will substantially fulfill current energy demand and reduce environmental pollution in the valley by replacing fossil fuels with clean solar electricity.

Since, Nepal has diversified geographical structure such as plain terai land to hills and mountainous range and also settlement pattern is also very scattered type, national grid extension of hydroelectricity in some places is not economically feasible. Therefore, in order to increase excess with energy to such scattered settle especially population residing in hill and mountainous regions, solar energy is only the feasible means. It also helps to reduce the dependency on imported fossil fuel and supports for avoiding energy crisis. Ultimately, it is a significant way to minimize the environmental degradation.

BIOGAS ENERGY

Biogas is very simple clean energy mean which can be produced from very simple technique. Biogas is the mixture of gas produced from the decomposition of biodegradable or organic materials such as animal dung, human excreta, food scraps, green wastes, food wastes, etc. When methanogenic bacterial are allowed acting upon such biodegradable organic materials in an anaerobic condition within the temperature of 26° to 35° for a certain period, biogas is produced. It is mainly composed of 60-70 percent methane, 30-40 percent carbon dioxide and some other gases (BSP, 2003).

Since around 80 percent people live in rural area and they involved in subsistence level agriculture and livestock farming, the biogas technology of energy source for domestic uses such as cooking, lighting, heating, etc. is highly feasible in Nepal. Cattle dung are easily available in farms, also human excreta, can be used to produce methane gas. Such practices are very popular in many parts of the world for the purpose of cooking and lighting. Since, the waste material exit from methanogenic bacterial is highly useful and productive in cultivation; rural people can additionally be benefited from this technology. Moreover, this technology is cheaper and simpler. Nepal is one of the least developed countries with the vast majority of people involved in subsistence agriculture. The use of biogas technology in Nepal has benefited the country in improving health, environment, economy and energy conservation.

In Nepali society mostly women take the responsibility of cooking and therefore, traditional energy sources such as burn of firewood, animal dung and crop residual has adversely affected the health condition of rural women which is the major challenge for rural poverty reduction strategies. Therefore, smokeless bio-energy in the household use would be significantly less the workload of women and it would bring significant changes in their health condition.

For self-sustainability, economic freedom, and environmental preservation point of view, biogas technology provides a cleaner and safer source of energy. Under this technology, along with methane gas, biogas digester produces high quality organic fertilizer. Such fertilizer is rich enough with nitrogen, potassium and phosphorus contents which can be a best alternative and import substitution of

chemical fertilizers. Once a biogas plant has been installed, there are insignificant operational expenses. Encouraging people in rural area to generate their own clean energy can help them change their livelihood. Therefore, biogas technology enables rural families to produce their own electricity, heat, and fertilizer and this would be the strong base for sustainable development and poverty reduction agenda.

Energy Policy and Planning

Nepal has sufficient potentiality to meet its domestic and industrial energy demand through domestically produced green energy sources. Only hydropower alone is sufficient not only to meet energy demand by domestic and commercial sector but also for export to neighboring countries. In order to meet one of the major targets of Sustainable Development Goals (SDGs) is to generate 15,000 MW of hydroelectricity by 2030 (NPC 2017). Instead of fossil energy renewable energy utilization contributes for transferring poor livelihood and its sustainability. Only 18 percent households in Nepal use imported LPG for domestic consumption (NPC, 2018). Very insignificant number use biogas and majority of people use traditional sources of fuel such as firewood, crop residuals, animal dung etc. The traditional way of using energy is not considered as a good way from health and environmental prospective. It is one of the major issues in sustainable development agendas. Therefore, switching to green energy uses by domestic sector will not only reduce poverty but also will contribute for environmental conservation.

To be self-reliant in energy, to get rid of excessive economic burden, to be secured from energy insecurity and to address growing environmental threats; Nepal must give priority over the substitution of petroleum products by immediate appropriate energy policy and planning for development and utilization of domestically owned abundant sources of green energy such as hydropower, solar power, biogas, wind power, etc. Nepal can become self-reliant on energy and can proceed on the path of prosperity through mainly two processes. First, it is urgent to formulate short and medium term; that is, up to five years energy plans and policies to substitute imported fossil fuel energy and traditional sources of energy used by households by domestically produced clean energy. It will be a big step for import substitution, lessen the terrible economic burden and secure from energy insecurity arising from petroleum imports and over dependency. Secondly, Nepal government should formulate long term plans and policies to use domestically produced energy for industrial sector. The long term plans and policies should also focused on replacing fossil fuel means of transportations by environmental friendly electric vehicles like metro-rail, mono-rail, east-west rail, cable car, ropeway, e-bus, e-cars, e-bikes etc. Subsequently, the plans and policies should encourage investment in green energy.

Energy Management

Till last year, Nepal faced up to 18 hours of power cut daily due to insufficient electricity and mostly due to mismanagement in power supply. That was considered as the major growth obstacle of the economy. Even households were compelled to use generators and excessive quantity of diesel for light. Diesel demand by household sector, industrial sector and transportation sector contributed for skyrocketing imports of petroleum products. Fortunately after when Mr. Kulman Ghising appointed as the CEO of Nepal Electricity Authority and Mr. Janardan Sharma appointed as the minister of energy, the power outage came to an end and since then power supply is regular and smooth. That was the charismatic managerial efficiency of CEO and strong support and commitment of the energy minister.

The production hydroelectricity is not smooth due to fluctuation of volume of water system in Nepal. Volume of water goes up in the rainy seasons and goes down in dry seasons. However, snow covered mountains are the back up to some extent. In dry seasons, snow melting from mountains contributes for increase in water flow. During the rainy seasons, the hydropower plants operate in full capacity and during the dry season operate at below the full capacity. As a result, there is surplus production of hydroelectricity in rainy seasons and less

production in dry seasons. Therefore, solar power and wind power should be installed for the backup and regular and smooth supply of power. Moreover, energy exchange transmission lines and cross boarder transmission lines with neighboring countries would be another effective way for making easy exchange and for energy export.

Nepal's neighboring countries India, China and Bangladesh are the potential energy importing countries from Nepal. World's giant economies India and China are the biggest market for Nepal's energy export. So, Nepal government can reduce its terrible trade deficit through import substitution of fossil fuel by domestically produced clean energy and export of such energy. Nepal can generate revenue of up to Rs310 billion per year in 2030 and as high as Rs1,069 billion per year in 2045 if the country is able to sell electricity to India by harnessing its hydropower potential (The Kathmandu Post, 2017). There are mainly four ways by which Nepal can decrease excessive use of imported petroleum products such as (i) driving electricity (ii) cleaner cooking, cooling and heating (iii) energy intensive industries and (iv) more power to powerless (Rijal, 2018).

MAJOR FINDINGS AND CONCLUSION

Without the plentiful access of energy, development process cannot be accelerated. And, development cannot be sustainable without the development of sustainable energy sources. At preset Nepal has to focus on overwhelming the challenges and threats of poverty, issues of gender and social inclusion and issues of climate change.

Despite, having huge clean energy potentiality and import substitution of petroleum products, Nepal faces severe energy crisis leading to long hours of power cuts which have stalled the economy at large. Today, the bitter reality in a country is that our industries, businesses and households are heavily relying on fossil fuels as alternative energy sources while in the other hand we have multiple renewable energy options that are either underutilized or are often overlooked. At this same time, Nepal also confronts the challenges of poverty, issues of gender and social inclusion and issues of climate change all at the same time. Promotion of renewable energy technologies has been one of the indispensable tools to overcome these challenges. Alternative Energy Promotion Centre (AEPIC), since its very establishment has been promoting sustainable energy solutions to off-grid rural households and communities in Nepal who primarily lack electricity to light their homes or burning polluting fuels either for their lighting or cooking needs or to run their local enterprises and businesses. More recently, AEPIC has also been promoting solar options to urban areas in an effort to lessen the burden of energy demand from the grid electricity. This booklet provides a broad overview of all these activities.

The development of clean energy sources such as micro-hydropower, solar and biogas systems provides improved cooking system, reliable, low-cost electricity to rural households and contributed to decreasing indoor air pollution. This is not only strengthens local governance but also supports the improvement of poor rural economies and livelihoods.

With the ample clean energy resources, rural households in Nepal can replace their traditional type of energy consumption pattern and that fosters rural livelihood, minimizing indoor pollution and health risks. Also, it helps in increasing the study hours of the children.

Green energy not only benefits for households, national economy and environment; but also contributes for reducing global warming. Moreover, the use of green energy adds numerous of other socio-economic benefits. The conclusion derived from questionnaire survey and focus group discussion with respondents and stakeholders are highlighted as follows:

Green Energy for A Self-Reliant and Stronger Economy

The substitution of traditional type of energy and imported fossil fuel by clean energy resources is extremely urgent to reduce Nepal's excessive economic burden and terrible trade deficit. Due to excessive import of petroleum products Nepal's BoT has been going tremendously deficit. Since Nepal has no its own source of fossil fuel,

the dependency on petroleum products has been increasing every year. Therefore, substitution of fossil fuel by domestically produced green energy resources such as hydroelectricity, solar power, wind power and biogas is necessary to make self-reliant and stronger Nepali economy.

Green Energy Means Energy Security and Independence

Since Nepal has no own source of fossil fuel, its energy demand is met by import. Due to Nepal's geographical structure, its petroleum import totally depends upon Indian Oil Corporation (IOC). India has shown its dominant behavior time and again and has been imposing blockades without any genuine reasons and makes fuel crisis in Nepal. Past several instances of India's behavior shows Nepal is highly energy unsecured economy. Due to no confidence on smooth supply of petroleum products, households and vehicle owners in Nepal keep extra stock in their home. This is the strongest proof of Nepal's energy insecurity. But most green energy sources don't need to be imported. Switching fossil fuel consumption into green energy means reduce our nation's reliance on imports of petroleum products. Utilizing more and domestically owned green energy sources can dramatically reduce Nepal's compulsion to spend huge amount of money in importing petroleum products and thereby leads to greater energy independence and security.

Go Green Energy for No Indoor Pollution and Health Risks

Majority of rural people use firewood, crop wastes and animal dung burn for cooking. Rural housings are traditional type and poorly ventilated. As a result, cooking practices produce high levels of indoor air pollution with health-damaging pollutants. In rural area, particularly women and young children, who spend the most time near the domestic fireplace, have high health risks such as lung cancer, breathing problems and other serious problems. Switching such traditional type of energy consumption into green energy sources specially biogas would help to reduce harmful smoke emissions and clean up air quality which improves rural health and minimizes overall healthcare costs.

Green Energy is an Inexhaustible Energy Source

Green energy sources are restocked naturally and have unlimited supply. Unlike finite sources of fossil fuel, natural resources like water sunlight and wind energy sources are inexhaustible and in continuous supply. Therefore, green energy is extremely important for not only to meet our present energy requirements, but to also prepare for future generations.

Green Power is the Ultimate and Best Energy Option

Green energy is only the ultimate and best option for the twin challenges of responding to a growing global energy demand for energy and reducing the negative externalities associated with current fossil fuel production and use. Investments in green energy would be an important contribution towards mitigating growing economic burden, climate change and energy insecurity. Green energy has other positive externalities such as social and environmental benefits, including mitigating several health problems and impacts on ecosystems caused by the extraction, transportation, processing and use of fossil fuels.

Policy Recommendation

In order to accelerate economic growth and poverty reduction strategies, this section presents policy recommendation focusing on import substitution of fossil fuel by domestically produced green energy.

- ♦ Clean energy plan, policy and program need to increase further and faster to reduce excessive economic burden arising from petroleum import, clean energy switch to address climate problems, reduce rural households health risk arising from indoor

air pollution, ensures easy energy access for all, and make sure the energy security.

- ♦ Nepal government should prioritize for domestically produced green energy for household and industrial consumption. Then after, should formulate plans and policies for energy export.
- ♦ Nepal government should simplify the licensing procedures for renewable energy investment projects.
- ♦ Nepal government should provide financial incentive such as tax exemptions and subsidy to promote the current stage of electric vehicles growth.
- ♦ Nepal government should immediately formulate the appropriate policy focused on the substitution of traditional type of household energy consumption pattern in rural area and LPG in urban area for cooking, heating and lighting by electric means and appliances.
- ♦ The joint collaboration between Nepal government and metropolitan offices throughout the nation for community-based energy utilization approach such as solar irrigation pumps, solar mini-grid, and solar street lights is necessary.
- ♦ Since rural population in Nepal is very scattered, national connectivity is difficult. So, biogas, solar power and off-grid community based micro hydropower program should be enhanced in order to make easy access to energy.
- ♦ Nepal Electricity Authority should search potential energy market in domestic and neighboring countries to sell surplus electricity in future.
- ♦ Nepal government should immediately go for encouraging the investments in charging stations, repair and maintenance centers. For this, government should provide incentives to existing petroleum pump owners and new investors to establish fast charging stations to promote public and private electric vehicles.
- ♦ Nepal government should increase confidence among investors, developers, manufacturers, lenders and other stakeholders in the scenario of energy security, growth, prosperity and sustainability.
- ♦ Nepal government must create an enabling environment for off-grid electrification of villages. Bangladeshi Models of microfinance can be used for village electrification of green energy. Green energy can be used effectively for sustainable development and poverty reduction by improving energy consumption pattern in traditional livelihoods of Nepal.

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