ROLE OF RENEWABLE ENEGY AND FDI IN POVERTY ALLEVIATION AMONG RURAL CHINESE AREAS: FUTURE CHALLENGES AND POLICY IMPLICATIONS

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ABSTRACT

Energy is vital in modern society and almost in every production process for sustainable economic growth. China is developing country and poverty is always higher especially in rural areas. The study examines the relationship between renewable energy (RE), as whole & by sources solar, wind, geothermal, foreign direct investment (FDI) and poverty alleviation (PA) for sustainable economic development in China. Ordinary Leas Square OLS and Fully Modified OLS methods are use in this study. The results found that there is long run relationship between variables and increase in investment and renewable energy sources production to reduce the poverty. Poverty causes lack of income and production resources, poor infrastructure, inequality and social discrimination. China first needed to overcome these issues for poverty alleviation for sustainable economic development.

Keywords: renewable energy resources, FDI, Poverty alleviation, Sustainable development goals

1. INTRODUCTION

China is on the way toward green energy superpower, leading globally in investment and installation of low-carbon technology. The most extensively argued drivers for this renewables surge include the effort to cut greenhouse gas emissions, promote energy security, and catch up industrialized nations in technological innovation. The main outline for green development of 13th 5-Year Plan (2016-2020), endorsed in March 2016 by the People' National Assembly of China includes to reduce emissions per unit of GDP by 40~45% as compared to 2005 levels and to enhance portion of non-fossil fuels energy to 15% by 2020. This plan also includes another policy initiative which is often overlooked is to tackle poverty and raise 55.57 million more population out of poverty.

Poverty is a global issue in almost all countries and continuously its existence is a big challenge in developing countries. Countries are always on track to reduce the poverty but never stopped [1]. In 2015, the Millennium Development Goals (MDG), 193 Member States of the UN General Assembly presented "the 2030 Agenda for sustainable development" which include 17 sustainable development goals (SDGs) and 169 targets. The mentioned goals have three dimensions social, economic and environmental development with five targets partnership, people, planet, prosperity and peace in world [2]. The purpose of (SDG) is to reduce poverty SDG (1) at global level but in some countries, the poverty is prevailing at extreme levels [3]. It has been globally recognized that assessment of poverty has continuously transformed from single-dimensional evaluation of income to multi-dimensional analysis of health, standard of living and education [5]. Multiple efforts have been made in poverty alleviation at local, national, regional and global levels [4]. It has been generally accepted that the 1.8 billion people in developing countries are still living below the poverty line US$ 1.90 a day which has decreased 0.776 billion in 2013 [5]. This universal decline in the percentage of people living under poverty line is due to extraordinary efforts made by Chinese government [6]. MDGs played a great role in poverty reduction efforts around the

globe and Chinese progress oriented poverty contraction program is one of the most significant element of poverty reduction attempts [7].

China is the most populated nation in the world and it is a mountainous country with hilly regions [8]. It is dominated by agriculture sector which includes 22% feeds of world's population with less than 7% of arable land [9]. Most of population living in rural China was affected by poverty due to harsh natural condition, unequal healthcare, less educational opportunities, impaired infrastructure and public assistances [10]. Chinese government is making continuous effort to eradicate poverty since the China came into existence in 1949. A huge work has been carried out during few past decades both at governmental and academic levels. Research work on rural poverty in China involves the type and definition of poverty [11-14], poverty line [15], poverty measurement [16], poverty targeting [17], economic growth [18], old age poverty [19], mechanism and pattern of poverty [20], poverty vulnerability [21-22], anti-poverty strategy and policy [23], migration and poverty [24], targeted poverty alleviation [25].

Renewable energy is the main source of clean and renewable energy due to zero-emission and zero pollution which may help to diminish the worst impacts of climate change and air pollution by preventing the greenhouse gases and other pollutants discharged by fossil fuels, which still makes up the biggest share of China's energy mix. Chinese government shifted its focus from fossil fuels for the above mentioned reasons, as well as to move the country toward technology leadership and to restructure domestic industries towards innovation, services and high value production for renewable energy equipment [26-29]. China is developing so rapidly making itself second biggest economy in the world, but it still has poverty in its rural areas [30]. The Chinese government, leaders and energy regulators have been committed to alleviate the poverty [31]. It is exceptional that poverty alleviation with RE has emerged as one of the most exemplar PA modes [32]. Chinese government declared multiple policies to promote RE industry [33]. The RE sector technology has improved and cost has dropped significantly [34]. Therefore, this sector has emerged briskly and industrial chain with independent self-reliant scholarly asset has been formed [35-36].

It is noticeable that RE has evolved expeditiously in contemporary years. The RE sector needs to add some innovative modes such as "RE +PA," to encourage further evolution. In those areas with huge potential of RE, power generation is integrated to support the poor recorded in the official repository [37-38]. It is feasible to enhance earnings by establishing renewable energy. The PA trial projects with photovoltaic (PV) electricity production were executed in 30 counties of 6 provinces (Anhui, Shanxi, Ningxia, Hebei, Gansu and Qinghai), where there was supporting policy and good infrastructure base. The application of these projects may support relieve economic stress by trading surplus energy [39-40]. Meanwhile, through these projects PV industry has been promoted effectively in these years. These creative trends of PA, such as PV "+agriculture," "+fishery," and "+housing construction," has flourished far and wide in China, making PA with PV power generation corporation encouraging [41-42]. The application of RE resources is significant for power generation in rural areas in China; however, there are multiple other issues in country regions in terms of finances, power grid capacity, technical knowledge, electricity demand, etc. The proportion of investment in various form of RE for poverty alleviation is given in figure1.
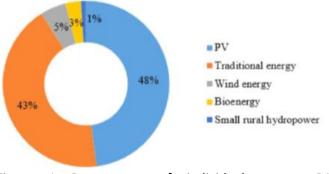

Figure 1 Percentages of individual energy PA investments in 2016 [37]

1.1 Current status of renewable energy and FDI

1.1.1   Poverty alleviation with renewable energy

Poverty alleviation through energy generation is being carried out in various economically poor areas in China. Economic poverty is defined that the income of households is below the poverty line in China (Poverty line in China: per capita net income for rural households is 475.5 $/years). Energy poverty is defined by International Energy Agency (IEA) as the inability to achieve and apply reliable electricity or to depend on conventional biomass fuel for cooking. A huge population in China especially in Western part mainly relies on traditional biomass energy. People living in remote rural areas of western part still cannot afford electricity for lightning; cooking and heating sue to

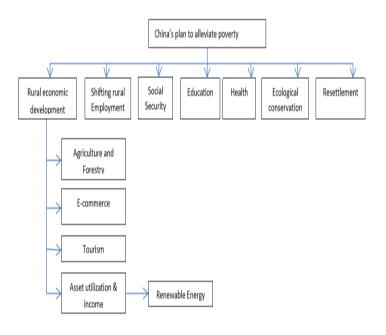poverty [43]. The Chinese plan to reduce poverty through application of RE is shown in figure2.

Figure 2 China's plan to reduce poverty through RE

1.1.2   Types of RE projects for PA

During last couple of years, pilot provinces including Anhui, Hebei, Gansu, Shanxi, Qinghai, and Ningxia have installed PV power generation projects to alleviate poverty in these areas. These ventures are implemented in the shape of PV household power plants, Village level PV plants, PV ground power plants and PV agricultural greenhouse plants [44].   The Village-level power plants were considered more effective in poverty alleviation.

1.1.3   Business modes
A.   Investment and financing mode
PA with RE production may be subcategorized into three main types with various financiers: (i) governments jointly invest at all stages (ii) governments and firms spend proportionately (iii) governments, enterprises and famers invest jointly. PA with RE production may be subdivided into eight sorts of investment and financing modes according to the distinctness of capital structure and operation modes [45].

B.   Operating mode
The energy production projects for PA are subcategorized into distributed small-scale power plants and centralized and big-scale power plants. Distributed power plants utilize their own generated power by themselves and impart excessive electricity to the grid [46, 47]. Large scale power plants generally transfer all the power into grid. Distributed power plants are helpful directly in poverty alleviation by selling excessive electricity to the grid whereas large-scale power plants are helpful in providing reliable supply of electricity in rural areas and indirectly helpful in poverty alleviation efforts.

1.2   Different policies for RE and FDI

1.2.1   National policy
National Energy Administration (NEA) delivered Notice on the development of 13th 5-year PV Poverty decline plan". This directive designated that quantity of single village-level power station must be supervised to almost 300 kW. When essential, the scope may be enhanced to 500 kW. Through this policy, it was suggested that average earning of various impoverished household recorded may be enhanced above the poverty line.

1.2.2   Regional policy
A.   Tariff policy
The National Development and Reform Commission circulated the "Notice on the Price Policy of PV Power Projects in 2018" in December 2017. The standard costs of new PV power station are reduced. Nevertheless, reference point electricity tariff of village level PV power plants and electricity subsidy standards of distributed PV household project were remained unaffected.

B.   Subsidy policy
China provides assistance for various PV power plants. There is definite subsidy on distributed power plants in China however subsidy extent on centralized power plants varies in various areas of China.

C.   Tax policy
The ministry of Finance and State Administration of Taxation circulated a directive regarding Value Added Tax (VAT) policy for power generation. According to this notice, taxpayers who trade their solar power equipment may get 50% VAT reimbursement. Local governments followed national standards for tax policies.

D.   Financing and investment policy
In China, the different power projects can be financed by the joint adventures by the power company and the government. The project company can also obtain the soft loans to install the power plants. Various regions (provinces) have introduced various financing and investment policies for power projects to alleviate the poverty. The RE may be further encouraged by following the given steps in the figure 3.
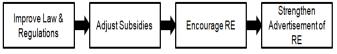
Figure 3 Steps to enhance RE for PA

1.3 Material and methods

Time series data from 2000 to 2017 used in this study to analyze the relationship between, total renewable energy & by sources, in terms of solar, geothermal, wind , poverty alleviation and foreign

The Equation 1 converted into log form as below:

$$LnPOVA = \beta_0 + \beta_1 LnRE + \beta_2 LnSolar + \beta_3 LnWind + \beta_4 LnGeothermal + \beta_6 LnFDI \quad (2)$$

Whereas, Lnpova indicate the natural logarithm of gross domestic product, LnRE represent the natural algorithm of renewable energy power generation as whole, LnSolar indicates the natural logarithm of solar as power generation, LnWind indicates the natural logarithm of wind power generation, LnGeothermal power generation, LnFDI represent the natural

Table 1 Unit root test Result

Variables	ADF				PP			
	Intercept		Int.+Trend		Intercept		Int+Trend	
	Statistics	prob.	Statistics	Prob.	Statistics	Prob.	Statistics	Prob
RE	-0.22	(0.91)	-2.27	(0.42)	-0.07	(0.93)	-2.23)	(0.44)
POV	-2.14	(0.23)	-1.73	(0.69)	-2.61	(0.10)	-1.63	(0.73)
FDI	-0.69	(0.82)	-2.14	(0.48)	-0.51	(0.86)	-1.88	(0.6.1)
SOLAR	-1.78	(0.37)	-0.22	(0.98)	-9.7*	(0.01)	-6.94*	(0.01)
WIND	-2.62	(0.10)	-2.52	(0.312)	-2.58	(0.11)	-2.55	(0.30)
GeoThrm	-3.34**	(0.02)	-2.59	(0.28)	-3.73*	(0.01)	-2.52	(0.31)
ΔGDP	-3.85*	(0.01)	-3.85**	(0.03)	-3.83*	(0.01)	-3.87**	(0.03)
ΔRE	-4.87*	(0.01)	-4.84*	(0.06)	-4.86*	(0.01)	-4.84*	(0.06)
ΔPOVA	-3.78*	(0.01)	-4.59*	(0.01)	-3.79*	(0.01)	-4.572*	(0.01)
ΔFDI	-4.80*	(0.01)	-10.14*	(0.00)	-10.1*	(0.01)	-4.8*	(0.01)
ΔSOLAR	-6.28*	(0.01)	-3.69*	(0.01)	0.67	(0.98)	-0.81	(0.94)
ΔWIND	-4.74*	(0.01)	-3.84**	(0.04)	-5.8**	(0.02)	-8.6	(0.00)
ΔGeothrm	-6.64*	(0.00)	-7.53*	(0.01)	-6.64*	(0.00)	-8.68*	(0.00)

*,** Rejection of null hypothesis at 1%, 5% level

direct investment FDI in China. The paper also examines the role of renewable energy resources and FDI to reduce poverty in rural areas. The data is collected from different websites International Energy Agency IEA, World Development Indicators WDI, the China National Energy Administration and the country Economy. The dependent variable is poverty reduction (POV) (% of population), and others are independent variables renewable energy (GWH), solar (MW), geothermal (MW), wind, FDI (% of GDP), respectively.

1.3.1 Specifications of the model

The study examines the relationship between renewable energy, as whole, by sources solar, wind, geothermal, FDI and poverty alleviation for sustainable economic development in china.

$$POVA = \beta_0 + \beta_1 RE + + \beta_2 Solar + \beta_3 Wind +$$

$$\beta_4 Geothermal + \beta_5 FDI + \mu \ (1)$$

logarithm of Foreign Direct Investment and μ is the Error term.

1.4 Empirical Results

1.4.1 Unit root test

The investigation apply first unit root test to assume stationary of variables, ADF and PP are used to test the integration of order. By using ADF and pp intercept, intercept and trend test it is found that all variables GDP, poverty, RE, solar, wind, geothermal and FDI are stationary at level I (0) in Table 1. Ordinary least square OLS and Fully modified FMOLS model are applied to check the long run relationship between variables.

1.4.2 Long run estimator results

The study use OLS and FMOLS in order to check the long run relationship in variables. OLS technique provides minimum variance mean-unbiased estimation. It is applied both in stationary and non-stationary variables when it is applied all the variables are stationary at level

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and must be stationary at first difference. Both OLS and FMOLS deal with endogeneity issues. When the variables are converted into natural logarithm the coefficient in table II are equal to the elasticity of the dependent variable with respect to the independent variables. First the testified coefficients should be statistically significant at 1% or 5% level. Poverty alleviation with respect to RE -0.15, GDP –0.08 and solar -0.28 indicates that increase in renewable power generation will lead the lower level of the poverty and increase the economic growth. FMOLS describe the long run relationship as shown in Table 2 represent that there is long run relationship between variables.

Table 2 Results of Long run estimators

Dependent Variable POVA	OLS		FMOLS	
Independent variable	Coeff.	P-Value	Coeff.	P-Value
FDI	-1.75*	0.00	2.02*	0.00
RE	-0.15*	0.00	0.10*	0.00
Geothermal	2.35*	0.00	2.80*	0.00
Wind	0.018**	0.05	0.21*	0.00
Solar	-0.28	0.84	0.24*	0.00

*,** Rejection of null hypothesis at 1%, 5% level

1.5 Conclusions

This paper examines relationship between renewable energy consumption, as whole, by sources solar, wind, geothermal, FDI and poverty alleviation for sustainable economic development in china. As it above mentioned that poverty has become social issue around the world and is hazardous for social welfare and sustainable development. The chinses government has always given great importance to rural issues and adopts policies and programs to overcome this issue in rural areas. China sees renewable energy is the only source which not only eliminates the poverty but also control the air pollution. China plan to install the micro solar energy system in poor rural areas to overcome this issue. China is still faces challenges as well-intentioned policy plans i.e. intermittency of the storage capacity, shortage of resource intensity, fluctuation of distribution system and improper way of reporting the renewable energy.

First, china should implement the renewable energy storage system. For example, renewable energy source of solar cannot store more energy in natural weather conditions. Second, there need manage the distribution system i.e. renewable energy generation source solar and wind farms are distributed without control software. Third, Reporting and editing is necessary for better grid management.

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