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Exploring own sources of revenue for KIIFB

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Abstract

This study explores own source revenue generation by the Kerala Infrastructure Investment Fund Board (KIIFB), a statutory institution created solely for the purpose of infrastructural development in the state through deficit financing. The issue of sustainability of KIIFB's current revenue sources coupled with the absence of innovative revenue generating methods has led to KIIFB's deficit financing model critical. Together with the absence of adequate revenue sources, this off-budget deficit financing technique has been now included the debt of the state by the CAG and deemed unsustainable. Also, the significance of infrastructure financing in tune with sustainable development goals needs to be taken care of in the contemporary scenario. The paper proposes to incorporate sustainable development goals into KIIFB's functioning by utilizing the space generated by the KIIFB projects to generate innovative own source revenue streams through the solar power generation. The paper discusses the potential of a carbon trading/offset or power monetization strategy by KIIFB and augment revenue from it as the importance of carbon emission-reducing techniques as an innovative revenue source is increasing these days.

Introduction

Infrastructure demand in developing economies has been rising in the last few decades. However, rising demand for infrastructure coupled with insufficient finances is among the key policy issues for sub-national governments in developing countries (Bahl et al 2013;

Farvacque-Vitkovic and Kopanyi 2014). Sub-national governments in developing countries such as India are characterized by the twin problems of huge infrastructure demand coupled with revenue adequacy for financing this huge infrastructural requirement and the lack of power over revenue tools required to finance it because of the skewed centralized nature of finances. (Satterthwaite, 2007). This is compounded by the increasing nature of urbanization which entails further infrastructure demand. Even though infrastructure provisioning is local in nature and sub-national governments, especially local governments are supposed to undertake local infrastructure requirements, they are still at the mercy of central governments while implementing major infrastructure projects or intergovernmental financial transfers required for it due to the lack of adequate resources (Gandhi & Pathak, 2016). As the local government is still a state subject in India, infrastructure in cities for example requires the state's permission and sometimes the central government's permission for financing local infrastructural requirements (Ministry of Housing & Urban Affairs 2018). These challenges force sub-national governments to pursue new innovative methods for infrastructural development.

Kerala Infrastructure Investment Fund Board (KIIFB) is one such statutory development financing institution that provides funds for major social and physical infrastructure covering critical sectors such as transportation, education, healthcare, IT and telecommunications, energy, and water in Kerala. Until now it is said to have financed projects to the tune of about seventy thousand crores (KIIFB 2023). However, there has been criticism regarding the modus operandi of KIIFB. Importantly, this came from India's Comptroller and Auditor General (CAG) which questioned the constitutionality of the 'off-budget' nature of transactions as well as the revenue model proposed by the KIIFB. CAG argued that the revenue model of KIIFB is unsustainable since no concrete revenue-generating mechanisms are in place apart from the cess income. Moreover, since the debt of the KIIFB needs to be repaid, and that too from the 'ring-fenced' cess, this can indirectly be a liability to the state government.

The criticism regarding the KIIFB model highlights certain issues. The important one is the near absence of income-generating financing sources. The second is the sustainability of the current revenue sources. The final one is concerning the significance of infrastructure and its financing in tune with sustainable development goals such as resilient infrastructure, sustainable cities and climate change. The onus is to develop infrastructure that is resilient, sustainable and climate friendly. In this view, this paper explores an innovative way of generating own source of revenue for KIIFB utilising the space created by KIIFB projects. Nowadays carbon offsets/trading is emerging as a mitigation method for climate change and an alternate method for revenue generation because Carbon pricing is increasingly recognized as an alternative source of government revenue globally. So this can be used as a method for revenue generation as well as reaching the goal of 'net zero' emission. The paper tries to explain the solar power generation and the resultant carbon offset/ trading as a method for climate change mitigation and also how KIIFB can augment revenue from this.

Broad review

The plethora of studies on the impact of infrastructure development and economic growth has been documented in detail Calderón & Servén, 2004). Röller and Waverman (2001), Agénor and Moreno-Dodson (2006) and Canning and Pedroni (2008). Though the benefits are well studied, there has been a stark deficit in infrastructure spending across the globe (Asian Development Bank, 2009; OECD, 2007). Many of the emerging markets, especially the low-income countries however, need increased infrastructure development to accommodate rising urbanization and promote inclusive growth (Bhattacharya, Romani, and Nicholas (2012). At this juncture, it has to be noted that much of the literature on infrastructure financing dwells on municipal financing of infrastructure.

It has been noted that the urbanization pattern is skewed toward the global south as India, China, and Africa constitute more than half of the world's urban population and will also be the world's major urban growth centers in the future (UN-Habitat 2018). It is also accentuated by the fact that cities in the global south were mostly unplanned and lacked significant global economic and political power and therefore urban governance is considered more complex and weaker than the north. According to the World Economic Forum (2018), India ranks 63rd out of 140 countries on infrastructure and therefore is reflected as one with the largest infrastructure deficits in the world.

India's rising number of megapolis, over-crowded roads, inadequate metro trains, airports and seaports, energy, health, and educational facilities can all be attributed to this low level of infrastructure spending. CRISIL (2017) notes that India could only spend about $1.2 trillion on infrastructure in the past decade (2007-17). Interestingly, even two-thirds of this infrastructure investment is from the public sector. Much of the literature mainly from the multilateral development agencies and consultancy groups discusses the reasons for the absence of private participation in financing infrastructure and ways of tapping the private investments and PPP mode for increasing infrastructure spending (ICRA, 2015).

From a regulatory perspective, ICRA (2015) notes the need for liberalizing domestic institutions as well as opening up external debt markets in solving the infrastructure financing conundrum. This study and Agarwal (2020) list many of the instruments used to raise infrastructure spending and financing. In this regard, Khan (2015) has also listed some of the initiatives taken by RBI to bring funding into infrastructure. Agarwal (2020) mentions the need for leveraging diaspora finance for infrastructure development. However, Harris and Pratap (2009) reveal the problems while depending on foreign financing of infrastructure as foreign capital servicing can be expensive with the depreciation of the domestic currency, and with populist governments unable to raise user charges to match the depreciation it can result in a problem.

However, the innovativeness of many of the alternate sources of income needs to be verified in the context of local specificities and how it can be instituted to raise revenue streams from the perspective of sustainability. There are very few studies that have analyzed the functioning of statutory development finance institutions like KIIFB in the national scenario. In the Indian context, the disappearance of many local taxes and how it impacts the financing of infrastructure has been studied in the context of municipalities. The recent introduction of centralized Goods and Services Tax (GST) which has subsumed many of the sub-national taxes and thereby reduced the local government's income is a fine example of subjection of local urban municipal body financial autonomy (Mankikar, 2018). The abysmal state of finances of Indian municipalities can be understood from indicators such as municipal revenue to GDP ratio of 0.45 %, own revenue to GDP ratio of 0.23 %, and municipal expenditure to GDP ratio of 0.37 % (Roy and Mangala 2019). Also, while the 'own revenue' of municipal bodies constitutes only about 51.6 percent of municipal revenue, the tax revenue constituted 32 % and nontax revenue constituted 19.7 % during 2012-13 (Mohanty 2016). Moreover, even with stagnating municipal finances, the bulk of the expenditure is considered utilized towards the revenue side and not much on capital expenditure thereby leaving critically low municipal expenditure on infrastructure. This low municipal revenue and low infrastructure spending are constrained by the mandate to maintain balanced budgets whilst municipal revenue powers are subjected to state legislative approval (Ahluwalia et al 2019; McKinsey 2010; HEPC 2011; NUPF 2018).

Numerous studies have been conducted in various disciplines related to carbon offsets, renewable energy, and economic development. There are also studies related to how public and private enterprises can produce electricity with carbon neutrality. For instance, Zhang et.al (2011) studied the trend in electricity generation and suggested the electricity-hydrogen synergy path and the electricity-hydrogen-carbon synergy path. Similarly, (Li et al., 2012) also suggested the composition of biomass energy with electricity and investigated the importance of electric power in promoting the carbon neutralization process.

Economic growth and promoting sustainability through the production of carbon-neutral energy production is very important in the current scenario. Many scholars have studied the role of carbon offsetting in achieving economic growth. Rivera and Sebring (2022), and Black et.al (2022), argue that renewable energy-producing firms are giving more interest in carbon offsetting as a source of extra revenue for their projects. And they argue that carbon taxes provide economic, environmental, and practical advantages due to ease of administration, investment opportunities, the potential to increase revenue, etc. Alex Y. Lo (2016), Dong et al. (2016), Philibert (1999) studying how carbon trading generates more investment opportunities and economic development. The authors argue that the impact of sustainability investment has a significant impact on the optimal order quantity and investment in sustainability. And it also states that the involvement of developing countries in emission trading through the negotiation of emission budgets provides them with capital inflows through emission trading and helps them to stimulate economic growth. Greenhouse gas emissions from coal-fired power generation are starting to fall, as governments and organizations pledge to curtail emissions, more capital is mobilized for energy transition, and renewable energy technologies become commercially competitive. Ertugrul et.al (2016) studied the effect of carbon trading and trade openness on the financial performance of developing countries, such as China, India, South Korea, Brazil, Mexico, Indonesia, South Africa, Turkey, Thailand, and Malaysia, from 1971 to 2011. The paper found that real income, energy consumption, and trade openness are the major determinants of carbon emission in the long run. But at the same time, Liu et.al arguing that that the implementation of carbon emission trading could not promote the selected firms to improve their R&D

investment, but it helps to improve the level of non-business income of enterprises incorporated into the trading system.

The relationship between carbon emissions and climate change is a widely accepted phenomenon. There is various scholarly article related to the effect of carbon emission and how it can be controlled for a sustainable future. Most of the studies arguing that to mitigate climate change policymakers should concentrate on the production of renewable energy. Morgan Stanley's (2023) research, Climate Action Tracker (2020) (climateactiontracker.org), Gorain et.al (2021), found that the target of voluntary carbon offsets of countries helps them to achieve the target of climate change and estimates that by the year 2030, the world must reduce its carbon emission by at least 1 gigaton. And the targets of "net zero" emission set by national governments cover 90 percent of total greenhouse gas emissions, these targets will promote more renewable energy in total production. Studies argue that to reduce the level of carbon emission in the atmosphere, it is necessary to concentrate on renewable energy techniques of energy production, forest conservation, and emission reduction strategies and generate market pull from them. Carbon Capture, Utilization, and Storage (CCUS) policy framework and its development mechanism in India by Mukhergee and et.al (2022) states that the sectoral break-up of CO_2 emissions reveals that, renewable energy make the greatest impact in India, and it can theoretically contribute to at most 30 percent of the de-carbonization by replacing conventional power generation methods. There is a study by Bai and Ru (2022) analyzes the impact of emissions trading systems (ETS) on emission reduction and renewable energy development, the paper also found that ETS implementation helps countries reduce greenhouse gas emissions by more than 12 percent

There are various empirical studies on solar installation on the rooftop of the buildings of both governmental and residents as a method for attaining sustainability goals and revenue generation. The literature argues that there is a need for strong investment in solar installation and a strong policy framework and argue that now Solar photovoltaic rooftop has emerged as a green technology for achieving sustainability goals. A study by Middelhauve et.al (2021) combined the modelling of the Photovoltaic panel's potential on the buildings envelope while retaining the energy system approach, and it was applied to a residential district in Switzerland. The proposed method of the study shows that the district can achieve carbon neutrality by using PV energy alone, but it requires the coverage of all the suitable rooftops and also part of the facades. Goel (2016) states that Solar photovoltaic rooftop has emerged as a green technology to solve climate change issues by reducing the dependence on conventional sources the solar based energy. The paper analysed the major issues and challenges for achieving the rooftop policy instruments and targets while recommending that there is a need for linking the target of solar energy with current policies like, 'Make in India', 'Smart City mission', and 'Digital India' as a way for developing the power system of the country.

Another study by Nayak (2018), says that the installation of solar rooftops in the residential sector in India has not been fully used even though the major share of the consumers of electricity is from the residential sector, and similarly there is a high possibility of roof space to install rooftop systems. Carl et.al (2016) in their study about the current use of public revenue generated through carbon taxes and cap-and-trade systems. The paper examines that more than $28.3 billion in government "carbon revenues" are currently collected each year in the world. Sreenath (2022) et.al states that South East Asian countries are blessed with a huge amount of solar potential, while the solar photovoltaic potential remains underutilized. The paper examines the solar PV policies in the ASEAN region over the past decade. It found that Vietnam has the highest installed capacity followed by Thailand and Malaysia. The study argues that solar PV growth is dependent on the regulatory policy and support mechanisms in the country.

Research gap and objectives

Even though KIIFB represents a watershed moment in the sub-national financing of infrastructure, it still has some lacunas. Instituted as a body corporate, KIIFB raises its funds from financial instruments permitted by the RBI and SEBI such as term loans from public sector banks, NRK chitti, and Masala bonds. The government has to guarantee any shortfalls to meet the debt servicing requirements of KIIFB and appropriate ring-fencing is provided through earmarking the dedicated Fuel Cess Motor Vehicle Tax (MVT) and petroleum cess. In essence, the model works using debt-based critical infrastructure development against future receivables of the state and importantly outside the budgetary purview. Therefore, it has the possibility of revenue shortages in exemplary conditions that were seen during the Covid times. Similarly, considering the global emphasis on sustainability, it is high time to incorporate these ideals into infrastructure development. This necessitates the need for identifying innovative sources of financing and implementing and the research gap lies here.

The experiences of the Covid pandemic period have shown that the revenue earmarked from the dedicated Fuel Cess and Motor Vehicle Tax (MVT) and petroleum cess can decline, thereby impacting the debt payments. To avoid a similar decline in revenue sources which is based on government contribution, it is highly imperative to raise a dedicated innovative and alternate revenue stream for financing infrastructure through KIIFB. How KIIFB can use the installation of rooftop solar on public buildings and generate revenue from carbon offset/trade. The study aims to answer this question.

The study will answer the research question raised above through the objectives of assessing the viability and exploring the potential of utilizing carbon offset/infrastructure financing as a means for revenue generation by KIIFB and the paper indents to conduct an analysis of the revenue generation potential from the implementation of rooftop solar installations in KIIFB's projects.

Scope of the research

From an academic point of view, few studies have studied the revenue potential of KIIFB. For further understanding about the revenue generating potential of KIIFB a detailed study is essential. As mentioned earlier, KIIFB marks a watershed moment in the sub-national financing of infrastructure, and highlighting its pros will be useful for other sub-national governments to develop similar institutions. Understanding the cons is also essential, as it brings out possible innovative and alternate mechanisms for ensuring a sustained revenue streams. From the viewpoint of Sustainable Development Goals, few works have linked infrastructure financing with the SDGs.

Proposed methodology for the research work

The data for the study is collected from various secondary sources such as the official website of KIIFBI, calculations of the National Renewable Energy Lab's PV Watts and System Advisory Model (SAM) about the efficiency and expected lifetime of solar panels, The Energy Report Kerala, WWF India & WISE, and the data set of Surface Meteorology and Solar Energy.

For analysing the viability and potential of KIIFB for utilizing its roof top space for generating solar power for carbon offset/trading for revenue generation, a 72 cell solar can be used.[1] For analysing the carbon credit potential of KIIFB-funded projects, a module of solar having 72 cells (size 156 *156 mm, thickness 200mm) having an efficiency (WS) of 14.5% and a life span of 25 years with the average performance of 85% can be calculated.[2] The efficiency of the solar cell may vary according to geographical conditions and climatic conditions. For calculation, the average efficiency of 13 percent is taken in to account. An area having a module of 72 cells solar panel is 2m2 and considering the efficiency of the cell is 13%.

Revenue generation potential of KIIFB is analysed by taking the average value of 0.932 tonnes of CO2 emission reduction per megawatt per hour of electricity (Sze SM. Physics of Semiconductor Devices) and calculating the amount of CO2 reduction per year. The amount of revenue generation is calculated by considering the value of carbon credit in the market and the yearly emission reduction of the proposed project.

Table -1 Solar insolation capacity in Kerala

SI. No	District	DNI (kWh/m2/day)	GHI(kWh/m2/Day)
1	Alappuzha	4.29	5.52
2	Kannur	4.47	5.43
3	Ernakulam	4.36	5.44
4	Idukki	4.52	5.44
5	Kasargod	4.77	5.54
6	Kollam	4.27	5.50
7	Kottayam	4.22	5.45
8	Kozhikode	4.50	5.47
9	Malappuram	4.70	5.49
10	Palakkad	4.55	5.51
11	Pathanamthitta	4.52	5.62
12	Thrissur	4.60	5.52
13	Wayanad	4.68	5.33
14	Thiruvananthapuram	4.34	5.52
	Average	**4.49**	**5.49**

Source: The Energy Report Kerala, WWF India & WISE 2013

The average solar radiation in Kerala is 5.49 KWhm2/day.[3] The Global Horizontal Irradiation (GHI) daily average of Kerala is 5.49 kWh/day. As per the general principle, any site with GHI is more than 1500 kWh/year is more suitable for solar PV technology. In Kerala the

[1] While there are mainly 3 types of solar size, 60-cell, 72-cell, and 96-cell; for commercial purposes 72 cell solar is commonly used.
[2] According to information available at http://www.webelsolar.com
[3] According to Surface Meteorology and Solar Energy Data Set http://esoweb.1arc.nasa.gov/sse/RETScreen)

annual value of 2003kWh/m2/year is based on the Meteonom Data (Ajithgopi, Sudhakar, K., & Keng, N. W. 2021). From this evidence, Kerala is the most suitable place for solar PV installation.

So the power of output is calculated as 1.4274 Kwh/day. If we consider 300 clear days in a year the total power production would be 428.2Kwh/year. A 72-cell solar panel has an expected rate of 25 years of life span, so during 25 years the power output becomes 10.7055Mw.

Carbon credit calculation

Revenue generation potential of KIIFB can be analysed by taking an average value of 0.932 tonnes of CO_2 emission reduction per megawatt per hour of electricity (S.M. Sze, Kwok K. Ng, 2006). Globally carbon trading is done by reducing the overall emission overtime through the generation of more power from renewable sources and offsetting its CO_2 emission. CO_2 emission reduction Mwh/year as per the calculation is 0.3988 tonnes per unit of 72 cell solar.

As mentioned earlier, the total power production will be 428.2 kw/h, which will be equivalent to 0.428 mw/h. In this module, CO_2 emission reduction Mwh /year as per the calculation will be,

$$= 0.428 \times 0.932$$

$$= 0.3988 \text{ tonnes}$$

If we take \$60 per tonne of CO_2 emission (average rate that is followed globally in carbon trading), we can earn approximately ₹1984.42(1 USD= Rs 82.69) from one module of 72 cell solar per year.

$$=0.3988 \times \$60$$

$$= 23.928$$

$$= \$24 = \text{Rs } 1984.42 \text{ (when } 1\$= \text{Rs } 82.69)$$

KIIFB has a projection of 5, 93,820 sq.m construction of buildings as per the project details provided by KIIFB's green building proposal (2021). One module of 72 cell solar requires 2 sq m for installation. Therefore from 593820 Sqm, we can install 296910 (593820/2) solar cells.

From 296910 solar cells, 589194142.2 per year (Rs 58.9 crore) can be earned as given below.

$$= 296910 \times 1984.42 = 589194142.2$$

Carbon offsetting versus monetizing of power

Considering the fact that carbon trading/offsetting is in a nascent stage in India, KIIFB can possibly think of monetising the solar power generated using its space. Let us analyse how much is this worth if given to GRID? This can be calculated as follows.

By using the rooftop of KIIFB's project of 593820 sq.m construction, we can generate 428.2 Kwh/year from 1 PV solar.

So by using 296910 solar cells, we can generate,

=296910 x 428.2kwh

=127136.862 MW/year

In the Indian scenario power is priced in the Kilowatt unit and 1 Kw of electricity is priced at 6.49. 1KW of electricity generated from solar when sold at a rate of 6.49 (KSEB, 2023) can generate Rs 825118234.38 (Rs 82.5 crore) revenue from the sale of electricity to Indian Grid or to KSEB. This indicates the green power generated by KIIFB fetches more value if sold to the grid or KSEB than used for carbon offsetting. Whatever the case be, the revenue generated from the KIIFB's green buildings can also be considered in tandem with the SDG goals. While these are the direct revenue benefits of this model, there are also indirect benefits such as less dependence of the state on the national grid for additional energy, especially during the summer season.

Conclusion

Now based on the above findings, we have some suggestions on mobilising own sources of revenue for the government, especially KIIFB in our case. Here we find that KIIFB can generate a certain amount of funds from the installation of rooftop solar PV on its buildings. KIIFB can generate electricity by using renewable sources and zero carbon emission. This electricity can be sold to the Indian grid or to KSEB and it may be used for carbon trading or offsetting. In this study, we concentrated only on infrastructure projects of KIIFB and rooftop solar installation but this also can be extended to other projects of KIIFB.

It is also essential to mention the costs of installing rooftops in KIIFB’s space. Considering the fact that KIIFB was solely designed to provide crucial infrastructural finance, it shouldn't be a problem for KIIFB to add a small percentage to the existing project cost for converting it into a green project. Apart from this, KIIFB has a history of finishing projects ahead of its completion time and thereby saving project cost. This savings can be efficiently used into installing rooftop solar and generating power from its vacant spaces. The falling costs of solar panels and Central government’s push towards installing rooftop solar will also add advantage to this model. Therefore, we feel that the cost of installing rooftop solar in KIIFB’s building spaces won't be much of an issue.

In the context of green financing, it necessitates the need for incorporating sustainability with infrastructure financing in tandem with the best practices followed globally. The study highlights the viability and potential of carbon trading/offset or solar power generation strategies by KIIFB and ways to augment revenue from it. The paper found that, by reducing carbon emissions, the KIIFB can earn more carbon credit or generate more revenue from selling it, and it is also possible to attract potential green financing by highlighting this sustainable energy source and its sustainable revenue stream. This provides scope for innovative non-tax revenue methods in the current scenario of enhancing revenue in the form of renewable power generation.

To conclude, in this paper an attempt has been made to highlight the revenue generating potential of KIIFB, the deficit financing infrastructure financing agency of the Government of Kerala. Since the data regarding the total rooftop space created so far by KIIFB was not available, a proxy, that is KIIFB’s green building proposal (2021); was used to highlight the potential rooftop space and the resultant solar power generation. Even with this, it was estimated that KIIFB's building has a potential to raise about 82.5 crores annually. If solar power generation is enabled in all the rooftop spaces of KIIFB, these figures are sure to go up. It has been mentioned that, when state owned enterprises having revenue potential incurs debt for the state, it is not included in the overall debt of the state. Therefore KIIFB should seriously think of generating revenue sources so as to move out of the ambit of a mere debt generating state owned enterprise. Once KIIFB generates financing from its resources and showcases its revenue potential, then only KIIFB can garner more borrowing to suit its mandate.

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