

**AN ECONOMIC ANALYSIS OF COAL-BASED THERMAL POWER PLANTS IN
INDIA**

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**AN ECONOMIC ANALYSIS OF COAL-BASED THERMAL POWER PLANTS IN
INDIA**

by

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Certificate

This is to certify that the thesis titled “**An Economic Analysis of Coal-based Thermal Power Plants in India**” being submitted by **Ms. Vandita Sahay** to the Department of Humanities and Social Science, Indian Institute of Technology Delhi, for the award of the degree of **Doctor of Philosophy**. She has faithfully carried out her study under our guidance and supervision and the accompanying thesis is her genuine and original work.

The results contained in this thesis have not been submitted, in part or full, to any other University or Institute for the award of any degree or diploma.

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(Vandita Sahay)

Abstract

Electricity is defined as the form of energy which is transferred with the help of wires and is used for lighting, heating and supplies power for machines. Electricity in a coal-based power station is generated by burning coal. Post-independence, the power sector witnessed significant progress with hydro and coal based thermal power plants - being the main source of electricity. But this improvement was not enough to meet the demands for electricity in a growing economy like India. To improve the dismal condition of the power sector, various policy level measures were introduced in India. But given these regulatory and structural reforms being introduced in the Indian power sector, the power sector was still not generating electricity efficiently and operating below its capacity. Within the power sector, coal based thermal power plants are of prime importance as 86% of thermal installed capacity in the country is through coal fired plants. Hence, they are of prime importance for the economic development of the country. Therefore, there is a need to study the efficiency and productivity of these plants and identify the reasons for their underperformance.

This piece of research was an attempt towards identifying firm specific performance drivers to enhance its practical utility. Thus, the focus was on investigating the factors contributing towards technical efficiency and productivity. Adopting the research methodology of quantitative analysis, the study was conducted for a period of ten years covering forty-nine coal-based power plants in India. The data was collected from “Review of Performance of Thermal Power Stations” reports and “Report on Fly Ash Generation at Coal/Lignite Based Thermal Power Stations and Its Utilization in the Country,” which are the annual publications by Central Electricity Authority of India, an organisation under Ministry of Power.

Starting with the general overview, along with the evolution of reforms post-Independence in the power sector, detailed description of data along with a thematic review of literature has been conducted for each chapter. Keeping the main objectives of the study in mind, technical efficiency estimates based on ownership, capacity and region has been highlighted. Slack analysis has been conducted as well to examine the amount of input reduction needed for the power plants. The determinants of technical efficiency along with benchmarking of thermal power plants, based on their performance has also been analysed. Measurement of productivity at plant level and region-wise, along with factors affecting productivity has been done.

For this purpose, non-parametric technique involving Data Envelopment Analysis (DEA) technique, Malmquist Productivity Index and Tobit regression to identify the factors leading to efficiency has been applied. Since the Electricity Act of 2003, was the chief game changer in the power sector, the data period used for the study is from 2005-06 to 2014-15. 2014-15 is the latest year for which the data was available.

It can be concluded that state owned plants were the least efficient ones and private plants were most efficient. The coal-based plants were over-employed which hindered the efficiency and productivity of these plants. The results indicated that on average, total factor productivity declined and witnessed a regress when the technical efficiency change component decreased. For improving the performance of state-owned plants, the policy makers and energy analysts need to be well-informed about the current status and condition of power plants. For this purpose, the study has suggested a few recommendations for policy makers to improve the performance of thermal power plants in the country.

शोध सारांश

भारत के कोयला आधारित ताप संयंत्रों का अर्थशास्त्रीय विश्लेषण

ऊर्जा का वह प्रवाह जिसका स्थानांतरण और वितरण बिजली के तार के माध्यम से किया जाता है उसे विद्युत कहते हैं। इसका उपयोग प्रकाश व्यवस्था, तापक उपकरणों और यंत्रों में शक्ति के प्रदायक के रूप में किया जाता है। ताप विद्युत संयंत्रों में कोयले से बिजली का निर्माण किया जाता है। भारत में, आजादी के बाद, ऊर्जा क्षेत्र में बहुत प्रगति हुई है। इनमें, जल और ताप विद्युत संयंत्र बिजली के प्रमुख स्रोत रहे हैं। यह प्रगति भारत जैसी विकासशील अर्थव्यवस्था की जरूरतों को पूरा करने में असमर्थ रही है। ऊर्जा क्षेत्र की इस निराशाजनक स्थिति को सुधारने के लिए, नीति स्तर पर उपाय लागू किए गए। इन नियामक और ढांचागत सुधारों के बावजूद भारतीय ऊर्जा क्षेत्र अपेक्षित मात्रा में बिजली का कुशलतापूर्वक उत्पादन करने में असफल रहा। भारतीय ऊर्जा क्षेत्र में, कोयला आधारित ताप संयंत्र प्रमुख स्थान रखते हैं क्योंकि पूरे देश की 86% उष्मीय संस्थापित क्षमता कोयला ज्वलित संयंत्रों पर निर्भर है। इस कारण से ये देश के आर्थिक विकास के लिए अत्यंत महत्वपूर्ण हैं। अतः इन संयंत्रों की कार्यकुशलता और उत्पादकता के अध्ययन की आवश्यकता है जिससे यह पता लगाया जा सके कि आशा से कम उपलब्धि क्यों हो रही है।

यह शोधकार्य उन कारणों और प्रदर्शन चालकों की छान-बीन का सविस्तर प्रयास है जो इन संयंत्रों की व्यावहारिक उपयोगिता को बढ़ाने में मदद करते हैं। यह जांच उन कारकों पर केंद्रित है जो तकनीकी दक्षता और उत्पादकता के सहायक हैं। मात्रात्मक विश्लेषण की शोध प्रणाली को अपनाते हुए, इस विषय का अध्ययन उनकास कोयला आधारित ताप संयंत्रों का सर्वेक्षण करते हुए दस वर्ष की अवधि में पूरा किया गया। आंकड़ों को "रिव्यू ऑफ़ परफॉरमेंस ऑफ़ थर्मल पावर स्टेशंस" और "रिपोर्ट ऑन फ्लाइंग ऐश एट कोल/लिग्नाइट बेस्ड थर्मल पावर स्टेशंस एंड इट्स यूटिलाइजेशन इन द कंट्री," नामक प्रतिवेदनों से लिया गया है। केंद्रीय विद्युत प्राधिकरण, जो विद्युत मंत्रालय के अधीन है, वार्षिक रूप से इन प्रतिवेदनों का प्रकाशन करता है।

हर अध्याय में सामान्य विवरण से शुरुआत करते हुए, ऊर्जा क्षेत्र में स्वतंत्रता के बाद आए विकास पर नज़र डालकर, आंकड़ों का विस्तारपूर्वक उल्लेख और साहित्य सामग्री की विषयगत समीक्षा की गई है। मुख्य उद्देश्यों को ध्यान में रखते हुए, स्वामित्व, धारण शक्ति और प्रांतों के आधार पर तकनीकी दक्षता को विशेष रूप से दर्शाया गया है। संयंत्रों में संसाधनों (इनपुट) की कटौती के परिक्षण के लिए स्लैक विश्लेषण भी किया गया है। तकनीकी दक्षता के निर्धारकों और ताप संयंत्रों के मानदण्डों का विश्लेषण उनके कार्य निष्पादन पर आधारित है। भिन्न-भिन्न प्रकार के संयंत्रों को

श्रेणियों में बांटकर उनकी उत्पादकता को संयंत्र-स्तर और प्रांतों के हिसाब से आँका गया है। इसके साथ ही उत्पादकता को प्रभावित करने वाले कारकों का मूल्यांकन भी किया गया है।

इस शोधकार्य के लिए गैर प्राचलिक तकनीक का उपयोग किया गया है जिसमें डाटा डेवलपमेंट अनालसीसिस (डी ई ए) तकनीक, माल्मक्विस्ट प्रोडक्टिविटी इंडेक्स और टोबिट रिग्रेशन द्वारा उत्पादकता में वृद्धि करने वाले कारकों की जांच की गई है। ऊर्जा क्षेत्र में, विद्युत अधिनियम 2003 एक क्रांति लेकर आया था इसलिए आँकड़ों को 2005-06 से लेकर 2014-15 तक के वर्षों से लिया गया है। 2014-15 के बाद के आँकड़े उपलब्ध नहीं हैं।

निष्कर्ष यह माना जा सकता है कि राज्य स्वामित्व वाले सरकारी संयंत्रों की उत्पादकता कम थी और गैरसरकारी निजी संयंत्र ज्यादा कार्यक्षम रहे हैं। कोयला आधारित ताप संयंत्रों में ज़रूरत से ज्यादा लोग रोजगार पर हैं जिस से इन संयंत्रों की कार्यक्षमता और उत्पादकता में बाधा आती है। परिणाम इस बात की ओर संकेत करते हैं कि औसतन, तकनीकी दक्षता में बदलाव लाने वाले घटकों में कमी आनेपर कुल घटक उत्पादकता में गिरावट आई और उसका क्षय हुआ। सरकारी संयंत्रों की उत्पादकता में वृद्धि करने के लिए, नीति निर्माताओं और ऊर्जा विश्लेषकों को संयंत्रों की मौजूदा परिस्थितियों के बारे में अधिक जानकारी और सचेत रहना होगा। इस उद्देश्य के लिए, इस शोधकार्य में नीति निर्माताओं के लिए कुछ विशेष सुझाव दिए गए हैं जिन से देश के ताप संयंत्रों की उत्पादकता और दक्षता में वृद्धि होगी।

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