

EFFICIENT PLANNING AND MANAGEMENT IN INDIAN SCHOOL EDUCATION

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ABSTRACT

Sustainable development goals (SDGs) are a set of 17 interlinked goals set by the United Nations in order to achieve prosperity for all. These goals focus on improving the standard of living broadly through better education, environmental consciousness, poverty reduction, equality, good health and sustainable cities and communities. A key goal, SDG 4 aims to provide quality education for all and ensure equity and inclusivity. There is a need to develop action plans at the global as well as local level to achieve these goals. The needs of developed and developing countries such as India are quite dissimilar given its scale and diversity. It is manually not possible to take decision for large scale problems. The current work deals with the planning and management aspects in the Indian school education through quantitative models which can be solved using algorithms and software. The thesis presents mathematical models that aid in school education decision-making and can be replicated to other contexts and geographical locations with minor alternations. The models need to be efficient in terms of solving problems at scale as well as be effective to consider the requirements of all stakeholders with conflicting objectives.

The thesis presents work that is at the intersection of SDG 11, SDG 12 and SDG 13 along with SDG 4, which is the key focus. The overall objective is to improve the education governance and delivery for better satisfaction of people's aspirations and expectations. It starts with a literature review to develop an understanding of factors that affect academic performance of schools and their interrelationships. These factors vary in different education systems and geographical locations. An empirical study of about 800 government schools in Delhi, India for three academic years attempts to uncover these factors. This study helps to identify the schools that need improvement and a set of interventions that can help enhance their performance using statistical analysis and geotagging of schools. This part also provides a conceptual model using game theory to understand school inspections with respect to the probability of violation by schools and their chances of being caught. The performance of schools depends on its resources, that is, manpower and infrastructural resources, and its operations as identified through a literature survey. Teachers are arguably the most important manpower resource in schools and their distribution is skewed towards areas with good

accessibility. There are two ways to improve teacher distribution. The first way is to transfer teachers followed by recruitment in case of large deficits within the network or recruiting teachers in a decentralized manner that would incur heavy cost and reduce utilization. The second way is to consolidate schools in case of a presence of a large number of schools with low enrolments, since it is not economically viable to provide good quality resources in all schools. This work explores both these aspects.

The next study provides empirical insights into teacher distribution in Delhi, India over the three academic years using statistical methods. The results indicate that the teacher distribution depends on school location, years of existence, medium of instruction, number of inspections, school type and school size. We develop mathematical models that help achieve an equitable distribution of teachers through centralized transfer of teachers by optimizing the deficits and transfer distance. The models help formulate fair and transparent transfer policies. The results indicate a good amount of reduction in the number of teacher deficit schools and maximum deficit in each school.

Next, the thesis presents mathematical models for school consolidation, a special case of facility location problem to ensure walking accessibility versus quality trade-off in school education. This involves school closures and reallocation of students and teachers to nearby schools without opening any new schools, due to a presence of a large number of small schools. The suite of models can be helpful for the decision-makers in a variety of situations based on the needs of a given administrative area. In this context, we present two case studies of a district each in the states of Karnataka and Andhra Pradesh in India. The first case study illustrates the effect of a model to minimize the disruption while consolidating different types of schools with variable number of grades. The second case study shows the effect of all school consolidation models on primary schools and assists the decision-makers on usage of these models customizing their needs.

Students often travel distances beyond the scope of walking for better educational opportunities. They use school buses, public transport and private vehicles for this purpose. Studies show school commute affects academic performance in schools. In India, schools plan their transportation autonomously. Hence, it is required to develop a holistic framework that provides safe and convenient commute to school and also considers the environmental aspects. In this regard, it is important to understand the enablers for the use of school buses and shift non-bus users to school buses for operational efficiency. We develop a framework for this

purpose to incorporate the views of experts, parents of current bus users and non-bus users. The survey of experts helps to rank the factors that affect bus usage while the survey of parents of current users gives their perception of buses to help formulate improvement strategies. The survey of non-bus user parents helps to understand the reasons that inhibit use of school buses and possible interventions that can cause a likely shift to school buses. A key factor that affects school bus usage/ non-bus usage is the design of bus routes that may be long in terms of distance and time. The last part of the thesis provides a model to minimize the operational costs of school buses for schools whose buses are not stationed at the school, but located at third-party depots throughout the city. We apply the framework to improve school buses and the mathematical model to a prominent school in Delhi, India that helps reduce their operational costs by about 12% per annum and lead to a potential shift of more than 50% of non-bus users to buses.

Overall, the thesis provides models that aid decision-making in the planning and management aspects of school education. We demonstrate the models through case studies and examples to assist decision-makers and planners to make efficient decisions using quantitative techniques.