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主 論 文 の 要 旨

論 文 題 目 Material stock accumulation in society: modeling, forecasts, and socio-economic drivers

社会に蓄積されたマテリアルストック：モデリング・将来予測・社会経済要因

氏　　　名　FISHMAN Tomer

論 文 内 容 の 要 旨

This work attempts to answer the question 'What are the trends of material stock in countries as they mature?'. Material stocks of buildings and infrastructure provide numerous services such as dwelling, transport, and communication, forming the physical foundations of society. The usability, quantity, and quality of materials stocks dictate the amounts of material and energy flows necessary to maintain, expand, and provide energy to them. building on the foundations of socio-economic metabolism, material flow and stock analysis, industrial ecology, and environmental economics, this work presents new methods to account and analyze societal material stocks. This includes (1) A deterministic method to calculate historical and future material stocks is presented with case studies of Japan and the United States, (2) a framework and stochastic method for forecasting material stock accumulation including levels, speed, and acceleration for 46 countries and the world, (3) multiple analysis methods including decomposition and panel regressions to understand the drivers of material stock growth in Japan and its prefectures. The overall results show that material stocks are growing at different paces and trajectories in different regions, countries, and the world, but in only a limited number of archetypal growth profiles. While economic activity is the main driver of material accumulation, population trends are also significant, especially at the subnational level of disaggregation. These results suggest that although in all countries material stock is growing and each have their unique characteristics, general overarching attributes were found which can be exploited for improving material stock usage. The methods developed in this work offer empirical tools to analyze past trends and plan future policies and can be expanded to any region or country