

System dynamic modeling of green and white roofs as climate change adaption

Manwinder Singh, Qiuyan Yuan

University of Manitoba, Canada

ABSTRACT

Climate change is forcing communities to adapt to changing climatic conditions, as climate risk is becoming a pressing threat to humanity. Green roofs and white roofs can be used effectively as climate change adaption in an urban environment, but their selection is a complex procedure that involves gathering and analyzing multiple sources of information and projecting different future scenarios. This study aims to compare the performance of green and white roofs. This report evaluates climate change adaptation techniques based on roof performance and the effectiveness of System Dynamics Modeling (SDM) using STELLA software to implement green and white roofs as climate change adaptation scenarios in urban areas. SDMs support the integration of quantitative variables of the system (physical elements) as well as intangible variables (such as policies) which makes them favorable for such analysis.

Various scenarios having a combination of different percentages of green and white roofs are analyzed and the effectiveness of these scenarios is discussed for different cases. The study shows that the performance of green roofs is better as compared to the white roofs for the avoidance of carbon emissions due to energy reduction in cooling and heating. This is because green roofs work in both winter and summer while white roofs mainly work in summer. Also, green roofs are helpful in carbon sequestration while white roofs cannot store carbon. However, white roofs are more effective for one-time carbon offset value as compared to green roofs. Also, the performance of the white roof is best for net radiation with lower values in comparison to green roofs. In a nutshell, the overall performance of green and white roofs depends upon the weather of the region selected for the analysis. On this basis, a particular roof type can be selected for the overall best performance.

Keywords: Systems Dynamics; Urban Green Infrastructure; Climate Change and Adaption; Green Roof; White Roof