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# Estimating Poverty Levels from Satellite Imagery: A Comparison of Human Readers and an Artificial Intelligence Model

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**Abstract :** The subfield of poverty and welfare estimation that applies machine learning tools and methods on satellite imagery is a nascent but rapidly growing one. This is in part driven by the sustainable development goal, whose overarching principle is that no region is left behind. Among other things, this requires that welfare levels can be accurately and rapidly estimated at different spatial scales and resolutions. Conventional tools of household surveys and interviews do not suffice in this regard. While they are useful for gaining a longitudinal understanding of the welfare levels of populations, they do not offer adequate spatial coverage for the accuracy that is needed, nor are their implementation sufficiently swift to gain an accurate insight into people and places. It is this void that satellite imagery fills. Previously, this was near-impossible to implement due to the sheer volume of data that needed processing. Recent advances in machine learning, especially the deep learning subtype, such as deep neural networks, have made this a rapidly growing area of scholarship. Despite their unprecedented levels of performance, such models lack transparency and explainability and thus have seen limited downstream applications as humans generally are apprehensive of techniques that are not inherently interpretable and trustworthy. While several studies have demonstrated the superhuman performance of AI models, none has directly compared the performance of such models and human readers in the domain of poverty studies. In the present study, we directly compare the performance of human readers and a DL model using different resolutions of satellite imagery to estimate the welfare levels of demographic and health survey clusters in Tanzania, using the wealth quintile ratings from the same survey as the ground truth data. The cluster-level imagery covers all 608 cluster locations, of which 428 were classified as rural. The imagery for the human readers was sourced from the Google Maps Platform at an ultra-high resolution of 0.6m per pixel at zoom level 18, while that of the machine learning model was sourced from the comparatively lower resolution Sentinel-2 10m per pixel data for the same cluster locations. Rank correlation coefficients of between 0.31 and 0.32 achieved by the human readers were much lower when compared to those attained by the machine learning model – 0.69-0.79. This superhuman performance by the model is even more significant given that it was trained on the relatively lower 10-meter resolution satellite data while the human readers estimated welfare levels from the higher 0.6m spatial resolution data from which key markers of poverty and slums – roofing and road quality – are discernible. It is important to note, however, that the human readers did not receive any training before ratings, and had this been done, their performance might have improved. The stellar performance of the model also comes with the inevitable shortfall relating to limited transparency and explainability. The findings have significant implications for attaining the objective of the current frontier of deep learning models in this domain of scholarship – eXplainable Artificial Intelligence through a collaborative rather than a comparative framework.

**Keywords :** poverty prediction, satellite imagery, human readers, machine learning, Tanzania
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