

# Tree Balanced Designs Assuming Proportional Network Effects for Agroforestry Experimentation

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## Abstract

In agroforestry experiments involving tree-crop mix, effects of trees may be felt on the very plots on which they grow as well as plots in the neighborhood. The influences of trees on nearby plots imply that there are underlying connections among the plots through a network of tree effects. This tree network effects can be viewed in a manner similar to a simple graph where nodes are connected. Therefore, choosing appropriate model for agroforestry design is paramount to ensure that all sources of variation are adequately accounted for. This study aimed to develop a class of designs under proportional network effect model which account for tree effects from main as well as adjacent plots, with network effect proportional to direct effect of tree. The designs are referred to as resolvable network balanced designs (RNetBD), a property that makes them to be suitably used in multiple locations. The characterization properties of the designs have been studied and the designs are found to be variance balanced for estimating direct effects of trees. The efficiency factors of the designs are generally high and appear to increase as number of tree species increases. It is shown that, as the number of

tree species increases, the range of values of the proportionality parameter for which efficient and practically useful designs are obtained, decreases. The designs are recommended for agroforestry experimentation involving multiple tree species with a single crop.