Abstract 24:

Multi-environment performance analysis to predict genotype by environment interactions (GxE) and resilience in livestock

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Performance of the existing livestock genotypes in smallholder systems of the tropics is too low to meet growing demands for animal source proteins. One approach to enhance current levels of productivity and address food security in Africa is sourcing improved genotypes developed for medium-input systems. These imported genotypes need to be tested for their yield and adaptability in the local environment. There has been a lack of comprehensive analytical framework to evaluate performance and resilience of livestock genotypes across environments. The biophysical factors and management practices of smallholder farmers are heterogenous and require experimental designs and analytical methods which can disentangle the genetic potential of test strains from environmental confounding factors. Machine learning approaches were followed in the present study to fit species and phenotypic distribution models and identify the most important ecological factors influencing productivity. A theoretical framework of multi-environment performance analysis (MEPA) is used in plants to analyse GxE and stability. MEPA was adapted to evaluate five chicken genotypes distributed to farmers in diverse agro-ecologies of Ethiopia. We have applied ANOVA, regression, additive main effects multiplicative interaction model (AMMI), linear mixed-effects models (LMM), and Generalized Additive Models (GAMs) to evaluate performance and stability of chicken body weight across 45 testing sites. LMM and GAMs resulted in a better model fit than ANOVA and AMMI. Our approach demonstrates the applicability of MEPA in livestock to identify genotypes with superior performance and wider adaptability.