

EGU2020-22514, updated on 07 Jul 2022

<https://doi.org/10.5194/egusphere-egu2020-22514>

EGU General Assembly 2020

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## Success of the co-production and delivery of local and scientific weather forecasts information with and for smallholder farmers in Ghana

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Many West African farmers struggle to cope with changing weather and climatic conditions that keep them from making optimal decisions and meeting food and income security. The development of more accessible and credible weather and climate services (WCIS) can help local farmers improve their adaptive capacity. Such adequate WCIS often requires a joined collaboration between farmers and scientists to co-create an integrated local and scientific forecasting knowledge. We examine (i) the design requirements (i.e. Both technical and non-technical tools) and (ii) evaluate the outcomes of a successful implementation of the co-production and delivery of WCIS in Ada East district, Ghana. We implemented a user-driven design approach in a citizen science experiment involving prototype design and testing, training workshops, and interviews with farmers, agricultural and meteorological extension agents from 2018 to 2019. Farmers were handed with digital tools (i.e. Smart phones with web and mobile applications) and rain gauges as research instruments to collect and receive weather forecast data, and interact with scientists.

Our results show that farmers' engagement increased over time and is associated with the trainings and the improvement of the design features of the applications used. The evaluation shows an increase in the usability of tools, the reach or networking with other farmers, and the understanding of uncertainty (probabilistic) aspect of the forecasts over time. Local farmers evaluated both the local and scientific forecasts as accurate enough and useful for their daily farming decisions. We concluded that using modern technology in a co-production process, with targeted training, can improve the access and use of weather forecasts information.