Title: *RiceFocus* - **Empowering the IRRI Rice Crop Manager through the 6th grain FieldFocus multicrop big data platform.**

The delivery, at scale, of locally-relevant and actionable information to smallholders, farming in diverse production landscapes remains an ongoing development agriculture challenge. The integration of big data from different sources and different digital technologies packaged in powerful digital solutions offer new chances for empowering data-driven farming to benefit and make food secure large number of smallholders and provide extension with relevant advisory content.   Well-tested ICT tools like the Rice Crop Manager (RCM, http://webapps.irri.org/ph/rcm) provide seasonal recommendations based on information provided by farmers, crop modeling and best management practices. RCM is a great success and has reached nearly 50,000 rice growing farmers within one year of release in Eastern India. RCM is also widely used in the Philippines, with more than 1 million generated recommendations across several seasons for about 200,000 farmers since its release in 2013. 6th Grain is an emerging global software and digital agriculture company. 6th Grain has developed FieldFocus as big- data analytical platform to provide farmer- specific advice for a wide variety of crops. **We will develop and test *RiceFocus* to empower RCM to deliver scalable and timely crop management recommendations responding to field variability in crop performance.** This pilot study will build on the ongoing partnership between IRRI and the Government of Odisha in the development and implementation of RCM and satellite/UAV based rice monitoring in India.

Crop growth responses to environmental conditions such as availability of resources, abiotic and biotic stresses vary with time and space. Our capability for forecasting and predicting these responses are limited, particularly with the complexity of their interaction and the continuous change of agro-pedo climatic conditions at scale and within farmers' fields. Remote sensing data provides up-to-date and high resolution characterization of a farmer's field that can be used with modeling approaches for developing timely field-specific recommendations assisting farmers in their decision making to secure their crop and maximize their resource use efficiency.

The capability of 6th grain's FieldFocus in processing multiple data sources will be the core digital engine for computing actionable recommendations for different rice growing landscapes. RCM provides agronomic data and crop modeling at the field level while satellite imagery provides data at landscape level. Weather monitoring and UAVs bring in critical climatic and biophysical assessment to deal with uncertainties both at field and landscape levels.

Open source weather data (GSOD, NASA, CHIRPS) in combination with local stations data and an analogue based seasonal weather forecast will be combined with the IBM weather forecast used by 6th grain. The 6thgrain platform currently uses Sentinel-2 imagery (10 day, 10 m resolution) and plans to add higher spatial and temporal resolution Planet Lab imagery (daily at 3 m) in the future. Such VISNIR satellite imagery will be of limited value due to high cloud cover in rice growing regions of Asia, so we

are focusing on the use UAV imagery for this pilot study. UAV based crop monitoring is under rapid development and adoption worldwide including many CG centers and national partners. UAV's can fly beneath the clouds, providing very high, centimeter level resolution data at low cost, and are easily deployed when and where needed. A UAV training workshop will be conducted for standardizing data collection procedures including flight planning, sampling, and processing. This pilot study will be limited to the use of color (RGB) UAV imagery, since this is the most commonly available UAV data. UAV image processing will be conducted using a commercially available cloud service (Drone Deploy or sarmap) for generation of color maps (orthomosaics), vegetation indices and digital surface models. These outputs will then be uploaded along with standardized metadata for analysis and display on *RiceFocus*.

In the first 6 months of the project RCM, weather, and UAV imagery will be collected from sites at Puri and Balasore and from a long term field site at IRRI-OUAT Research farm in Bhubaneswar. These data will be integrated into FieldFocus platform to calculate field size and yield targets for each selected site. RCM will integrate FieldFocus field sizes and yield targets into its decision making calculators to provide pre-season recommendations. In-season recommendations will be adjusted using FieldFocus field monitoring which includes weather forecasts , actual weather, and real time UAV imagery. Field testing of 15-20 voluntary farms will be conducted during the last 6 months to test the effectiveness and feasibility to deliver pre-season and within season recommendations based on real farmers' target yields data, and in-season changes.

The funding for this pilot will be used for: a) travel and information exchange between partners -15%; b) UAV data capture, processing, and training -15%; c) data processing, modeling and integration -60%, and; d) project management -10%. The data generated during the project will include i) complete rice field delineation of the pilot site ii) farmers RCM field data and yield estimates, and iii) time series remote sensing and weather data

RCM, weather monitoring, satellite/UAV data capture and collection of ground data are all self-sustaining through the IRRI-Odisha partnership. 6[th]grain is very interested in partnering with IRRI to develop a rice module for the FieldFocus platform (*RiceFocus*) ultimately resulting in a private-public partnership business model for sustainability and scale.

Next steps for *RiceFocus* would include (1) integration of SAR satellite and UAV multispectral and thermal remote sensing data along with new algorithms for further refining dynamic agronomic management recommendations (2) customization and/or crowdsourcing of weather data to improve accuracy (3) development of *RiceFocus* as a delivery platform for non-RCM farmers via linkage with IVR/SMS mobile channels, and (4) creation of farm data analytics for tracking successes and failures at farmer level to evaluate impact and optimize *RiceFocus* recommendations. A grand pilot applying the integrative approach in regions of Southeast Asia or South and Eastern Africa could be the next major project phase to improve *RiceFocus* to account for larger variability and to expand ability of *RiceFocus* in big data integration including generating recommendations for different crops in rotation.