What is your idea?

New technologies 'from space down' in principle hold the promise of improving living conditions for hundreds of millions of poor people within short time frames and at very low cost. However, in many food insecure settings, application of satellite data to agriculture is significantly constrained by the lack of detailed, reliable and geo-referenced data on growing conditions and crop performance. Capitalizing on the massive volumes of satellite based data requires an iterative process of analysing remote sensed data in the light of actual results on the ground. **This effort seeks to work with partners in remote sensing and on the ground in Africa to develop the most efficient and effective ground-truthing systems necessary for calibrating and validating satellite based observations of food systems. We believe this is a key step for unleashing satellite data for application in diverse domains such as production forecast and estimation, crop insurance, and precision agriculture.**

How will you pilot it?

Planet, a private company and partner, maintains a network of more than 200 satellites that sense all inhabited land area on earth every day at seven meters per pixel resolution. This network complements a host of other satellites already in orbit, notably those deployed by the National Aeronautical and Space Administration (NASA) and the European Space Agency. Planet, ESA, and NASA specifically aim to improve food security via a 'from space down' approach. Enormous volumes of data are available to be brought to bear on the task.

Unfortunately, agricultural production estimates are, in Africa and in many other developing regions, late and often very weak--sometimes they are non-existent, even for key staple crops. This dearth of timely and reliable information on production volumes is costly. It impedes responses to food crises. It hampers public policy formulation. It retards nascent democratic processes by depriving voters of information on basic performance in a crucial sector. It leads to inefficient agricultural market functioning as knowledge of supply is critical to proper price formation. Finally, it is, as noted above, strongly impeding application of the growing mass of remote sensed data, mainly from satellites, due to the paucity of adequate ground-truthing data.

An effort 'from the ground up' is needed to complement the literal billions of dollars in investment dedicated to observation 'from space down'. Fortunately, technological advance is also redefining the potential for collecting this information in areas with limited infrastructure. Satellite imagery, vast processing power, machine learning algorithms, unmanned aerial vehicles (UAVs), very high resolution photography, inexpensive location technologies, robust and low cost solar powered sensor stations, and rapidly expanding cellular phone networks create large and largely unexploited opportunities to efficiently and effectively collect data on the ground.

This project will seek to determine the best ways to exploit these opportunities. We believe that some variation of an area frame based approach to collecting geo-referenced ground-truth information is likely to be most promising. Satellite imagery can be used to divide target regions (countries) into land use strata. Strata are likely to include dry land mixed use, intensive agriculture, rangeland/bush, and

other designations as appropriate. Within each stratum, clusters can be selected that represent a fixed contiguous area (to be determined). Within each cluster, a series of small area squares (number and size to be determined) can be identified and geo-located. UAVs offer potential to take high resolution photos of each square within the cluster and machine learning algorithms have the potential to interpret this photography in terms of crops and their yield.

To complement this production information, we will consider how to apply sensors developed by Arable, our other external partner. Arable has developed a low-cost, solar powered station that collects information on canopy biomass, precipitation, air temperature, humidity, and barometric pressure. This suite of geo-referenced information is exactly what is required to calibrate and validate satellite based analyses.

Reliance on these technologies shifts the nature of the ground-truthing task from a mainly logistical operation to a principally analytical challenge. For this reason, we will seek to engage with in-country policy research institutes (PRIs). They possess:

- analytical capacity combined with demonstrated data collection capabilities,
- a degree of independence, and
- formal and informal links to statistical authorities.

These PRIs will help to develop ground-truthing strategies that are appropriate to local circumstances.

The 12-month work program includes:

1) A detailed desk study considering the best potential approaches performed with inputs from Planet and Arable.
2) A canvassing of 10 PRIs based in Africa to determine a limited subset (likely two or three) with the interests, capabilities, and (ideally) independent funding to engage in the project.
3) A small workshop gathering together relevant experts from remote sensing, crop modeling, and data collection to evaluate and critique suggested approaches.
4) A demand generation exercise, targeted at key sources of demand for the information that the project seeks to ultimately create, such as central banks, ministries of finance and agriculture, and private operators, to hone final plans and create a constituency for their operationalization.

If the pilot is successful, the next step would be the operationalization of the developed approach in multiple countries. Additional funding from outside the CGIAR will be actively sought.