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eFarm: A Tool for Better Observing Agricultural Land Systems

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Abstract: Currently, observations of an agricultural land system (ALS) largely depend on remotely-sensed images, focusing on its biophysical features. While social surveys capture the socioeconomic features, the information was inadequately integrated with the biophysical features of an ALS and the applications are limited due to the issues of cost and efficiency to carry out such detailed and comparable social surveys at a large spatial coverage. In this paper, we introduce a smartphone-based app, called eFarm: a crowdsourcing and human sensing tool to collect the geotagged ALS information at the land parcel level, based on the high resolution remotely-sensed images. We illustrate its main functionalities, including map visualization, data management, and data sensing. Results of the trial test suggest the system works well. We believe the tool is able to acquire the human–land integrated information which is broadly-covered and timely-updated, thus presenting great potential for improving sensing, mapping, and modeling of ALS studies.

Keywords: smartphone; human sensing; social sensing; crowdsourcing; agriculture; land use; citizen science

1. Introduction

Land constitutes the terrestrial component of the earth and stands at the center of the coupled human and natural systems [1], while agricultural land occupies about 38% of earth's terrestrial surface: the largest use of land on the planet [2]. Land systems reflect the state and result of human systems interacting with the natural system, while the agricultural land system (ALS)—with the functionality of providing vital resources to society, such as food, fuel, fibers and many other ecosystem services that support production—is one of the most important land systems for human society [3]. Understanding the spatial-temporal characteristics of agricultural area, its internal states such as crop allocation, farm management, and disturbance, as well as the human activities that are relevant to the changes of the state, have great implications on food security, sustainability, and social development [3–5].

The biophysical features of ALS have been effectively sensed by remote sensing techniques, which covers a wide range of observation from land cover (i.e., cropland distribution) to crop parameters (e.g., crop phenology, biomass, and yield), as well as the estimation of soil moisture and drought [6,7]. On one hand, there are a number of existing regional/global land cover datasets derived from remotely-sensed images, which are able to provide information on cropland distribution and its changes in both spatial and temporal dimensions [8,9]. In many cases, the preliminary remotely-sensed images received from satellites—which have not been processed to land cover data yet—have been used directly to observe the state and changes of cropland, giving particular attention to some hot-spot areas [10]. These observations help to understand land cover though land use and farm management,