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CITIZEN SCIENTISTS MONITORING THE ENVIROMENT: THE LATEST APPS FROM IIASA

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KEY POINTS

- *Earth Observation and Citizen Science Center (EOCitSci) at IIASA have built monitoring apps*
- *Promotion of sustainable agricultural intensification for farmers in Mexico*
- *Land cover change monitoring and validation of statistics across Europe*
- *Monitoring of threats and hotspots of change in key biodiversity areas in Spain*

1   INTRODUCTION

The Earth Observation and Citizen Science Center (EOCitSci), at the International Institute for Applied Systems Analysis (IIASA), has been producing mobile apps designed to engage citizens in documenting and sharing land use and land cover information for the purposes of food security and environmental monitoring. Three of these latest applications are: 1) Agrotutor, an application produced as a joint collaboration with the International Maize and Wheat Improvement Center (CIMMYT), to promote sustainable agricultural intensification for farmers in Mexico; 2) FotoQuest Go 2018, the latest iteration of the ongoing FotoQuest campaigns promoted by EOCitSci, which are designed to test the concept of land cover validation by citizens, more specifically, comparison with the 3-yearly Land Use/Cover Area frame Survey (LUCAS), produced by the statistical office of the European Union (EUROSTAT), and 3) Natura Alert, an application built in the framework of the Horizon2020-funded LandSense project in cooperation with Birdlife Spain, aiming to provide the birdlife community with tools to report current threats to important bird areas. The aim of this paper is to present an overview of these apps.

2   AGROTUTOR: SUSTAINABLE AGRICULTURAL INTENSIFICATÏON IN MEXICO

The Agrotutor mobile application was built within the frame of the project "Technological Portfolios and Modeling Techniques for Sustainable Intensification" in 2017 and is currently in a second phase of development. Its purpose is to facilitate the communication of proven agricultural best practices providing geo-located and timely information for parcels and crops registered by farmers across Mexico. The application allows farmers to register parcels and crops grown on them at different periods of time and simultaneously provides them with timely agronomical recommendations, potential yield and financial benchmarking information as well as historical and forecasted weather data. Farmers, in turn, can decide on whether they provide information on soils, management and yields, which can be used as inputs for the crop models creating a feedback loop allowing for continuously improved recommendations. A series of screenshots purporting the dynamics from the Agrotutor app is shown in Figure 1.

The application can use the mobile phone's GPS to geo-reference the registered parcel but the farmer can also identify it over very high resolution satellite imagery (from Google Maps). Farmers can also delineate

the parcels and introduce basic information such as crop type and the specific cultivar planted, including maturity type, ideal climate and planting date, but also record CIMMYT-promoted parcel technologies and all agronomical activities performed, such as fertilization, irrigation, pest management amongst others.

Figure 1. Current version of the Agrotutor mobile app including information provision and feedback loops.

The agricultural activities recorded by farmers in the app can include details such as costs, products used, doses, etc. Once the basic parcel information and geo-location have been registered, the application provides crop and location-specific information, transmitted in a simplified way but representing large data sets and calculations. This includes a) the outputs of IIASA's EPIC crop model (Jones et al. 1991, Williams 1995) which show potential performance (yield) for 5 different years for irrigated and non-irrigated areas, b) based on CIMMYT's extensive ground data, anonymous benchmarking information regarding costs, income, utility and performance (yield) and c) current, forecasted and historical weather information. When selected maturity and ideal climate for the cultivar were registered, the app uses growing degree days (from planting date onwards) to display a series of windows of opportunity in a calendar form, i.e. suggested optimal periods of time to execute agronomical activities on the selected parcels, e.g. fertilization. Additionally, farmers can access links taking them directly to tailor-made materials previously developed by CIMMYT, providing tutorials for best agronomical practices and can also create their own user profile. In the current second phase, additional benchmarking information including recommendations from the International Center for Tropical Agriculture (CIAT), Colombia, are being added as well as an additional market price forecast module (Cuaresma, Hlouskova and Obersteiner, 2018). The whole set of features is aimed to provide farmers with a full Decision Support System (DSS) for a sustainable and optimal use of cropland in Mexico, which in turn benefits the surrounding agro-ecosystems by avoiding over-exploitation of soils and excessive use of fertilizers and pesticides.

3   FOTOQUEST GO 2018: LAND COVER TREASURE HUNTING

FotoQuest Go is a citizen science initiative aimed at collecting observations of land use and land cover across Europe. FotoQuest GO aims to complement data gathered through the European Union Land Use/Cover Area frame Survey (LUCAS) and assesses the quality and reliability of citizen-generated land-use data. Participants are asked to go to specific locations and take photographs using the FotoQuest Go app (Fig 2), and identify the land cover, such as crops, grass, forest, roads, or buildings.
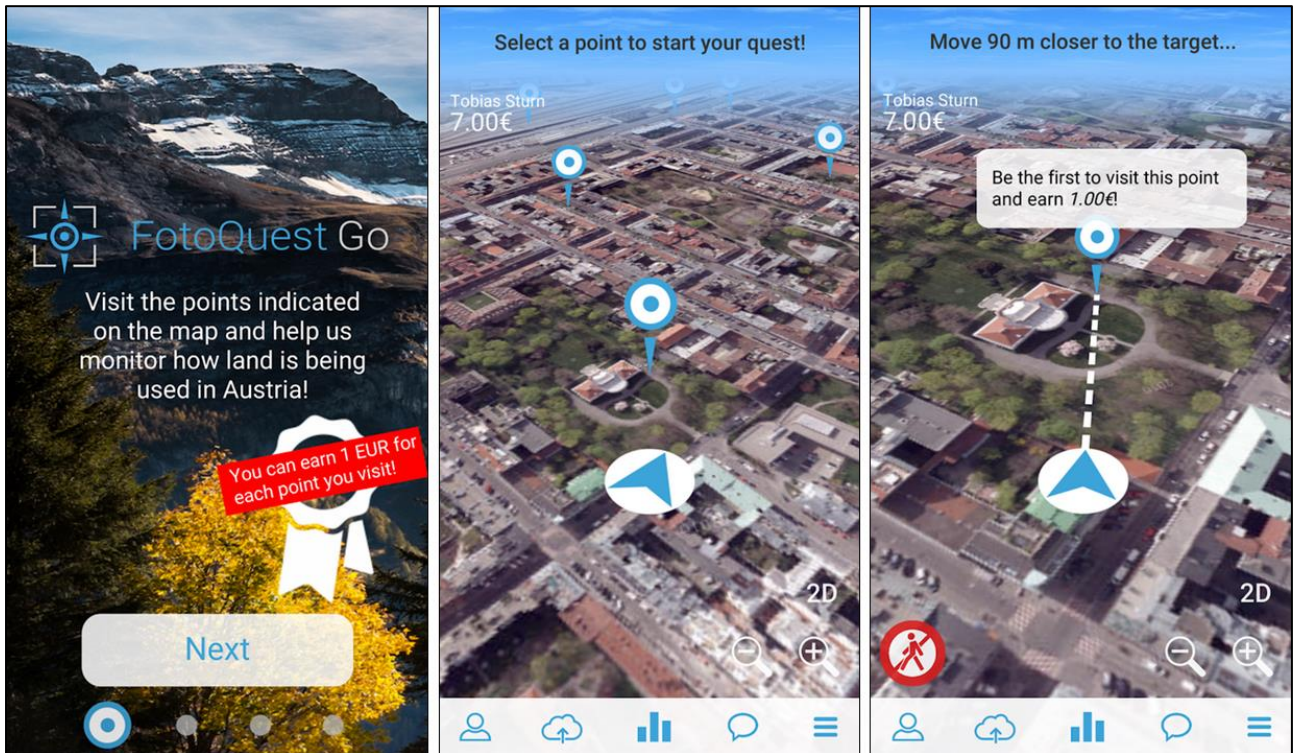

Figure 2. FotoQuest Go 2017 interface. A similar interface albeit Europe-wide will be implemented in 2018

The FotoQuest Go 2018 locations match official survey points used by LUCAS so that the data can be compared directly with LUCAS data in order to assess the quality of the contributions made by citizens. Building on previous campaigns and results (Laso Bayas et al 2016), features such as pictures to help crop identification and an improved decision tree for selecting the land cover selection have been implemented. To build confidence in the citizen-generated data, as well as to improve the data quality, near real-time feedback mechanisms have been implemented since the 2017 FotoQuest Go campaign and will be improved during this year's campaign. The current campaign also aims to validate land cover not only in Austria, but across Europe.

With regards to the app mechanics, feedback and rewards, once the participants download the app and start it, they are shown available locations in their surroundings where they could go to (Fig 2). Once they arrive, they are shown previous pictures from the LUCAS 2015 campaign and asked whether change has occurred. They are also asked to take photographs of the location and in four cardinal directions following the FotoQuest Go app indications (e.g. arrow pointing in direction requested is shown on screen). Once they upload the results from their quest, near real-time feedback is sent directly to the participants within 24 hours. The player would then earn 1 EUR if their submission passes the quality check, and the location they visited is removed from the map.

Initial results from the 2017 campaign and survey responses indicate an improvement in land cover selection through detailed and timely feedback to participants, which also enhances their motivation for further improving data quality.

4   NATURA ALERT: BIODIVERSITY HOTSPOTS OF CHANGE

All across the globe, common bird species, such as those living in agricultural fields, are declining. The overuse of fertilizers and intensive farming practices are making their habitats and food disappear. Spain has one of the largest Natura 2000 networks in Europe, where these sites are designated as key areas for breeding and resting of rare and endangered species, but many of these areas are still threatened. The Natura Alert app (shown in Figure 3) and the BirdLife network of committed volunteers will be reporting threats to biodiversity and changes in specific habitats (arid lands, wetlands, grasslands, etc.) to help improve BirdLife's network of Important Bird and Biodiversity Areas and other key environmentally sensitive regions. Natura Alert empowers citizens with a tool to inform local authorities about the threats and changes. The Natura Alert app was created by the LandSense team, a Citizen Observatory aiming to aggregate innovative EO technologies, mobile devices, community-based environmental monitoring, data collection, interpretation and information delivery systems to empower communities to monitor and report on their environment. The app was developed based on a series of consultations with SEO/Birdlife and its monitoring programme coordinators and volunteers, and is currently being beta-tested with SEO/Birdlife volunteers and IBA caretakers. An additional change detection module will soon be added to the app, which will highlight hotspots of potential landscape change (as detected by EO data) to trigger volunteers and caretakers to validate these hotspots with in-situ observations. Extension of the Natura Alert app for use by the Hellenic Ornithological Society (HOS) and Dutch Society for the Protection of Birds (VBN) is now being considered.
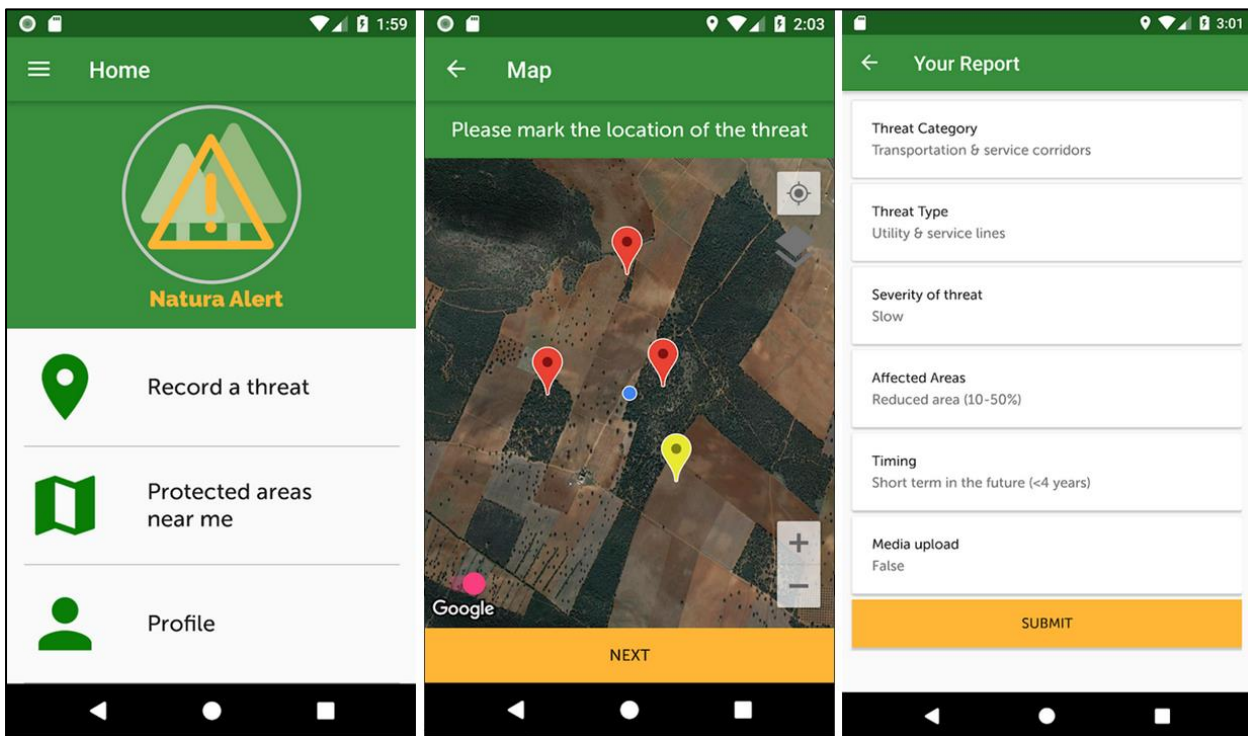

Figure 3. Natura Alert app interface

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