Agriculture under Conflict – Satellite Earth Observation to measure Impact on Food Security

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To respond timely to emerging famine, reliable and consistent information related to agricultural production is needed but difficult to obtain in areas under conflict. Earth Observation has proven to be very useful; not only to determine changes in agricultural production over time and to identify areas where food security has become critical, but also to plan post-conflict agricultural investments and relief aid.

The FAO recently launched the Water Productivity through Open access of Remotely sensed derived data (WaPOR) portal. WaPOR allows to monitor status, changes and trends in agricultural production, (irrigated) water consumption, and water productivity in areas under conflict from 2009 onwards.

Results from Syria and Yemen show that the response of agriculture on conflict varies greatly between and within countries. WaPOR data provided insights in the impact of conflict on irrigated agriculture, i.e. a shift to rainfed agriculture and an increase in agricultural activities in relatively safe areas.

Introduction

Food insecurity is often closely related to conflict. Conflict is the main reason behind the reversal of famine, for example in South Sudan, Somalia, Yemen and north-eastern Nigeria. International organisations are partnering up to act early and prevent future famines. In order to respond timely to emerging famine, reliable and consistent information related to agricultural production is needed. However, this data is often difficult to obtain in areas under conflict as the normal data collection is disrupted and official agricultural statistics are no longer available or reliable.

Satellite Earth Observation provides a powerful and cost-effective technique to obtain information on agricultural production. Satellite derived information allows to determine changes in agricultural production over time and identify areas where food security has become critical, which is useful to identify the magnitude of food insecurity, but also to plan post-conflict agricultural investment and relief aid. The objective of this paper is to assess changes in agricultural production in countries under conflict.

The FAO recently launched the remote sensing for water productivity programme. Its objective is to provide stakeholders at different scales – from the policy level to the farm level – to develop workable solutions to sustainably increase agricultural production and water productivity. One of its outputs it the Water Productivity through Open access of Remotely sensed derived data (WaPOR) portal, which allows monitoring of agricultural water productivity in near real time. WaPOR 1.0 was published in June 2018.

Materials & method

This study uses the continental level (level I) data which is available for Northern and sub-Sharan Africa and the Near East from 2009 until present. WaPOR level I data has relatively large pixels of 250m that do not allow interpretation of patterns or analysis of individual fields, but do show the general agricultural trends in irrigation schemes. The Above Ground Biomass Production is used as

proxy indicator of agricultural production and Actual Evapotranspiration is used as an indicator of water consumption. Net Biomass Water Productivity indicates water use efficiency. Precipitation provides context to annual variations. The methodology includes:

- change mapping: relative change prior to and during conflict;
- trend analysis from 2009 to 2017;
- statistical analysis using averages per administrative area and irrigation scheme; and
- relationships between parameters, e.g. biomass production, water consumption and rainfall.

This analysis focused on irrigated agriculture in Syria and Yemen. It assesses the status, changes and trends in agricultural production, (irrigated) water consumption, and water productivity before and during conflict. Water productivity as measure of the water use efficiency is expressed as a function of biomass production and actual evapotranspiration.

Results

On average, water consumption and biomass production in irrigated land in Yemen did not change considerably since 2009. But when looking at individual irrigation schemes, considerable variation in performance was observed which could not be attributed to rainfall. Figure 1 shows the biomass production (y-axis) and actual evapotranspiration (water consumption, x-axis) for irrigated land near the cities Sana'a and Marib. In Sana'a most water is pumped from ground water aquifers, which requires scarce and expensive fuel. Since 2014 the WaPOR data show water productivity increased as the biomass production was maintained at the existing level while the water consumption decreased. In Ma'rib irrigation scheme the irrigation water is obtained from a dam. It is a relatively secure area in Yemen where the irrigated land expanded considerably since 2013, resulting in proportionally increased biomass production and water consumption and hence no changes in water productivity.

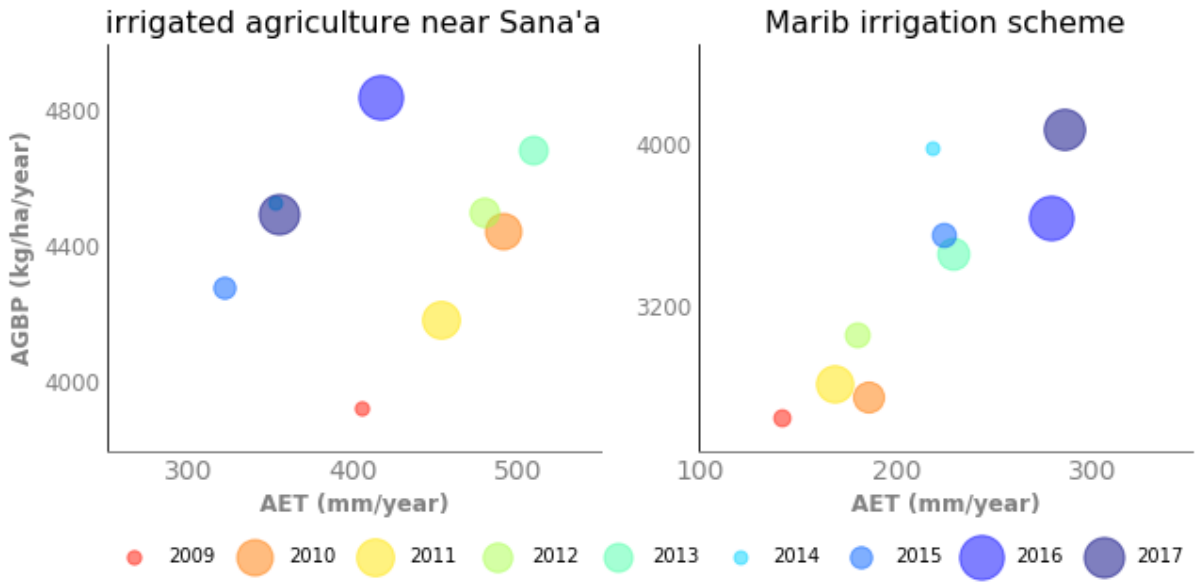

Figure 1 Above Ground Biomass Production (AGBP, kg/ha/year) as a function of Actual Evapotranspiration (AET, mm/year) for irrigated agriculture in Sana'a and Marib, Yemen. The size of the bubble refers to the Precipitation (PCP, mm/year).

Generally, agricultural production in irrigated areas in Syria was reduced in terms of extent and productivity, especially in summer when no rainfall is available. However, the analysis also showed

that the production in spring increased, especially in the Al Hassakah region, suggesting a stronger focus on rainfed agriculture as coping mechanism of the rural population.

The conflict in Syria started in 2011. The analysis focused on irrigated land around Al Raqqah and Al Eis. In Al Raqqah agricultural production varied greatly from year to year. Agricultural production in the irrigated land serviced by Bir Al Hashim pumping station was reduced in 2013, with other areas following in 2016 and 2017. In Al Eis agricultural production was reduced by half and water consumption was significantly lower in 2014, 2016 and 2017. In both irrigation schemes the biomass production in 2015 was at pre-conflict levels which we could not explain.

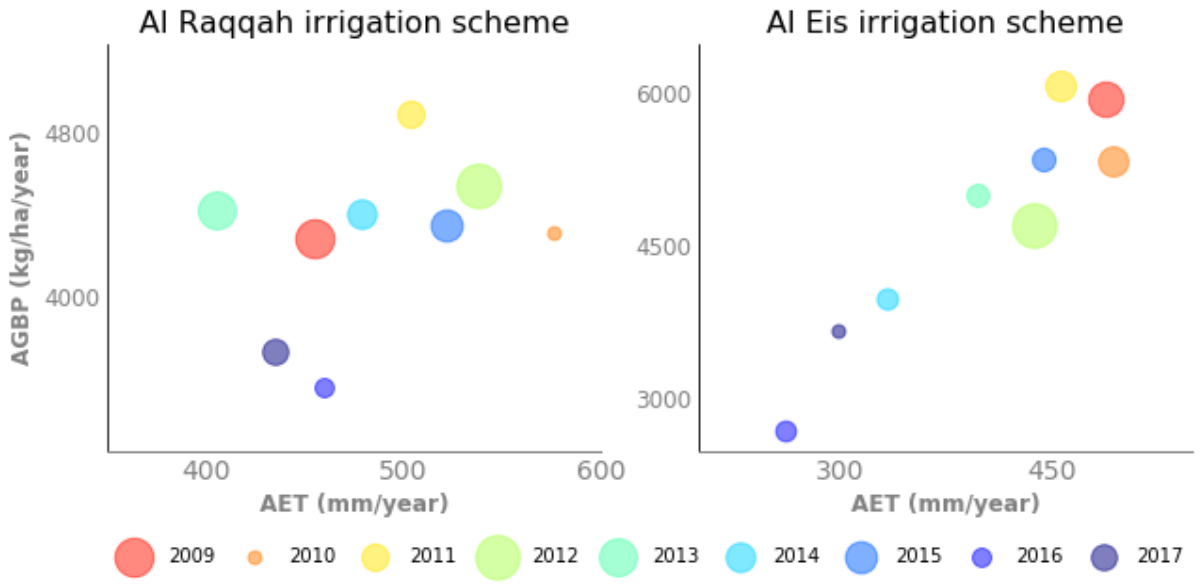

Figure 2 Above Ground Biomass Production (AGBP, kg/ha/year) as a function of Actual Evapotranspiration (AET, mm/year) for irrigated agriculture in Al Raqqah and Al Eis, Syria. The size of the bubble refers to the Precipitation (PCP, mm/year).

Conclusion

Unfortunately limited information is available from the ground to interpret and explain the observed trends. For example, satellite observations of reduced production and lower water consumption in an irrigation scheme do not tell whether these changes are the result of damage to the irrigation infrastructure, safety issues preventing access to the fields, lack of labour, or no access to market.

Nevertheless, the analysis based on satellite derived data did show that the response of agriculture on conflict varies greatly between, but also within countries. The open access WaPOR data provides an unprecedented opportunity for change and trend analysis, also in countries under conflict. With its historical and near real time operational data it increases the understanding of changes in agricultural production over time and space. It shows that Earth Observation technology provide frequent and consistent information on agricultural production which can be integrated in food security and famine models assisting decisions makers to move towards famine prevention, preparedness and early action.