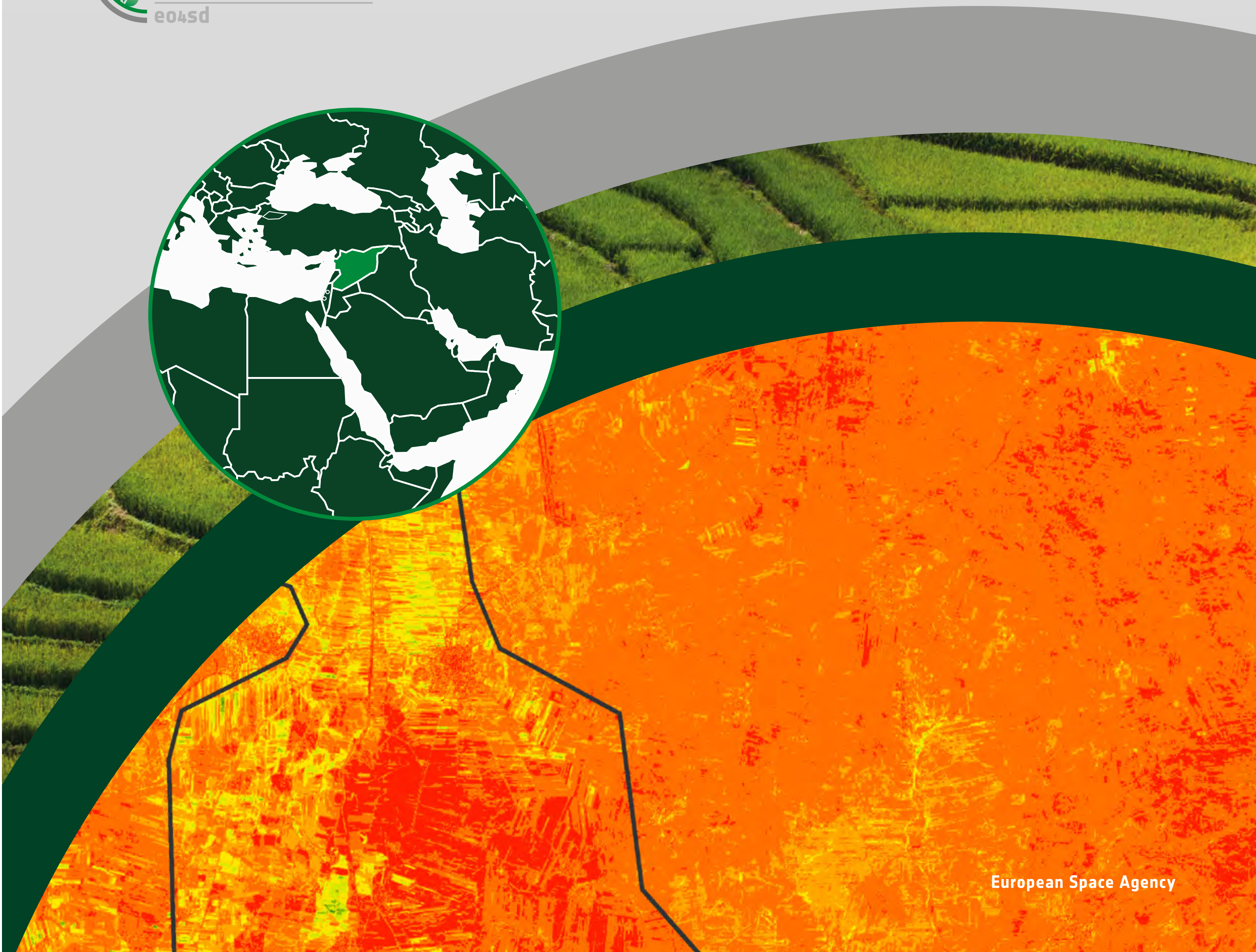
LARGE-SCALE EXPLOITATION OF SATELLITE DATA IN SUPPORT OF INTERNATIONAL DEVELOPMENT

→ EO4SD – EARTH OBSERVATION FOR SUSTAINABLE DEVELOPMENT

Agriculture and Rural Development Cluster - Syria

Satellite-derived information to assess the consequences of armed conflict on the agriculture sector

agriculture and rural development eo4sd



European Space Agency

Cover image illustrates vegetation status as observed in the Syrian Al Eis agricultural area based on sixty Sentinel 2 observations acquired between 2016 and 2017. Red and orange colours indicate no (or low) vegetation. Before war this area had active agriculture production however due to persisting conflict the farming activities seized almost entirely.

Credit: GeoVille for ESA/World Bank, 2017

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ACKNOWLEDGEMENTS

This study has been carried out in the framework of the collaboration between the European Space Agency (ESA) and the World Bank Group to support the assessment of the economic and social consequences of the Syrian armed conflict as of early 2017, particularly focusing on the agriculture sector damage. Its elements constitute a contribution to the World Bank Report "**The Toll of War: The Economic and Social Consequences of the Conflict in Syria**" issued on July 10, 2017.

The analysis was developed under the scope of the Agricultural and Rural Development Cluster project - a part of ESA's Earth Observation for Sustainable Development initiative (EO4SD) which aims at demonstrating the benefits of geospatial information products and services to support agricultural monitoring and management tasks. The objective of the project is to demonstrate to the development partners how technical assistance interventions and financial investments in agriculture sector can be measurably enhanced by using EO-derived information. For more information on the EO4SD initiative see http://eo4sd.esa.int/agriculture.

The EO4SD - Agriculture and Rural Development Cluster is implemented by a consortium of specialist service providers in the European Earth Observation sector which brings together EO technical proficiency and a wide experience in developing geospatial operation services in the agriculture and rural domain: eLEAF (The Netherlands) (lead), DHI GRAS (Denmark), GeoVille (Austria), Satelligence (The Netherlands), University of Twente - ITC (The Netherlands), Lahmeyer International (Germany), Nelen & Schuurmans (The Netherlands) and SpaceTec Partners (Belgium).

The assessment in Syria was carried out by Annemarie Klaasse, Remco Dost (eLEAF) and Eva Haas, Michael Riffler, Christina Ludwig, Fabian Nagl (GeoVille) and Anna Burzykowska (ESA). Graphic layout of the report was provided by ESA Earth Observation Graphic Bureau (EOGB).

eleaf FEED THE WORLD

eLEAF provides satellite based applications and data to optimise crop production and water management. The Netherlands-based company is a pioneer in operational satellite based solutions, and with its continuously developing algorithms, it has delivered data for more than 50 countries. Clients range from public authorities that need a solution for complex resource management issues to commercial clients that require reliable operational monitoring products for the optimisation of their production processes. eLEAF's data and applications support clients worldwide to use water sustainably, increase food production and protect environmental systems.

GeoVille

GeoVille Information Systems GmbH (GeoVille) operates internationally, providing consultancy services and solutions related to Earth Observation, geo-information and geographic information systems. The Austria-based company works with global clients such as international institutions, MDBs, national and regional authorities as well as the private sector, so far in 370 projects and 120 countries. Applications target amongst others water, agriculture, forestry, environment and natural resources, urban and rural development as well as infrastructure. GeoVille's mission is to offer end-to-end EO-solutions with a particular emphasis on providing dedicated geo-information products tailored to customer needs.

1. INTRODUCTION

Despite an urgent need to understand the consequences of the armed conflicts on civilian populations, agricultural statistics in conflict-affected countries are often not available, or of questionable accuracy, especially when security conditions disrupt the normal data collection and needs assessment process. However timely and reliable information on agricultural production helps to better plan preventive interventions by building resilience prior to the conflict, target humanitarian aid during the conflict, and focus rehabilitation actions after the conflict ends.

Food insecurity can be both a cause and consequence of social and political disruptions impacting millions of people[1]. Therefore quantifying agricultural losses is critical in order to estimate the ability of affected populations to subsist and recover. This is important because, in many cases, indirect deaths through disease and malnutrition, or those precipitated by lack of access to markets and affordable food, exceed deaths sustained directly from military interventions or security operations[2].

Satellite Earth Observation (EO) is a powerful and cost-effective technique to assess agricultural production in difficult accessible areas on a wide range of spatial and temporal scales. It provides historical and operational data and can rapidly identify changes in a consistent and repeatable manner.

The Sentinels, a new fleet of European satellites supporting the European EO Copernicus programme, are delivering a wide range of data and imagery applicable for the monitoring of agricultural production and food security. In combination with already existing satellite sensors such as Landsat and MODIS, the Sentinels offer up-to-date, objective and unbiased information at detailed and regional scale, also when ground information is not available. In particular, Sentinel-1, -2, and -3 are supplying Earth Observation data for agriculture and food security monitoring. These data are characterised by a high revisit time, large geographical coverage, rapid data dissemination and coherent and reliable sensing. While Sentinel-1 provides high-resolution, all-weather, day-and-night radar imaging mission, Sentinel-2 is a multispectral high-resolution imaging mission. Both started a new area for space based detailed, large scale agricultural monitoring. This is supported by Sentinel-3, a medium-scale multi-instrument mission that has high potential for the early detection of deterioration of vegetation conditions.

The potential of satellite EO in assessing agricultural production (losses) in areas under conflict is demonstrated in this report for four areas in Syria as part of an Environmental Social Impact Assessment (ESIA) conducted by a World Bank team in early 2017. The ESIA intended to generate an updated, integrated, and multi-sector analysis in order to inform future policy decisions and reconstruction efforts and shape future development response. Because the country has remained inaccessible to the World Bank team, and severe data shortages were encountered, the study relied heavily on satellite EO based analysis cross checked where possible with social media postings from the territory or other available information for the assessment of physical damage.

The EO analysis of damage in the agricultural sector delivered under the support of the European Space Agency illustrated changes in cultivated area and agricultural production using pre-conflict EO data from 2011 and non-conflict data from Turkey as a baseline. The results revealed distinct spatial and temporal patterns of agricultural production change that undermined the sector's existing productivity and recovery capacity.

[1] International Food Policy Research Institute, Conflict and Food Security Brief available at http://www.ifpri.org/topic/conflict-and-food-security.

[2] Geneva Declaration Secretariat, 2008. Global burden of armed violence. Chapter Two. The many victims of war: indirect conflict deaths. (www.genevadeclaration.org/fileadmin/docs/Global-Burden-of-Armed-Violence-full-report.pdf).

2. OBJECTIVES

Food security is a function of food production and access to (affordable) food. Conflict situations have an impact on both, as well as on the viability of food distribution networks (infrastructure), local markets, and collection of agricultural information for planning purposes. The goal of this project was to demonstrate that satellite EO – capable of regular and consistent mapping of large areas – can deliver timely information on agricultural production changes at both field and regional scale in order to identify most impacted areas, agriculture input supply chains disruptions and future development assistance needs.

This report focuses on the impact of conflict on agricultural production in terms of cultivated area and agricultural productivity. Its objective was to assess and monitor status, trends, and sector's adaptive/coping strategies in the selected areas in Syria. The mapping results revealed how security-related situations dominated agricultural production change in the vicinity of frontlines (e.g. abandonment of rural areas), impacting household incomes and food security. Generated data has also provided an overview of the sector performance at the national scale between 2011 and 2016, identified the areas where priority investments may take place in order to stimulate recovery efforts, and established a baseline for monitoring and evaluation of future investments.

The analysis has been provided with the support of the field data available and openly published by World Bank, UN Food and Agriculture Organization and World Food Program. The authors remain responsible for the content of this report and any errors or omission that could remain.

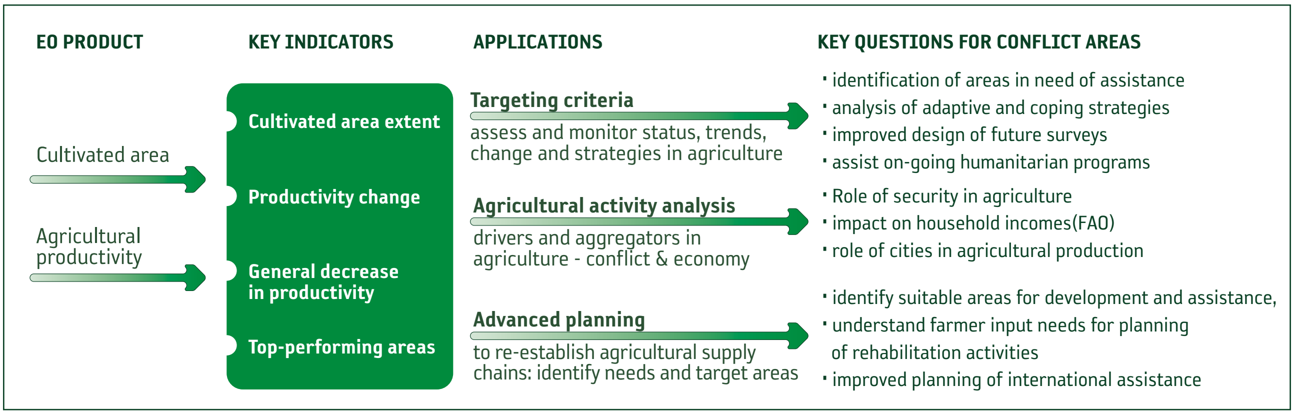
3. METHODOLOGY

The rapid development of communication and information technologies (ICT) has transformed the global information flow. The most significant improvement provided by satellite EO is related to the access to more detailed information, which can be verified objectively, as well as near-real time information retrieval time, better data quality (as well as growing quantity) which allow decisions to be made faster and more effectively.

The main function of Earth Observation is signalling and detection of changes in time in an non-intrusive manner. In crisis management and conflict monitoring high resolution imagery (typically commercial or classified data) is considered crucial for detailed coverage of the areas of interest (ranging from near real time to couple of days), however the ability to cover large areas with medium to low resolution imagery (often openly available) with a regular revisit time allows to identify and consistently follow several important crisis indicators.

This general surveillance enables detection of potentially troubled areas giving away the hints for more detailed observation. This is particularly relevant to agriculture monitoring which is driven by seasonality and longer-term vegetation change and require both current and historical data input provided in a consistent and repeatable manner in order to reveal where change has happened. Therefore targeting criteria (strategic information requirements) are critical to be set forth upfront and in connection to observation scenario that is suitable for the observed phenomena (in this case development of spatial crop distribution and productivity indicators). Depending on the character of the crisis situation these targeting criteria are including agricultural area extent, productivity, performance, infrastructure, change analysis. Key questions here are, for example, what information is needed for analysis to identify the areas in need of urgent assistance or those that require more longer-term adaptive and coping strategies (e.g. transition from irrigated to rainfed agriculture, rehabilitation of irrigation, or change in crop types). This information is then used to define immediate (short-term) as well as strategic (medium- and long-term) interventions. Wide area coverage and general surveillance is also important to help to improve the design of future data collection efforts and ground surveys as well as in the context of monitoring and verification.

Agricultural production capacity is characterised by three variables: land utilisation (extent of cultivated areas), cropping intensity (number of crop cycles in a year) and crop yields (productivity). All three variables can be derived from openly available EO data on the national and field-level scales. Typically, the temporal and spatial changes analysis pertains to **(1) cultivated area assessment** (acreage and crop types) and **(2) agricultural productivity**. Large-scale (e.g. coarser resolution but country-wide information) is used to identify priority areas sustaining most change which are then further investigated at field scale to understand the drivers and impacts on local community and households.



Information products derived from the cultivated area and agricultural production maps at both national and local scale can be classified as:

- Cultivated area extent
- Start of season and seasonal development
- Productivity change
- General increase/decrease in productivity
- Top (under) performing (e.g. top 10% villages or regions)
- Change in water consumption and water stress

Cultivated area maps are based on the analysis of time series of optical satellite imagery that provide information related to the chlorophyll content of plants, such as Sentinel-2 and Landsat at local scale, and MODIS and Sentinel-3 at the regional scale. Imagery is used to derive phenological information, e.g., Start-of-Season (SoS), maximum value (MV), cyclic fraction (as integral between SoS and MV), number of peaks, etc., in order to extract the various growing cycles for different crop types. A comparison of the vegetation density for key moments during the growing cycle allows a comparison between fields prior to and during the conflict and thus makes the identification of abandoned agricultural fields possible.

The vegetation index is a qualitative indicator of changes in agricultural productivity. The Normalised Difference Vegetation Index (NDVI) is related to plant greenness, making use of a relatively high absorption in the visible light and low absorption in the near infrared light by plants. Values range from -1 (water) to 0 (no vegetation) up to 1 (very green vegetation). The NDVI used is derived from atmospherically corrected Landsat 5 Thematic Mapper (TM) and the Landsat 8 Operational Land Imager (OLI).

Mapping of biomass production is a quantitative indicator of agricultural productivity in kilograms per hectare. The dry matter biomass production is calculated based on the fraction of Absorbed Photosynthetically Active Radiation (fAPAR), soil moisture stress and weather conditions and related stress. It refers to the growth of total living plant material above and below the ground (such as stems, leaves, roots, fruits and grains). It is closely related to net primary production (NPP) and can

be linked to crop yield. In this analysis conducted for the territory of Syria the regional scale annual Above Ground Biomass Production from the FAO WAPOR database is used, but biomass production can also be estimated at field scale using Landsat and Sentinel-2 satellite imagery at 10-30m.

In general, the EO-based agricultural monitoring (status, change, trends) can be combined with available non-EO data: maps of the conflict evolution and socio-economic data from the agricultural and household surveys such as the ones provided by the Food and Agriculture Organisation of the United Nations (FAO). The EO and non-EO data sources integration has been an important part of this study.

This report illustrates this methodology applied to agriculture sector impact analysis focusing on three major agricultural production areas in Syria which include several irrigation schemes:

- Agricultural land around Tel Hamees in Al Hassakeh governate, the “bread basket” of Syria, in the Kurdish area,
- Al Eis irrigation scheme southwest of Aleppo in the Aleppo governate, located in the frontline between the zones of influence of the various fighting forces during the conflict; and
- The irrigation scheme near Ar Raqqah, the areas controlled (at the time of the study) by the Islamic State (also called ISIS or ISIL).

The performance of these irrigation schemes were evaluated under the time of conflict and then compared to the performance of similar schemes in neighboring Turkish areas in order to establish a baseline of the production status under business-as-usual scenario (supposed performance if un-affected by the conflict) as exemplified in Figure 1.

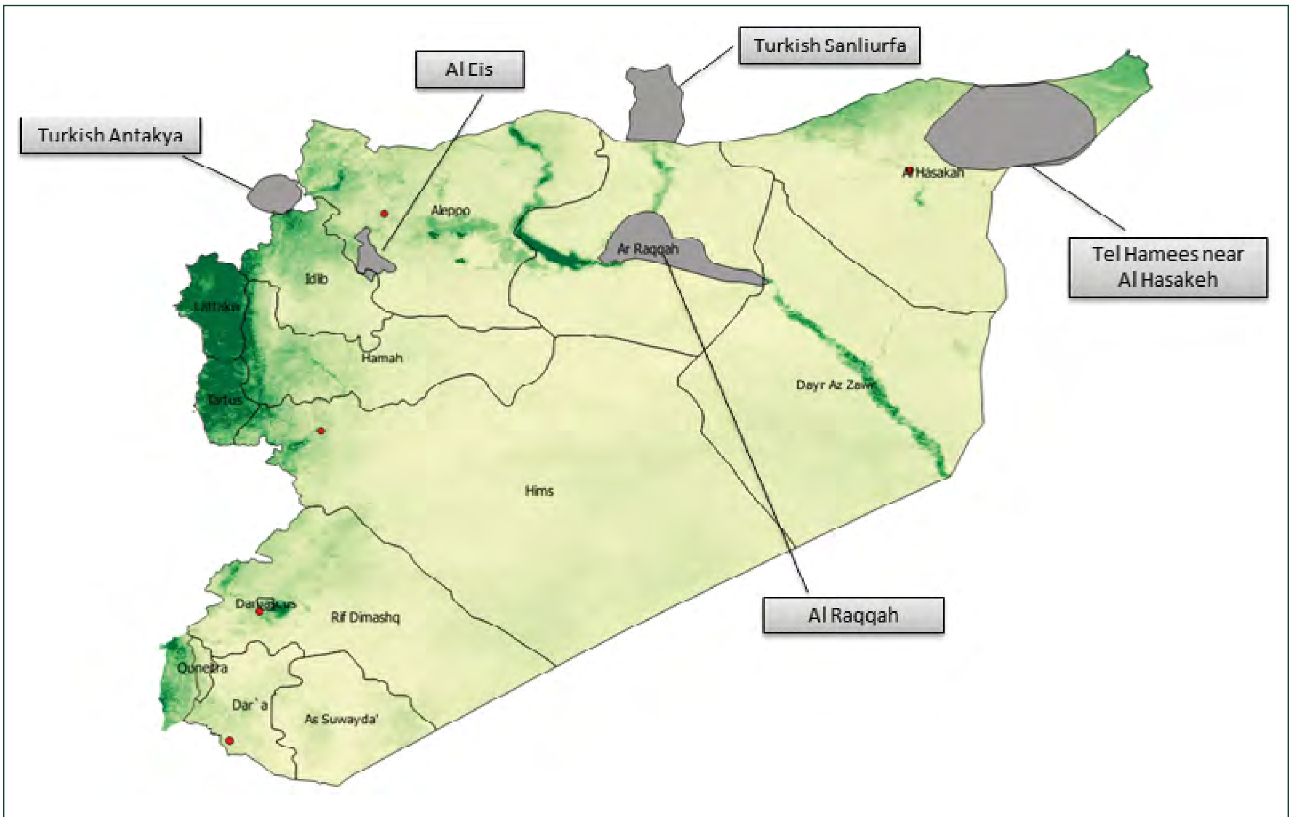


Figure 1 Study areas included in the EO4SD demonstration.

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

4. RESULTS AND FINDINGS

The analysis of EO data sources provided an assessment of the agriculture productivity for the entire territory of Syria (and selected areas of Turkey) for years 2011 (pre-conflict) and 2016 at a national scale (250x250m resolution) as well as changes in agricultural extent and productivity at field-scale in selected areas (10x10m to 30x30m resolution).

The results which are presented in the form of maps and statistics at different administrative levels offer clear and objective monitoring of status, trends, change and adaptive/coping mechanisms adopted by the farmers. Key findings are provided below:

- Both productivity per hectare and the total amount of cultivated land have decreased in size and degraded in capacity since the conflict begun,
- Cultivated areas in Al Eis were reduced by 64%, from 34,327 hectare pre-conflict to 12,308 hectare in 2016. In 2016 only 4% (1,780 hectare) of Al Eis was used for irrigated summer crops,
- Productivity in Al Eis decreased both in winter (-36%) and summer (-47%). Average productivity in Ar Raqqah decreased by ~20% in 2016 as compared to 2011. In Al Hassakeh productivity decreased during the dry summer but increased in the spring, suggesting a stronger focus on rainfed crops.

Table 1 Average productivity for key dates in Al Eis, Tal Shihab, Al Hassakeh and Ar Raqqah

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

Area	2011 date	2016 date	Average productivity			
			2011	2016	change (%)	Change
Al Eis	21-Feb	19-Feb	0.47	0.30	-36	Strong decrease
	1-Sep	29-Aug	0.30	0.16	-47	Strong decrease
Tal Shihab	15-Jul	12-Jul	0.30	0.26	-10	Small decrease
	16-Aug	13-Aug	0.30	0.25	-17	Small decrease
Al Hassakeh	4-Mar	1-Mar	0.25	0.41	60	Strong increase
	27-Aug	24-Aug	0.13	0.11	-15	Small decrease
Ar Raqqah	27-Mar	24-Mar	0.29	0.23	-21	Decrease
	18-Aug	15-Aug	0.28	0.23	-18	Decrease
	19-Sep	16-Sep	0.29	0.23	-21	Decrease

- In Al Eis, the villages of Tal Mamu, Tleilat and Tal Dadine are in the top 10 of most affected villages in terms of abandoned land, productivity and loss of moisture (related to irrigation capacity). Other affected villages were Dalama, Western Atshana, Zyare Semaan, Maryuda and Makhala (see Table 2 and Table 3 for the results of Al Eis, and appendix)

Table 2 Al Eis: Top ten villages regarding the absolute area of abandoned agricultural land (fallow) and top ten villages with most cultivated areas in their surrounding in 2016.

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017) with input data from the FAO

Abandoned agricultural land (fallow)				Cultivated land in 2016			
Postal code	village name		area (ha)	Postal Code	village name		Area (ha)
C1090	Eastern Atshana	عطشانة شرقية	1968	C1167	Zeitan	زيتان	1512
C1180	Tal Dadine	تل دادين	1206	C1015	Khan Tuman	خان طومان	1273
C1151	Zyare Semaan	زيارة سمعان	1136	C1171	Tal Allush	تل علوش	1076
C1093	Western Atshana	عطشانة غربية	1136	C1152	Hmeira	حميرة	955
C1182	Hadher	الحاضر	1108	C1018	Qarras	قراص	848
C1178	Dalama	دالمة	979	C1168	Jazraya	جزارايا	780
C1173	Tal Mamu	تل ممو	948	C1154	Berna	برنة	769
C1177	Tleilat	تليلات	888	C1071	Tal Aqareb	تل عقارب	668
C3900	Hmeimat Eldayer	حميمات الداير	794	C1153	Barqum	برقوم	606
C1067	Big Oweinat	عوينات كبيرة	775	C1182	Hadher	الحاضر	598

Table 3 Al Eis: top 10 of lowest and highest productivity change of winter crop (February) and summer crop (August/September) from 2011 to 2016.

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017) with input data from the FAO

underperformance					good performance				
Postal code	village name		Change in productivity		Postal code	village name		Change in productivity	
			Winter crop	Summer crop				Winter crop	Summer crop
C1173	تل ممو	Tal Mamu	-0.35	-0.32	C1079	صعيبية	Saeebiyeh	-0.09	-0.01
C1183	مريودة	Maryuda	-0.32	-0.40	C1179	جميمة	Jamimeh	-0.05	-0.01
C1151	زيارة سمعان	Zyare Semaan	-0.37	-0.18	C1050	تل ماسح	Tal Masih	0.00	-0.02
C1177	تليلات	Tleilat	-0.27	-0.36	C1072	بطحة	Batha	-0.05	0.00
C1184	مكحلة	Makhala	-0.30	-0.30	C1113	مشرفة ارجل	Mashrafet Arjol	-0.05	-0.01
C1093	عطشانة غربية	W. Atshana	-0.33	-0.13	C1057	ارجل	Arjel	-0.03	0.00
C1178	دالمة	Dalama	-0.27	-0.15	C3891	أبو الظهور	Abul Thohur	0.31	-0.02
C1156	زمار	Zmar	-0.32	-0.08	C3899	تل سلمو	Tal Silmo	0.03	-0.01
C1172	حوير العيس	Hawir Elis	-0.24	-0.18	C6328	غريريفة	Gharirifeh	0.00	-0.01
C1180	تل دادين	Tal Dadine	-0.22	-0.25	C1118	مريقص	Mreiqes	-0.01	0.01

4.1 National scale information from 2010 to 2016

Low resolution satellite imagery is capable of providing information concerning the change in productivity from year to year (it is possible to provide weekly data as well) on the national scale while conflict develops. An example in Figure 2 shows the change in Above Ground Biomass Production in Syria from 2010 to 2016 as compared to base year 2009, derived from an annual dataset at 250m spatial resolution available in the FAO Water Productivity Open-access portal WaPOR. Although not offering details at the field level, this kind of country wide information is very useful to assess change over time and to identify priority areas where most of the transformation takes place.

In Al Eis, the villages of Tal Mamu, Tleilat and Tal Dadine are in the top 10 of most affected villages in terms of abandoned land, productivity and loss of moisture (related to irrigation capacity). Other affected villages were Dalama, Western Atshana, Zyare Semaan, Maryuda and Makhala (see Table 2 and Table 3 for the results of Al Eis, and appendix 8.2)

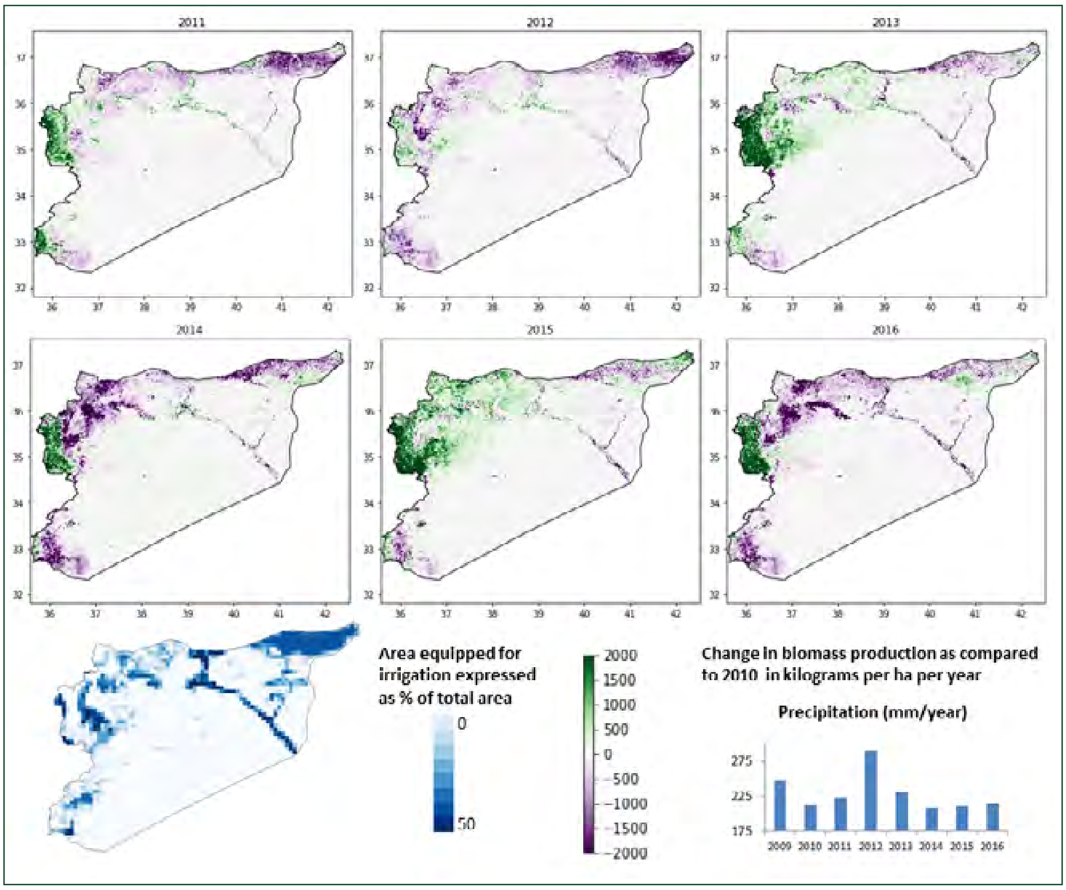


Figure 2 Absolute change in biomass production from 2011 to 2016 as compared to 2010 (in kg/ha/year) (Input data: annual Above Ground Biomass Production from the FAO WAPOR database and Global Map of Irrigated Areas – version 5.0).

Credit: Global Map of Irrigated Areas – version 5.0.

The analysis done for the territory of Syria shows that the biomass production in the country has decreased considerably since 2013, especially in 2014 and 2016. Figures 2 and 3 illustrate the average annual biomass production over time at 250m resolution: the biomass production in Al Hasakeh has remained at the 2010 level from 2013-2016, but biomass production in Al Eis declined dramatically in 2016 from 5 tons to less than 2 tons per hectare per year. Al Raqqah and Tal Shihab both experienced a decline from 1-1.5 tons per hectare per year when comparing 2016 to 2011.

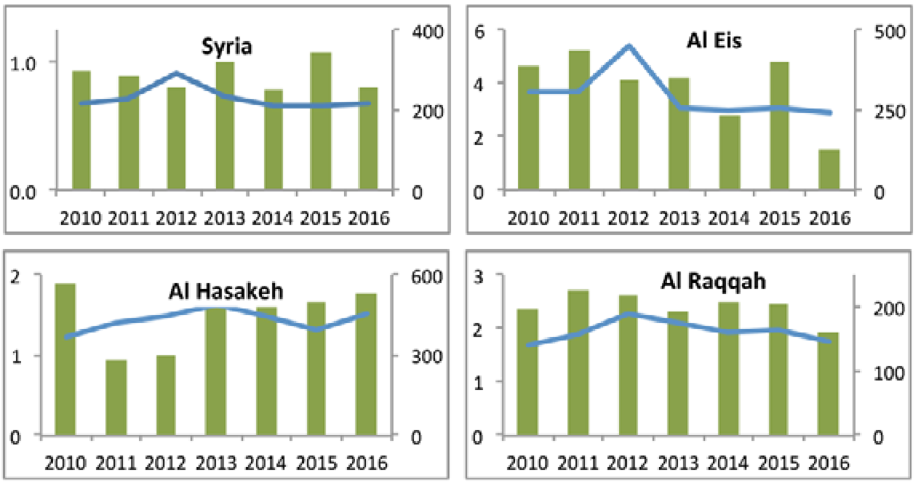


Figure 3 Average biomass production [tons dry matter/ha/year) and average precipitation [mm/year] in Syria (country wide and four agricultural areas) from 2010 – 2016 (Input data: annual Above Ground Biomass Production from the FAO WAPOR database).

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017).

According to UN statistics agricultural areas in the governates of Hassakeh, Aleppo and Raqqa were accounting for 28 %, 21 % and 12 % respectively of the effectively cultivated land in the country[4]. Irrigation there has been conducted mostly by traditional surface irrigation (by gravity) and pumping from wells. Before the war the government had started irrigation modernisation however the conflict has led to widespread damage to irrigation systems. This conflict-driven disruptions and labor shortages have played important roles in the loss of agricultural output. According to the World Bank and the FAO Food Security Study[5] the damage to pumping stations (both for surface and groundwater irrigation), irrigation structures, and equipment, and the poor availability of electricity and fuel, many farmers have abandoned irrigation and turned to predominantly rainfed crops such as barley, coriander, and other herbs. The EO-based analysis confirmed and quantified these findings for Al Eis, Al Hassakeh and Al Raqqah territories.

Al Eis territory

Al Eis is a surface irrigation system southwest of Aleppo in the Queiq (Aleppo) River basin. When not used for irrigation, the Queiq River discharges in the Matah depression (Sabkhat al Matekh) south of the study area. Figure 4 shows the change in annual biomass production in Al Eis from 2011 to 2016 as compared to 2010. **Biomass production in Al Eis decreased drastically since 2012, especially in 2014 and 2016.**

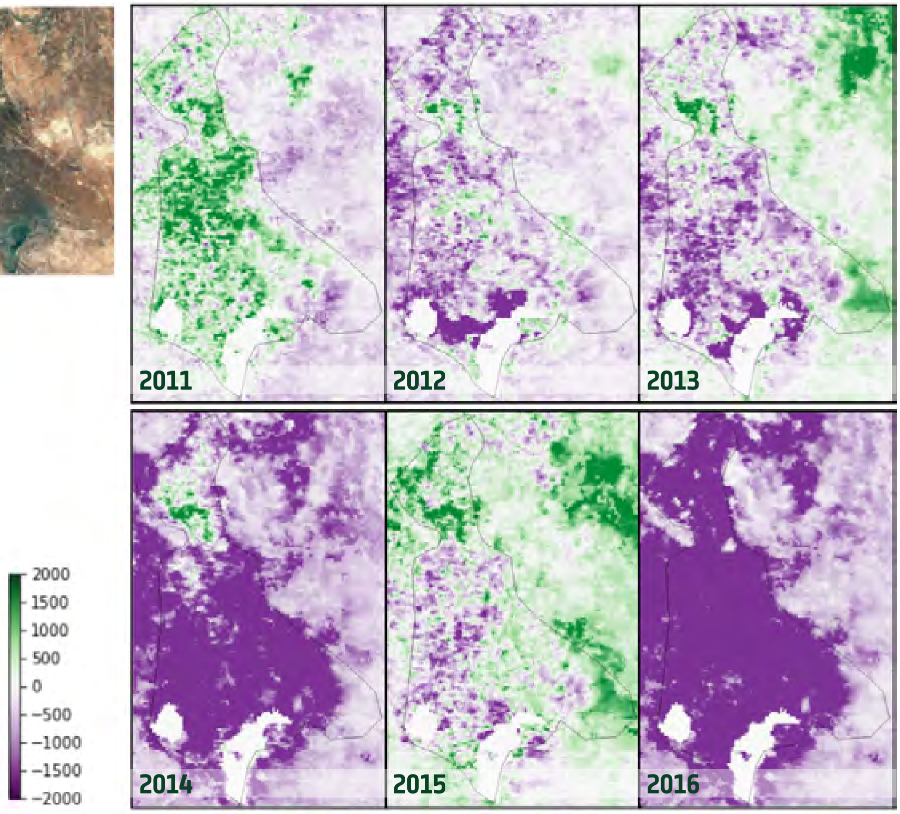


Figure 4 **Absolute change in biomass production from 2011 to 2016 as compared to 2010 (in kg/ha/year) (input data: 250m annual Above Ground Biomass Production from the FAO WAPOR database) extracted for Al Eis.**

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

[4] FAO Water Report 34, 2009 (http://www.fao.org/nr/water/aquastat/countries_regions/SYR/)

[5] World Bank Report "The Toll of War: The Economic and Social Consequences of the Conflict in Syria" issued on July 10, 2017.

Al Hassakeh territory

The study area in Al Hassakeh governate is located northwest of Al Hassakeh town (Habur plains, around the Jaghijagh and Jarrah Rivers tributing to the Khabur River). Agriculture there is both rainfed and irrigated. Irrigation is mostly from wells (groundwater) and can be supplemental (wheat) or full scale (summer crops such as maize and cotton). Figure 5 shows the biomass production from year 2011 to year 2016 at regional scale (250m) as compared to 2010. Overall biomass production decreased in 2011 and 2011. Since 2013 biomass production shows considerable variation over the area. Biomass production in irrigated fields around Tel Brak has decreased by 2 tons per hectare, but the areas in the southeast - which likely turned to rainfed - show increased productivity.

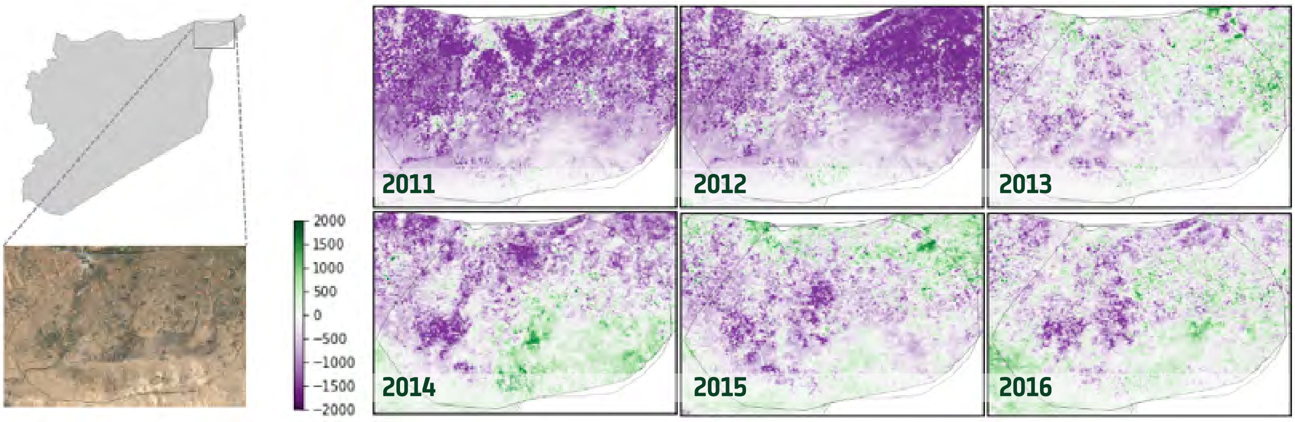


Figure 5 Absolute change in biomass production from 2011 to 2016 as compared to 2010 (in kg/ha/year) (input data: 250m annual Above Ground Biomass Production from the FAO WAPOR database) for Al Hassakeh

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

Al Raqqah territory

In Al Raqqah the irrigation system near the town of Al Raqqah where the Balikh River joins the Euphrates River. It is located 40 km downstream of Tabqa dam that created Lake Assad. Irrigation water is supplied by gravity from the Lake. Figure 6 shows the spatial patterns of biomass production changes near Al Raqqah. **It illustrated that in 2013 and 2014 only part of the irrigation scheme – especially the area serviced by Bir el Hashim pump station - was affected by the conflict, but that in 2016 the whole irrigation scheme produced around 1 – 2 tons per ha less per year.**

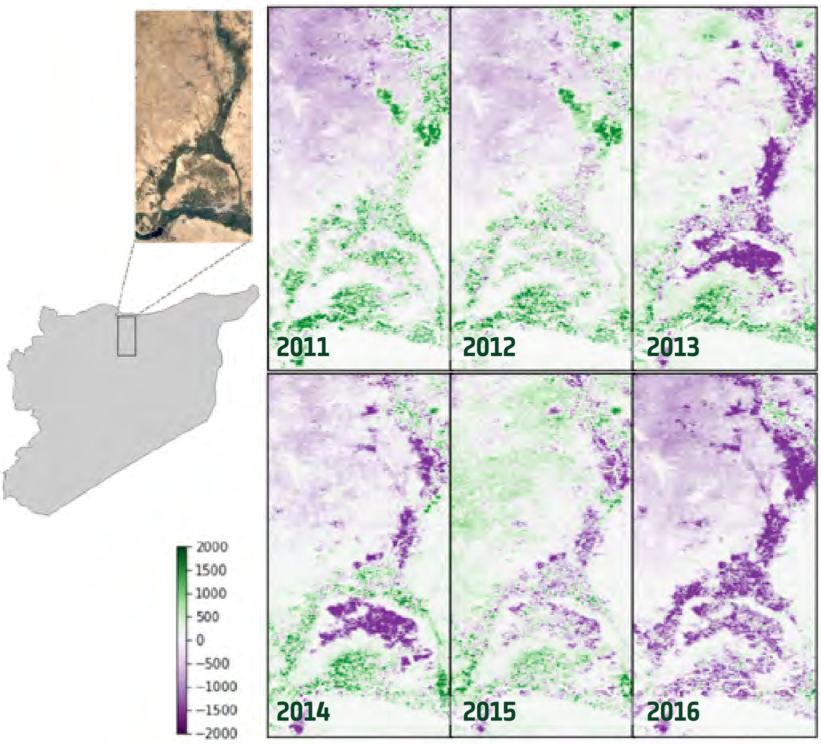


Figure 6 Absolute change in biomass production from 2011 to 2016 as compared to 2010 (in kg/ha/year) (input data: 250m annual Above Ground Biomass Production from the FAO WAPOR database) extracted for Al Raqqah.

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

4.2. Field-scale information on agricultural extent

The Figures 2-6 represent overall biomass production in the entire region. **However, field scale data are necessary to identify changes in agricultural extent.** Biomass production at regional scale may include natural vegetation, and weeds growing in abandoned fields or around irrigation leaks. The following examples show how field scale satellite Earth Observation data can filter and customise this information to reveal changes in the specific agricultural areas extent and productivity at 10-30m resolution.

Analysis of field-scale Landsat and Sentinel-2 satellite imagery at 10-30m resolution verified that the extent of cultivated areas has significantly decreased in the Al Eis irrigation scheme (45,672 ha) between 2011 and 2016. **While pre-conflict 34,327 ha in Al Eis irrigation scheme were under cultivation, less than half of the area was still in use in 2016 (12,308 ha).**

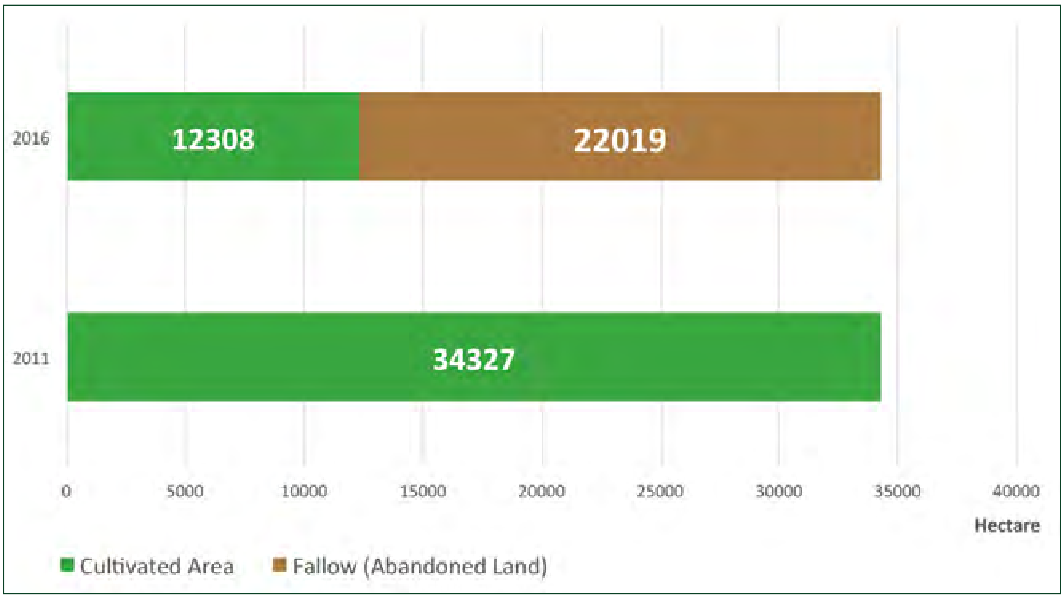


Figure 7 Distribution of cultivated and fallow (abandoned) land in 2011 and 2016.
Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

A detailed classification of the cultivated area in Al Eis (Figure 8 and Figure 9) shows that half of the Al Eis area has been fallow or abandoned in 2016 compared to the cultivated area extent in 2011. The detailed classification of the cultivated area in Al Eis demonstrated that in 2016 the remaining active cultivations are mainly winter crops (11.5%), followed by spring crops (10.9%). Summer crops, that typically need irrigation, are only found in 3.9 % of the Al Eis area. Two cropping cycles are rarely found in 2016.

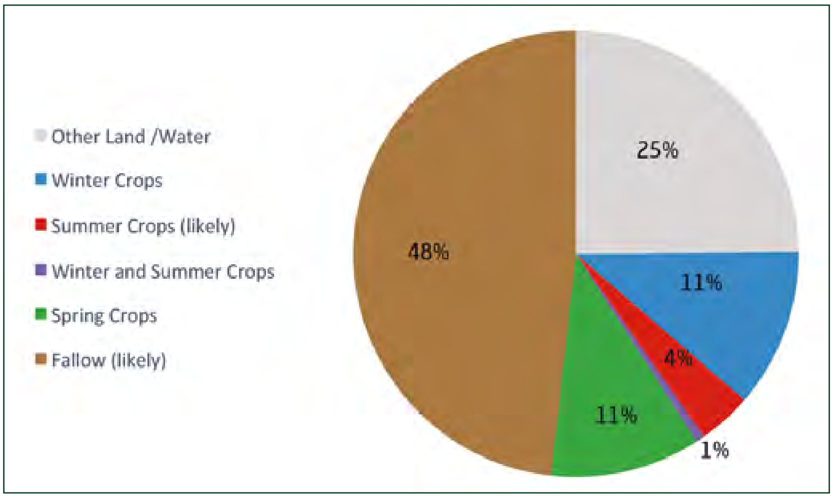


Figure 8 Detailed classification of the cultivated area in Al Eis in 2016.
Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

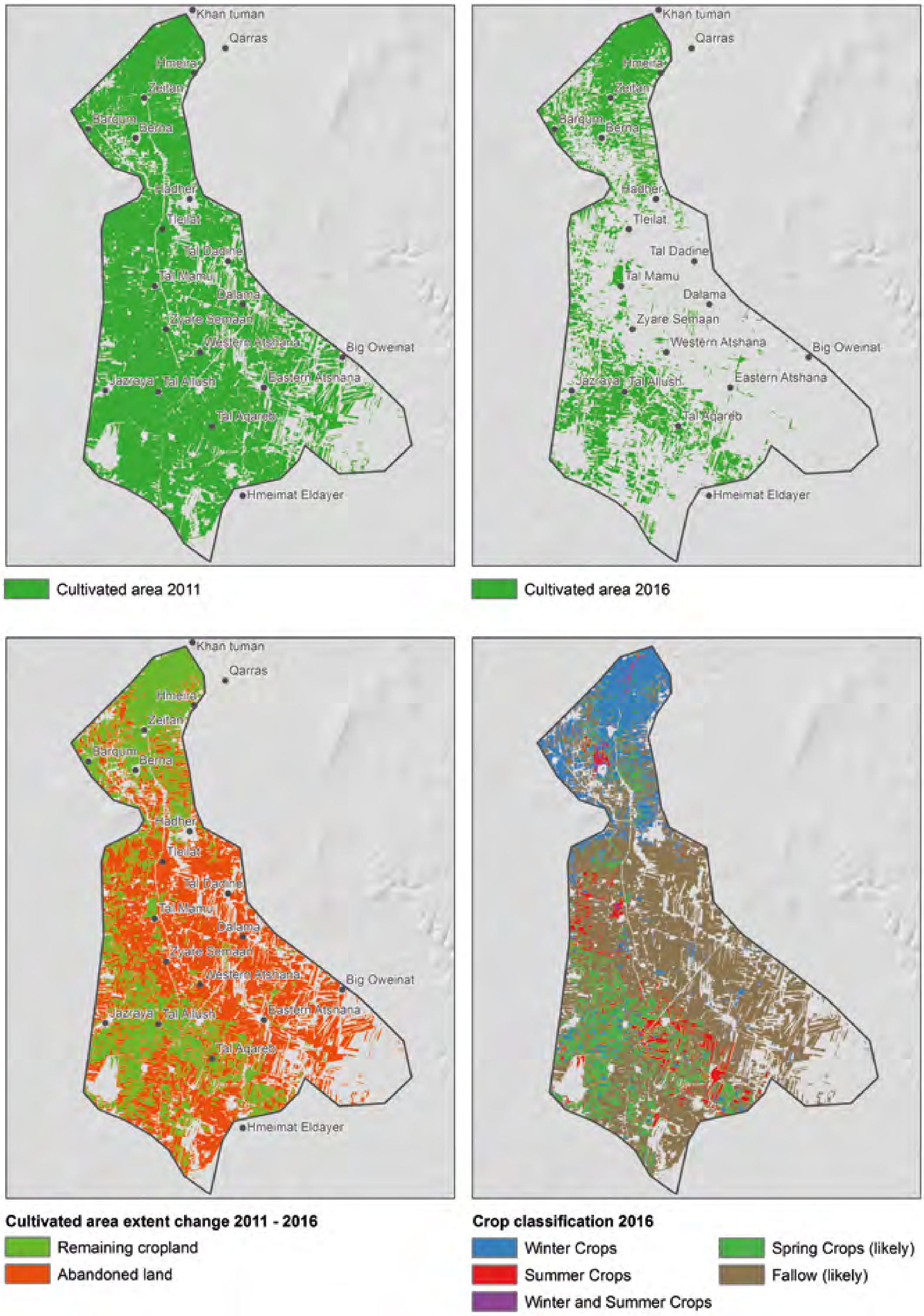


Figure 9 Cultivated area extent in 2011 and 2016. The time comparison shows that the cultivated area extent has decreased by more than half over the conflict. In 2016 mostly winter crops were cultivated in the northern part, while summer and spring crops are found mostly in the southern part, where also more water resources are available. The eastern part is not anymore under cultivation, which is most likely related to the fact that this area was part of the conflict zone and a war frontier.

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

4.3. Field-scale information on agricultural productivity

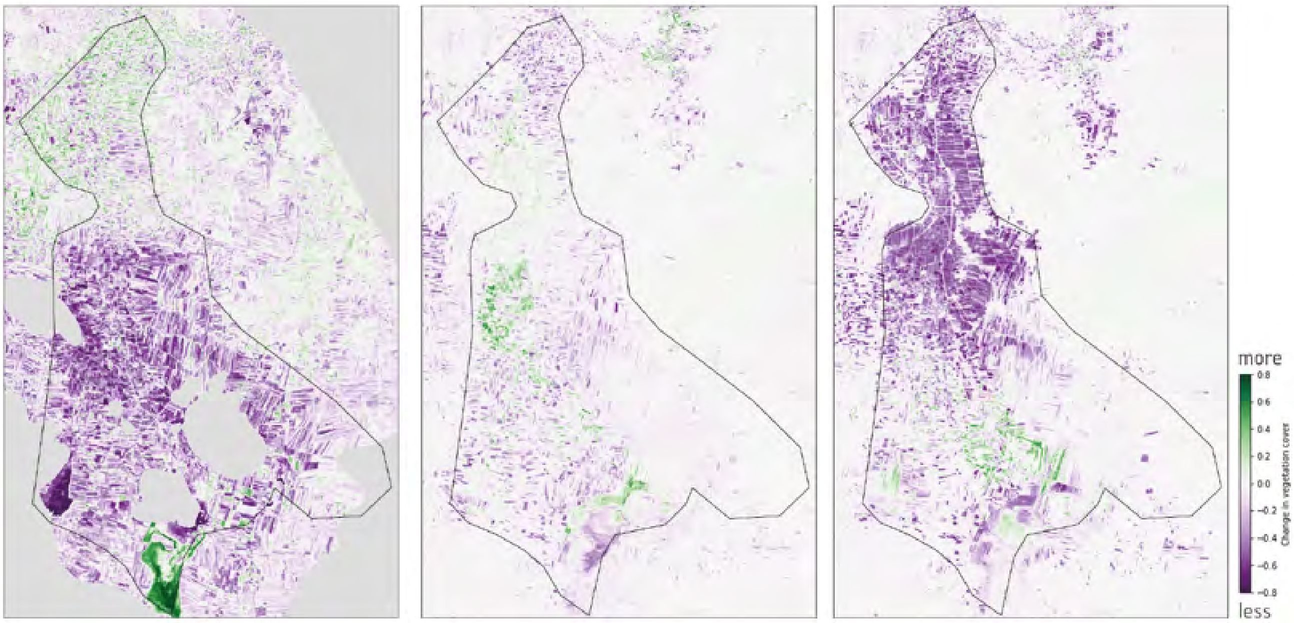
The change in agricultural productivity at field scale is estimated using the vegetation index measured at the same month in 2011 (pre-conflict) and 2016 (conflict). The decrease in average productivity is the result of at least three factors:

(1) reduction in cultivated land area,

(2) lower productivity of the cultivated land (biomass), and

(3) decrease in cultivated land use intensity (e.g. one cropping season instead of two cropping seasons).

Figure 10 shows the change in productivity in Al Eis between 2011 (pre-conflict) and 2016. Productivity of winter crops decreased in the centre and southern part of Al Eis but increased in the north. Productivity of summer crops decreased in all areas except for small areas in the centre (July) and south (August/September).



21/2/2011 - 19/2/2016 | 15/7/2011 - 12/7/2016 | 1/9/2011 - 29/8/2016

Figure 10 Al Eis: change in productivity (vegetation cover) for February (left), July (center) and August (right) from pre-conflict in 2011 to conflict in 2016.

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

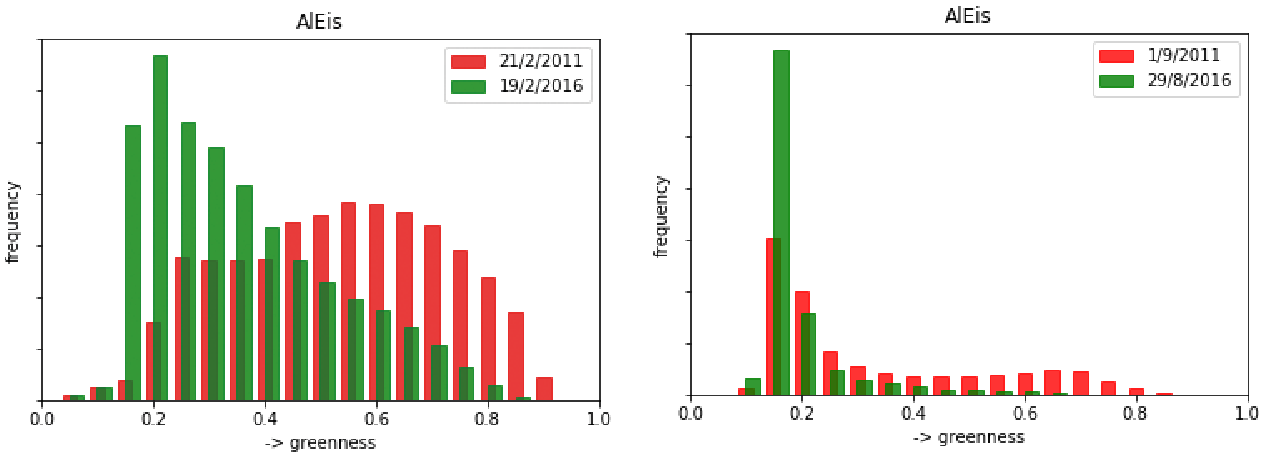
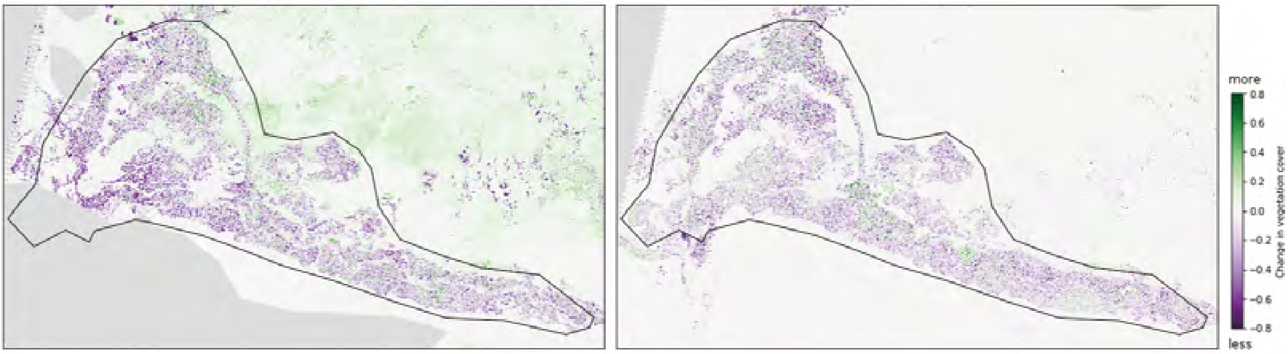


Figure 11 Al Eis: frequency distribution of productivity during winter (left) and summer (right) in 2011 (red) and 2016 (green).

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

In Al Raqqah productivity changes are relatively homogeneously distributed over the area. The findings suggest that most of the change in productivity is due to a reduction in productivity in fields, e.g. caused by a shift from irrigation to rainfed cultivation, and not because of abandoned land.



27/3/2011 - 24/3/2016 18/8/2011 - 15/8/2016

Figure 11 Al Raqqah: change in productivity (vegetation cover) in spring (March, top image) and summer (August, bottom image) from pre-conflict in 2011 to conflict in 2016. Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

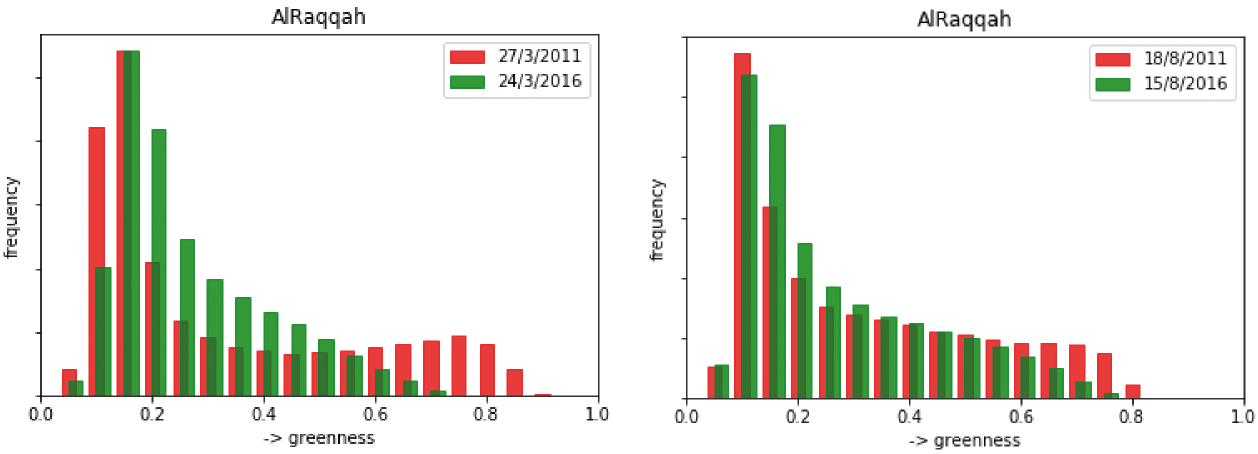


Figure 12 Al Raqqah: frequency distribution of productivity during winter (left) and summer (right) in 2011 (red) and 2016 (green). Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

Most of the agriculture in the area in Al Hassakeh governate was already rainfed and because of it had a lower dependency on irrigation and fertilizers and resilience to adverse input conditions. Figure 14 shows that production decreases are located in specific areas, most probably areas that relied on irrigation pre-conflict. As a result, observed productivity as a function of a vegetation index increased considerably in the spring.

4/3/2011 - 1/3/2016 27/7/2011 - 23/7/2016

Figure 13 Al Hassakeh: change in productivity (vegetation cover) in spring (March, left image) and summer (July, right image) from pre-conflict in 2011 to conflict in 2016.

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

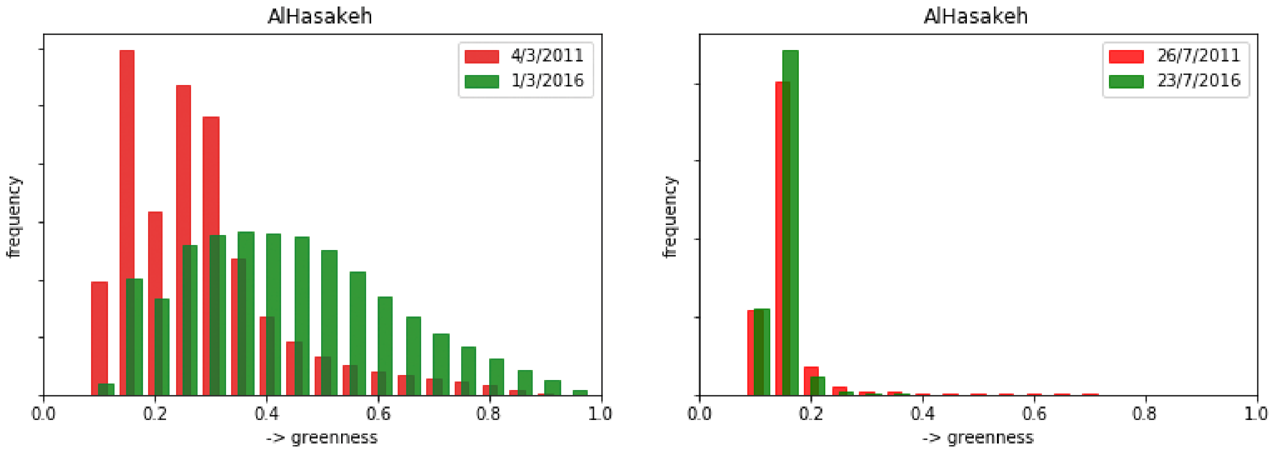


Figure 14 Al Hassakeh: frequency distribution of productivity during winter (left) and summer (right) in 2011 (red) and 2016 (green).
Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

4.4. Field-scale information on relative agricultural productivity

One of the research questions posed to this analysis concerned relative agriculture productivity assessment: Syrian agricultural sector performance prior to conflict and Syrian agricultural sector performance relative to neighboring (conflict un-affected) regions (Turkey).

This analysis is particularly significant given the fact that Syria had been a net producer of wheat in the prior 20 years (excluding drought years) but production of this crop has dropped approximately 55 percent to the pre-conflict average (2007–11) according to the World Bank, FAO and WFP Assessment in 2016[6]. Indeed, a decrease in agricultural productivity in the Al Eis area is apparent when compared to an irrigated area not affected by conflict such as the neighboring Turkish Antakya region. As can be seen in Figure 16 the vegetation activity is not present or in general significantly lower in the Syrian irrigated area compared to an intact Turkish irrigation scheme in 2016. Only in the south western part the agricultural sector potential is still average compared to the Turkish area, indicating that parts of the systems resilience has been maintained.

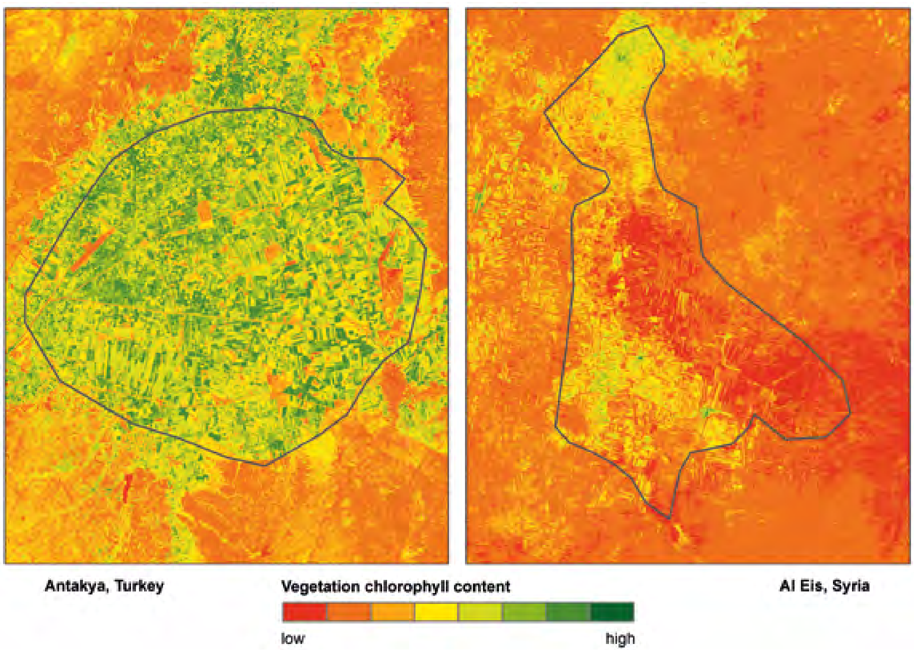


Figure 16 Vegetation activity in an intact irrigation scheme in Turkish Antakya (left) compared to the Syrian Al Eis area. (right) derived from 60 Sentinel-2 observations. The maps show the maximum value of chlorophyll vegetation reaches within a year. While most of the areas in Al Eis show no or low vegetation productivity and thus maximum values (red to yellow), most areas in the Turkish area are productive with high maximum values (green). The higher the maximum value during a vegetation cycle the 'fitter' is the observed vegetation.
Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

[6] World Bank Report "The Toll of War: The Economic and Social Consequences of the Conflict in Syria" issued on July 10, 2017, and FAO/WFP Special Report "Crop And Food Security Assessment Mission To The Syrian Arab Republic", 14 November 2016.

Another clear indication of the decrease in relative agricultural productivity and a shift from irrigated to rainfed agriculture is the analysis of the start-of-season. This indicates the moment in time when the first vegetative activity can be observed. While the start-of-season in the Turkish irrigation scheme is clearly decoupled from the surrounding natural vegetation, the Syrian Al Eis region shows this association only in south western part. In the majority of the Al Eis region the start of season is comparable to the surrounding natural vegetation, which is a clear signal that the production is mainly rainfed and no longer irrigated. This is supported by the observation of the changed in wetness frequency during the dry season, which is concentrated in the same regions of Al Eis (Figure 17).

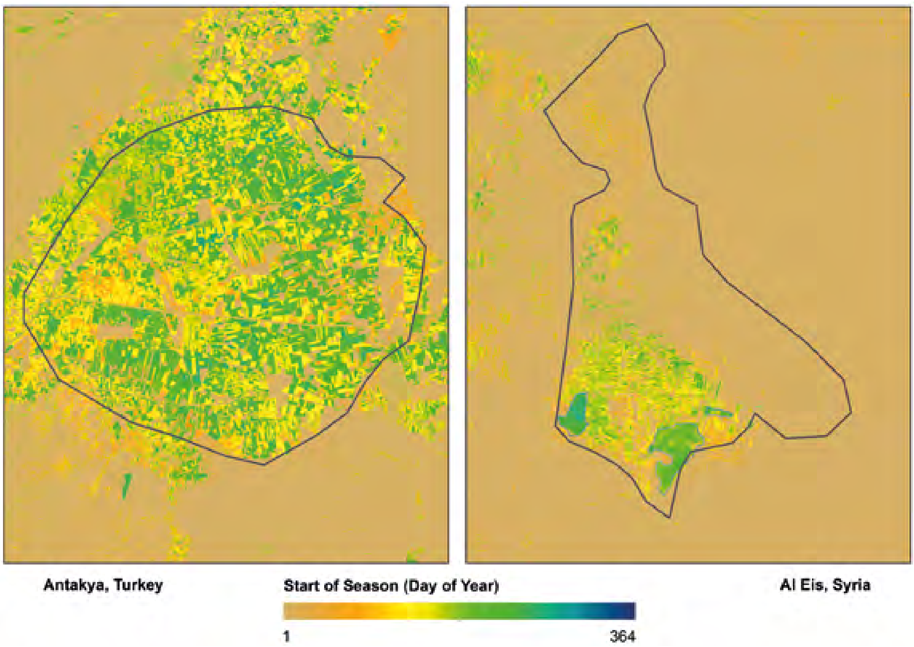


Figure 17 The start of season derived from Sentinel-2 satellite data observations between November 2015 and 2016 in the Turkish Antakya (left) and Syrian Al Eis region (right). The day of year (DOY) is related to the first observation and indicates when the first vegetative activity was observed. While the Turkish area shows a clear difference to the surrounding natural rainfed vegetation, the start of season in the Syrian area is only decoupled from the rainfed natural vegetation in the south western part. As lakes in the south of Al Eis could be potentially used for agriculture water support only their outline was drawn for the moment and field validation would be needed to confirm this observation.

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

Overall, the analysis showed that the average productivity in the Syrian irrigated areas was significantly reduced compared to Turkish irrigated sites (Table 4, Table 5). Both productivity and cultivated area extent remain the same in similar regions in Turkey while in Syria agricultural patterns have changed drastically. The figures show productivity in Syria in comparison to areas in Turkey and Jordan. Figure 18 shows that productivity in Turkey was similar in 2011 and 2016, while in Al Eis the productivity maps of 2011 and 2016 show a completely different picture with most of the pre-conflict vegetated land abandoned in 2016.

Table 4 Average productivity change in Al Eis and Turkey

	Al Eis	Turkish Antakya
February	-36	-22
August/September	-47	-8

Table 5 Average productivity change in Al Raqqah, Al Hassakeh and Turkey

	Al Raqqah	Al Hassakah	Turkish GAP
June	-6		17
July	-10	-15	8
August	-18	-15	-6

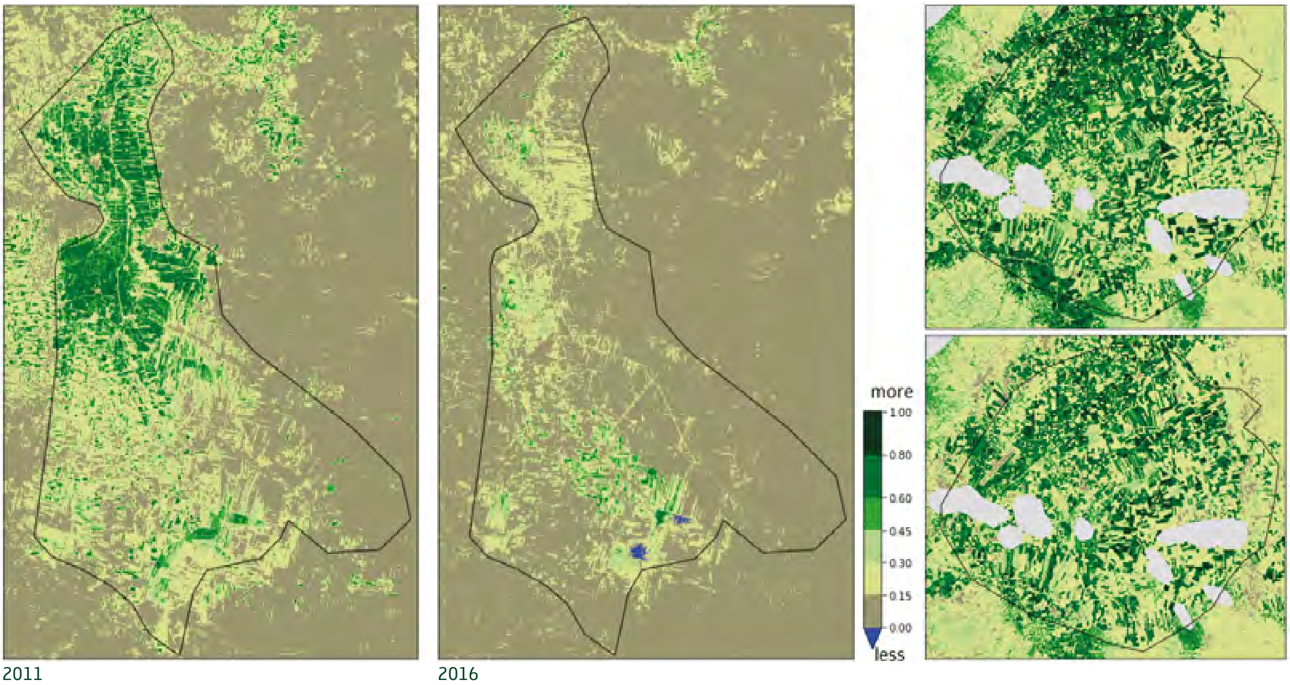


Figure 18 Al Eis: productivity in conflict year 2016 (center image) compared to the pre-conflict baseline situation in 2011 (left) and to non-conflict baseline in Turkish Ankalya in 2011 (top right) and 2016 (bottom right).

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

4.5. Sector resilience and revival potential

Previous figures demonstrated that irrigated agriculture in Al Eis irrigation system has disappeared since the conflict. However, the satellite imagery suggests some rainfed agriculture is still taking place. Figure 19 shows agricultural productivity in Al Eis in February 2016 and 2017. Patterns are very distinct, with in 2016 the highest productivity in the north, and in 2017 highest productivity in the southwest. Figure 20 shows productivity in spring and summer in Al Hassakeh in 2011, 2015 and 2016. Productivity increased in spring, which usually is a sign of increased rainfed production. Green fields in summer are irrigated, and have disappeared in 2015 and 2016.

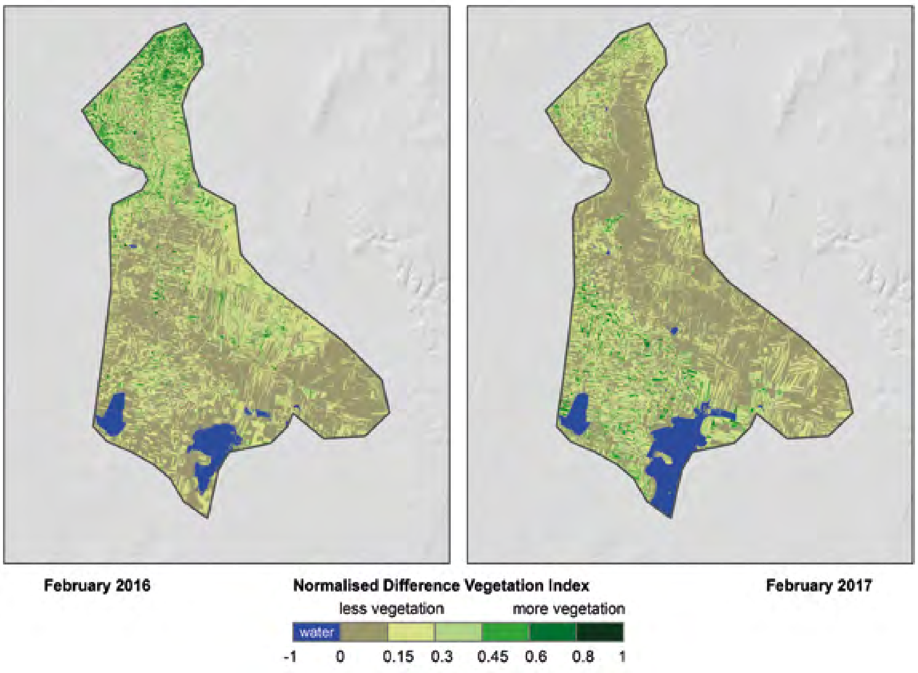


Figure 19 Recent observations (February 2017) compared to the same time in the previous year shows that the vegetation is even less developed in the northern and eastern part of Al Eis. Only in the south western part more vegetative activity is observed, probably related to the available lake water resources there that are significantly increased in 2017 comparing to 2016.

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

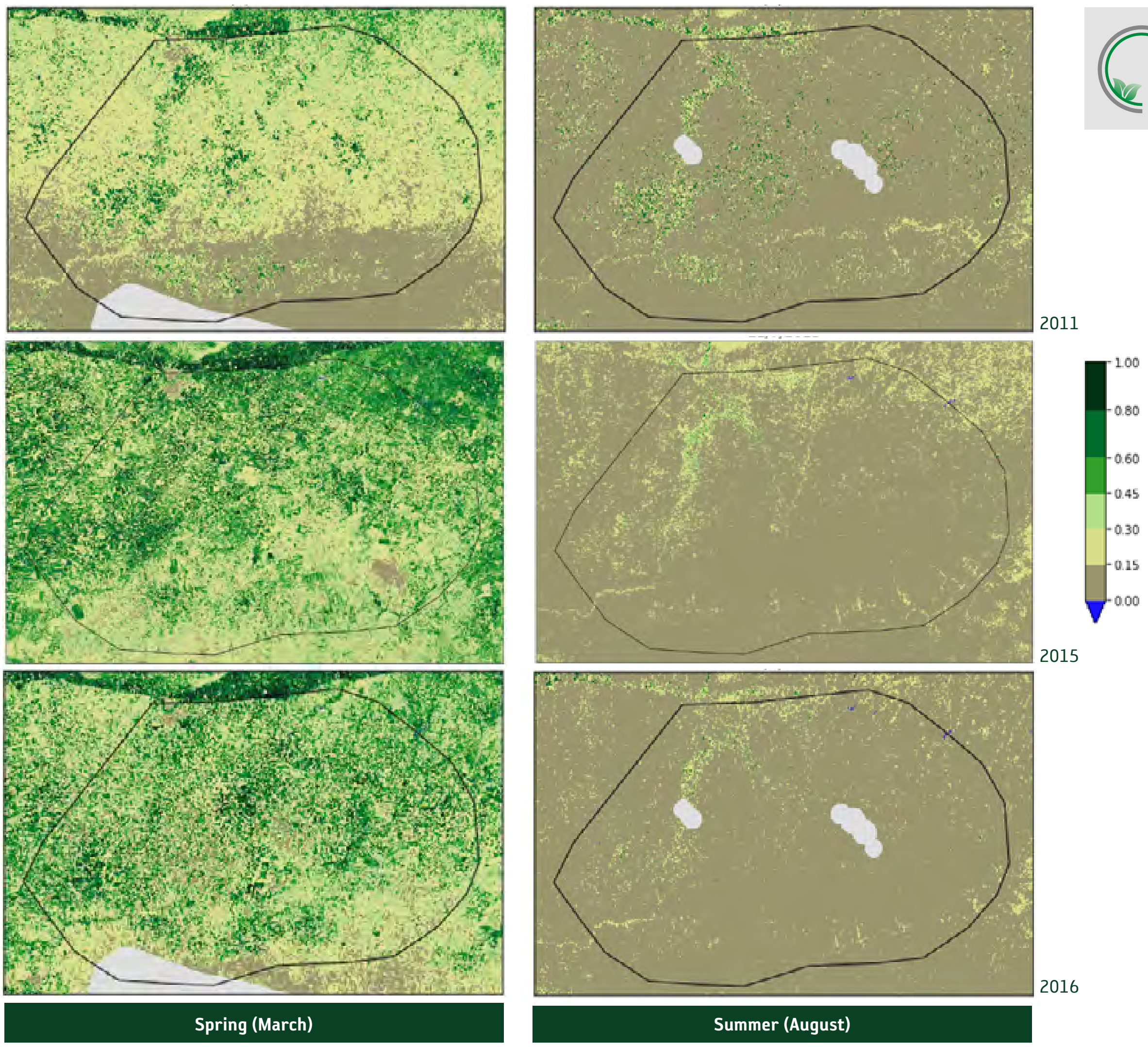


Figure 20 Al Hassakeh: productivity pre-conflict (2011) and during conflict year 2016.

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

4.6. Coping and adaptive strategies

A clear indication of changes in agricultural production and damages in irrigation infrastructure is observed when looking at the structure of fields and vegetation using Sentinel-2 imagery. Figure 21 demonstrates that the irrigation of fields is often only based on leakage from channels as the vegetation activity is higher close to these that sustained a spill (natural or manmade). This disruption however affects the structure of the fields and prevented a classification of field sizes using established techniques. However, it also shows that the channels are still served with water and that vegetation growth continues with water input as much as possible. In this case this innate land reclamation takes place in a way that compensates for abandonment of the **managed agricultural practice**.

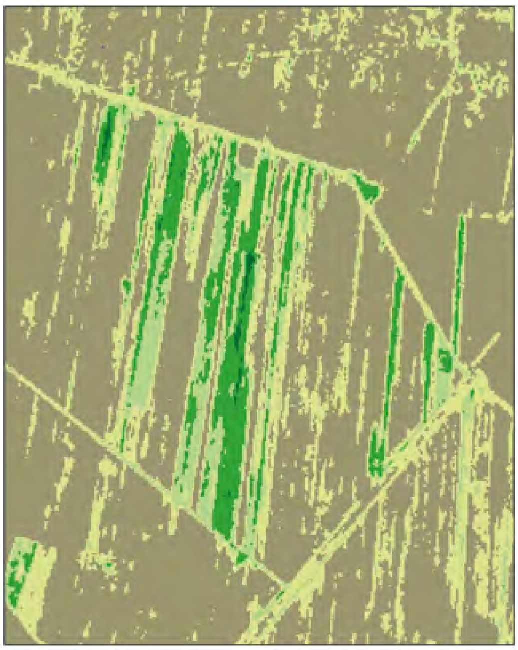


Figure 21 The damage of irrigation infrastructure and leakage to fields becomes clear as vegetation activity is highest close to a channel compared to the rest of the field. This observation in Al Eis shows that field structures are no longer clearly visible, which indicates a decrease in agricultural production quality.

Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

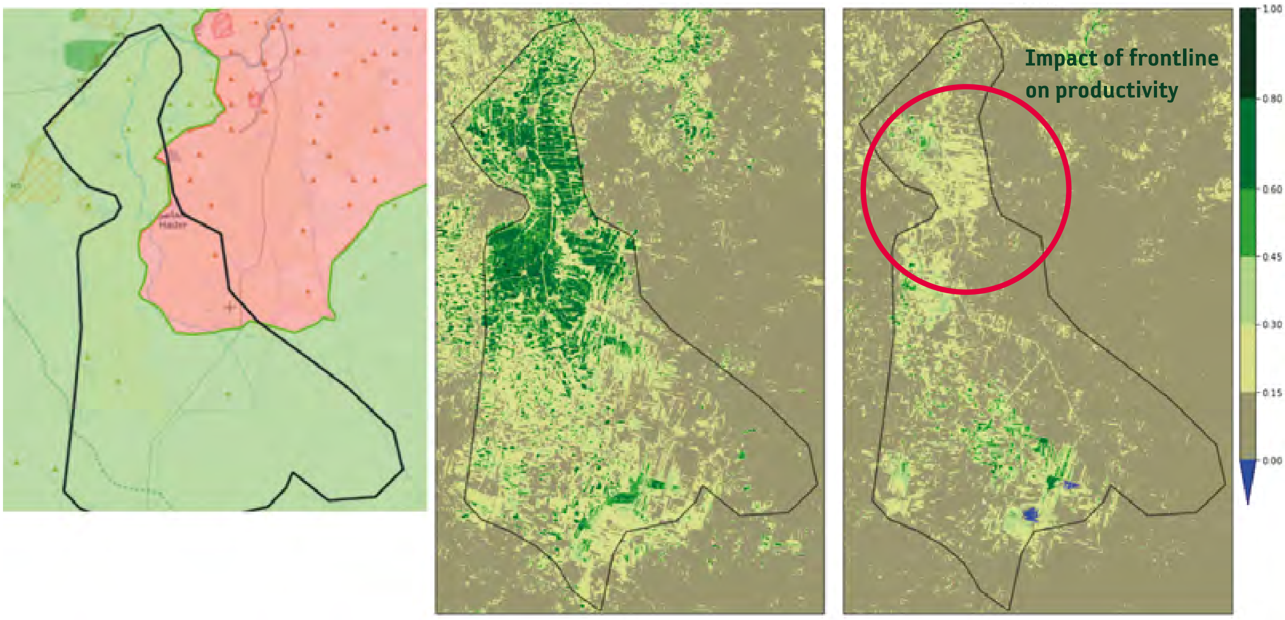


Figure 22 Impact of frontline on productivity. Pre-conflict (left) and during conflict (right).
Credit: Syria.liveuamap.com and EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

Figure 22 shows Al Eis area is at the frontline, and its impact on productivity.

In Ar Raqqah productivity increased in some areas. Figure 23 shows the relative productivity increase in August (18 Aug 2011 – 15 Aug 2016) downstream of a pumping station. The relative increase in productivity in another area might be explained by the nearbycity, as shown in Figure 24.

Figure 23 Relative productivity increase in August (18 Aug 2011 – 15 Aug 2016) downstream of pumping station, Ar Raqqah region.
Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

Figure 24 Relative productivity increase in August (18 Aug 2011 – 15 Aug 2016) around the city of Al Karamah (Ar Raqqah region).
Credit: EO4SD Agriculture Cluster (eLEAF/GeoVille for ESA/World Bank, 2017)

5. CONCLUSIONS

The agriculture and irrigation sector in Syria has been severely affected by the conflict in terms of land utilisation, cropping intensity and crop yields. Cultivated land has decreased by about 50% in the Syrian Al Eis irrigation scheme, formerly wet (potentially irrigated) areas in the dry season diminished by 36% and productivity has declined by 36% in winter and by 47% in summer. In Ar Raqqah productivity also decreased in spring and summer by on average 15%. In Al Hassakeh productivity decreased by 15% in summer but increased by 60% in spring.

EO is very useful for up-to-date and historical mapping of the impact of conflict on agriculture in terms of agricultural extent, productivity and irrigation performance. Satellite observations support the measuring of specific conditions explaining agricultural sector performance **prior to** conflict and agricultural sector performance **relative** to neighbouring regions that have not been affected by conflict-related disruptions: areas which are still actively producing and areas which have adopted coping mechanisms such as a transition from irrigated to rainfed agriculture or a change in crop type. Also it allows monitoring agricultural production over time while a conflict evolves, to assess a presence of both abandoned and reclaimed land, changes in cropping pattern (start-of-season, crop change, productivity and availability status) which helps to identify a potential for the agricultural sector revival after the fighting has seized.

Post-conflict reconstruction is another application area that can be facilitated by development of satellite-based solutions such as mapping of the rural roads network and irrigation infrastructure, or identifying areas where new construction is needed. Such suitability analyses can be provided at any administrative level for the whole country, helping to understand the potential for recovery. For sustainable peace and reconstruction, it is important that the agricultural production and markets are restored quickly. Together with value chain analyses which highlight e.g. the distance of agricultural areas to markets the locations in need of development are identified and investments can be prioritised.

6. RECOMMENDATIONS

Satellite Earth Observation is an excellent tool to monitor not only the impact of conflict on the agricultural sector, but also to map the dynamics, resilience and coping and adaptive mechanisms of the agricultural sector over time. **The recently launched Sentinel-2 satellites have opened new opportunities for monitoring agricultural areas by offering high resolution field-scale data at 10m spatial resolution for large areas with short time revisits (5 days)**. Together with the already existing Landsat satellite, it allows regular monitoring of agricultural extent and productivity at field-scale.

The study illustrated that even under conflict, damaged irrigation structures are being used, rainfed agriculture replaces irrigation, and farmers under uncertainty arising from conflict change to crops that are more profitable, easier to market, or more resilient for water stress.

There are several opportunities to expand the methodology applied for impact assessment in Syria - which initially focussed on field-scale mapping of cultivated area and agricultural productivity using the vegetation index - to other Earth Observation-based data products and information services which are providing quantitative information on **agricultural productivity, water stress and water use efficiency**. Field-scale analysis of the biomass production is useful for estimating productivity losses in kilograms per hectare. Satellite measurements of the energy balance can calculate the actual evapotranspiration and transpiration deficit in mm per day: the **actual evapotranspiration** indicates changes in water consumption and together with the biomass production is a measure of water use efficiency, showing production per unit of water; **transpiration deficit** is a measure of how much water the crop is missing for optimal growth and a basis for the calculation of **water stress**. Evapotranspiration, transpiration deficit and water productivity are fundamental to identify irrigation failure and measure irrigation performance[7]. Once field surveys are possible, the Earth Observation analysis can also be expanded with field-scale crop maps (crop type, rotation. performance) to support elaboration of agricultural statistics.

Correlation with other datasets, such as precipitation, is important to distinguish production losses associated with weather and ecological conditions (such as drought) from those arising from the conflict. Although never a sole cause of crises, these kinds of environmental dynamics and risk of natural disasters can become drivers of violence and instability and in turn fuel and prolong country-scale and international conflicts.

Satellite based information on agricultural production is increasingly used in addressing risks related to food insecurity however its particular value is in objective reporting that can form a basis of the dialogue between the different international development and humanitarian organisations involved in relief actions in the areas under conflict. This technical assistance was intended to introduce these important analytic instruments in order to bring qualified expertise and know-how to Economic and Social Impact Analysis (ESIA) study associated with Syria damage assessment. However the next step challenge is to standardise this information delivery to the World Bank and other development partners to support routine data collection, on-demand analytics and execution of studies, reports (such as ESIA) as well as broader agricultural programs which require information on issues such as land cover, crop cover, productivity, population distribution, water sources, areas of degraded lands, infrastructures damage and so on for the sector strategy planning and investment preparation.

[7] More information available at "EO4SD Agriculture and Rural Development – Service Portfolio" at eo4sd.esa.int/agriculture

7. ANNEXES

7.1. Balikh Irrigation Project map

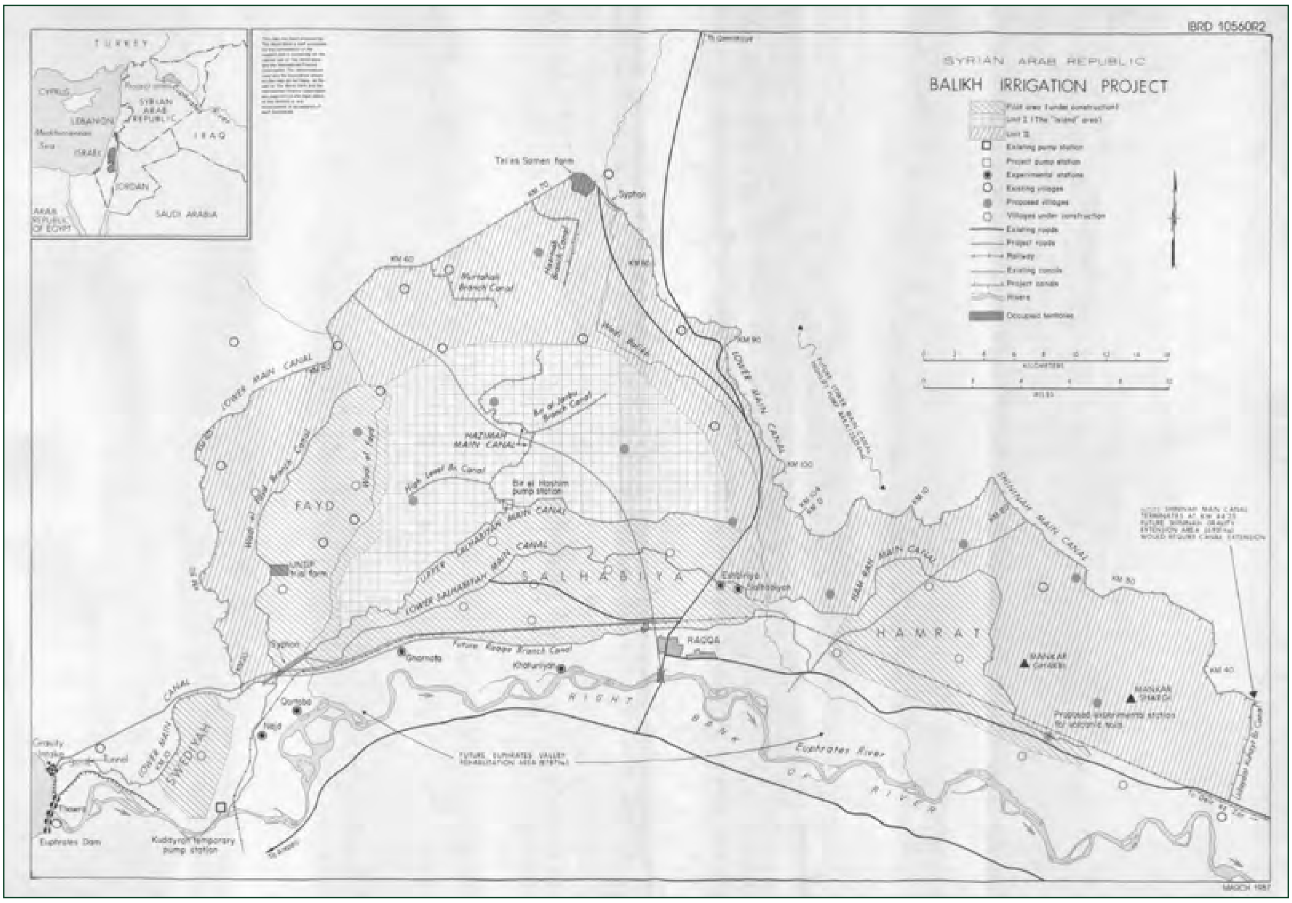


Figure 25 Balikh Irrigation Project (Al Raqqah), IBRD 10560R2, March 1987

7.2. Statistical results

Table 6 Top ten villages regarding the absolute area of abandoned agricultural land (fallow) in Al Eis.

Postal code	village name		Abandoned agricultural land (fallow)
C1090	Eastern Atshana	عطشانة شرقية	1967,73 ha
C1180	Tal Dadine	تل دادين	1205,87 ha
C1151	Zyare Semaan	زيارة سمعان	1136,33 ha
C1093	Western Atshana	عطشانة غربية	1136,14 ha
C1182	Hadher	الحاضر	1107,66 ha
C1178	Dalama	دلامة	978,86 ha
C1173	Tal Mamu	تل ممو	948,16 ha
C1177	Tleilat	تليلات	888,15 ha
C3900	Hmeimat Eldayer	حميمات الداير	793,67 ha
C1067	Big Oweinat	عوينات كبيرة	775,27 ha

Table 7 Top ten villages most affected by the decrease in wetness during the summer period that can be related to the irrigation potential. The mean wetness frequency is calculated based on the surrounding area of each village. All villages are located in the northern part of the El Ais region.

Postal Code	village name		Mean wetness frequency [%]		
			2011	2016	Change 2011-2016
C1177	Tleilat	تليلات	47	1	-46
C1167	Zeitan	زيتان	46	2	-44
C1154	Berna	برنة	48	5	-43
C1183	Maryuda	مريودة	66	29	-37
C1184	Makhala	مكحلة	48	17	-31
C1173	Tal Mamu	تل ممو	39	8	-31
C1182	Hadher	الحاضر	26	0	-26
C1180	Tal Dadine	تل دادين	23	0	-23
C1181	Iss	العيس	22	1	-21
C1161	Tal Bajer	تل باجر	29	10	-19

Table 8 Ten villages with most cultivated areas in their surrounding in 2016.

Postal Code	village name		Cultivated area in 2016
C1167	Zeitan	زيتان	1511,65 ha
C1015	Khan Tuman	خان طومان	1272,71 ha
C1171	Tal Allush	تل علوش	1075,53 ha
C1152	Hmeira	حميرة	954,97 ha
C1018	Qarras	قراص	847,91 ha
C1168	Jazraya	جزرايا	779,68 ha
C1154	Berna	برنة	769,24 ha
C1071	Tal Aqareb	تل عقارب	668,17 ha
C1153	Barqum	برقوم	606,23 ha
C1182	Hadher	الحاضر	598,07 ha

Table 9 Al Eis village top 10: lowest and highest productivity change of wintercrop (February) and summer crop (August/September) from 2011 to 2016

underperformance					good performance				
Postal code	village name		Change in productivity		Postal code	village name		Change in productivity	
			Winter crop	Summer crop				Winter crop	Summer crop
C1173	تل ممو	Tal Mamu	-0.35	-0.32	C1079	صعيبية	Saeebiyeh	-0.09	-0.01
C1183	مريودة	Maryuda	-0.32	-0.40	C1179	جميمة	Jamimeh	-0.05	-0.01
C1151	زيارة سمعان	Zyare Se-maan	-0.37	-0.18	C1050	تل ماسح	Tal Masih	0.00	-0.02
C1177	تليلات	Tleilat	-0.27	-0.36	C1072	بطحة	Batha	-0.05	0.00
C1184	مكحلة	Makhala	-0.30	-0.30	C1113	مشرفة ارجل	Mashrafet Arjol	-0.05	-0.01
C1093	عطشانة غربية	Western Atshana	-0.33	-0.13	C1057	ارجل	Arjel	-0.03	0.00
C1178	دلامة	Dalama	-0.27	-0.15	C3891	أبو الظهور	Abul Thohur	0.31	-0.02
C1156	زمار	Zmar	-0.32	-0.08	C3899	تل سلمو	Tal Silmo	0.03	-0.01
C1172	حوير العيس	Hawir Elis	-0.24	-0.18	C6328	غريريفة	Gharirifeh	0.00	-0.01
C1180	تل دادين	Tal Dadine	-0.22	-0.25	C1118	مريقص	Mreiqes	-0.01	0.01

Table 10 Al Hassakeh village top 10: lowest and highest productivity change of wintercrop (March) and summer crop (August/September) from 2011 to 2016

underperformance					good performance				
Postal code	village name		Change in productivity		Postal code	village name		Change in productivity	
			Winter crop	Summer crop				Winter crop	Summer crop
C4607	أبو توينة	Abu Tweineh	-0.03	-0.14	C4469	خراب غزال	Kharab Ghazal	0.27	0.01
C4640	تل اما	Tal Maha	-0.06	-0.10	C4677	يثرب	Yathreb	0.32	0.01
C4482	خراب عبد السيد	Kharab Ab-del Sayed	-0.03	-0.12	C4358	تل منصور حسكة	Tal Mansur Haskeh	0.30	0.01
C4670	مدينة رحية	Madinet Rehiyeh	-0.03	-0.10	C4586	تل احيمر	Tal Ehmeir	0.34	0.01
C4553	الرجم	Rejm	-0.04	-0.08	C4377	نورك	Nurak	0.28	0.01
C4641	الحسينية تل حميس	Hseiniyeh Tal Hmeis	0.01	-0.10	C4382	مسعودية البيزارة	Masudiyeh Elbizara	0.30	0.01
C4591	طواريج الغرقانة	Tawarij Elghaanah	0.02	-0.12	C4369	سيد علي	Sayed Ali	0.28	0.02
C4625	خراب عسكر	Kharab Askar	0.00	-0.08	C4339	صوفيا	Sofya	0.30	0.02
C4629	خويتلة رعيدات	Khweitleh Reidat	-0.01	-0.07	C4489	كبيبات	Kbeibat	0.31	0.02
C4605	طامنة البرية	Tamna Elbariyeh	0.02	-0.07	C4372	تل شعلان	Tal Shaalan	0.33	0.02

Table 11 **Ar Raqqah village top 10: lowest and highest productivity change of wintercrop (March) and summer crop (August/September) from 2011 to 2016**

underperformance					good performance				
Postal code	village name		Change in productivity		Postal code	village name		Change in productivity	
			Winter crop	Summer crop				Winter crop	Summer crop
C5732	حويجة فرج	Hweijet Faraj	-0.21	-0.10	C5725	الرحيات	Rohayat	0.07	-0.01
C5704	حاوي الهوى	Hawi Elhawa	-0.16	-0.09	C5771	السامرة_ عويجة حمد العساف	Samera - Oweija Hamad Elassaf	0.02	-0.01
C5714	ربيعة	Rabee'a	-0.16	-0.08	C5744	الرابية	Rabyeh	0.03	-0.01
C5770	الاسماعيلية_ فاطسة عبد الاسماعيل	Esmailieh - Fatsa Abdelesmail	-0.11	-0.08	C5733	الرحمانية	Rahmaniya	0.00	0.00
C5675	الخاتونية	Katuniyeh	-0.18	-0.07	C5784	الجابر	Jaber	0.01	0.00
C5726	القحطانية	Qahtaniyyeh	-0.12	-0.07	C6383	العطشانة	Atshana	0.01	0.00
C5743	شمرة	Shamra	-0.10	-0.08	C5763	الهالة_خس هبال	Hala - Khas Hbal	0.03	0.00
C6377	كبش وسطي	Middle Kabsh	-0.10	-0.07	C5774	اليعربية_ خس عجيل	Yarobiyeh - Khas Ejil	0.03	0.00
C5694	طالعة الأنصار	Talet Elansar	-0.09	-0.07	C5742	معيزيلة	Moezleh	0.06	0.00
C5786	مغلة كبيرة	Big Maghalla	-0.09	-0.07	C5734	مرج أبو شارب	Marj Abu Shareb	0.04	0.00

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