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Effects of the Islamic State of Iraq and Syria on Cropland Area

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Abstract Land cover data derived from satellite remote sensing was used to determine if there was a significant change in cropland area in territory once controlled by the Islamic State of Iraq and Syria (ISIS) compared to periods before the rise of ISIS. Results revealed that mean cropland area was largest during the pre-drought period (2000-2005) at 21,707 km^2, decreased during the drought period (2006-2010) to 17,119 km^2, and remained at about drought levels during a period of instability in both Iraq and Syria (2011-2013) and the Islamic State period (2014-2017), 17,530 km^2 and 17,335 km^2, respectively. Cropland area never returned to previous highs of the pre-drought period in ISIS territory but did return to previous highs in non-ISIS territory. Results of Analysis of Variance indicate that the effects of ISIS on cropland area were similar to devastating drought.

Keywords: *land cover change, Islamic state, cropland, remote sensing, Iraq, Syria*

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1. Introduction

War can have significant impacts on land-use decisions and land-cover change, and agricultural land cover can be the most susceptible to those impacts. War can also limit the availability and reliability of census data or other ground-based measures of agricultural productivity. Remote sensing data have proven effective for analysis of land-use and land-cover change within agricultural areas and can provide a spatial dimension that census-based studies may lack. With the proliferation of freely available long-term time series imagery, the use of such data for monitoring land-cover changes caused by instability has increased. For example, in research on the effects of different types of warfare in Iraq on cultivated area, Gibson et al. [1] used satellite imagery to determine there was little change in cultivated area between the Iran–Iraq War and the Gulf War but significant increases during sanctions, followed by drastic reductions once sanctions ended and food imports resumed. Gibson et al. [2] identified significant decreases in cropland area in Iraq between 2001 and 2012 using satellite imagery and were able to relate those changes to sociopolitical factors. In more recent research, Gibson et al. [3] used satellite imagery to compare cultivated area along the Euphrates River in Iraq across four different periods of conflict and found that recent instability in Iraq had a similar impact on cultivated area as a devastating drought in the region.

Unlike Iraq, Syria has not been embroiled in war for decades. However, understanding the impact of instability and conflict on Iraq's agricultural sector, I considered the recent civil war in Syria and the rise of the Islamic State of Iraq and Syria (ISIS) as likely to have a similar impact on agricultural lands. In this article, I sought to better understand the effects of ISIS on agricultural land use and land cover in territory it controlled in Iraq and Syria. Despite both Iraq and Syria's agricultural heritage, the impact of instability and loss of government control of territory, even if only for a relatively short time, raise questions about food security in those areas controlled by ISIS.

To contribute to the growing body of research that links conflict and instability with food security and environmental impacts, I posed the following questions for this study: How does cropland area in territory once controlled by ISIS compare to cropland area in the same territory before the rise of ISIS? Was the effect of ISIS on cropland area more like pre-drought, drought, or instability periods? How does cropland area in territory once controlled by ISIS compare to cropland area in territory never controlled by ISIS? Finally, if cropland area went down, what land cover class(es) went up?

Because I am comparing cropland area in overlapping territories, the study area can be understood in three ways. First, Iraq and Syria as a whole comprise 624,494 km^2. Based on the Moderate Resolution Imaging Spectroradiometer (MODIS) Land Cover Product Type 5 for 2017 [4], the most recent year available, the land cover of these two countries combined is made up of the following types and percentages: Water (1.0%), Forests (0.4%), Shrublands (9.9%), Grasslands (10.9%), Croplands (12.6%), Urban (1.0%), and Barren (64.2%). The study area is mostly arid to semi-arid, except for the coastal areas of Syria which experience a Mediterranean climate. The Euphrates River runs through both countries, while the Tigris River forms the boundary with Turkey and Syria before running through Iraq; both rivers make irrigated agriculture in an arid to semi-arid climate possible. Rainfed agriculture is possible in the mountainous regions in the north, and the coastal region of Syria.

ISIS gained and lost territory in different places and at different times between 2014 and 2017. The ISIS study area for this paper is based on a map by the Institute for the Study of War [5] and represents the maximum extent of territory controlled or influenced by ISIS (Figure 1). It includes 262,511 km^2. The land cover is made up of the following types and percentages: Water (1.2%), Forests (<0.1%), Shrublands (9.9%), Grasslands (2.6%), Croplands (5.2%), Urban (0.5%), and Barren (80.6%) [4]. The climate is arid and semi-arid, and includes croplands along the Euphrates River in both Syria and Iraq, as well as some rainfed agricultural areas in the north.

To compare ISIS-controlled territory to non-ISIS-controlled territory, a third study area was necessary, which is basically all of Iraq and Syria minus the ISIS-controlled territory described above. It includes 361,983 km^2 of the following land cover types and percentages: Water (0.8%), Forests (0.7%), Shrublands (10.0%), Grasslands (16.9%), Croplands (17.9%), Urban (1.4%), and Barren (52.3%) [4].

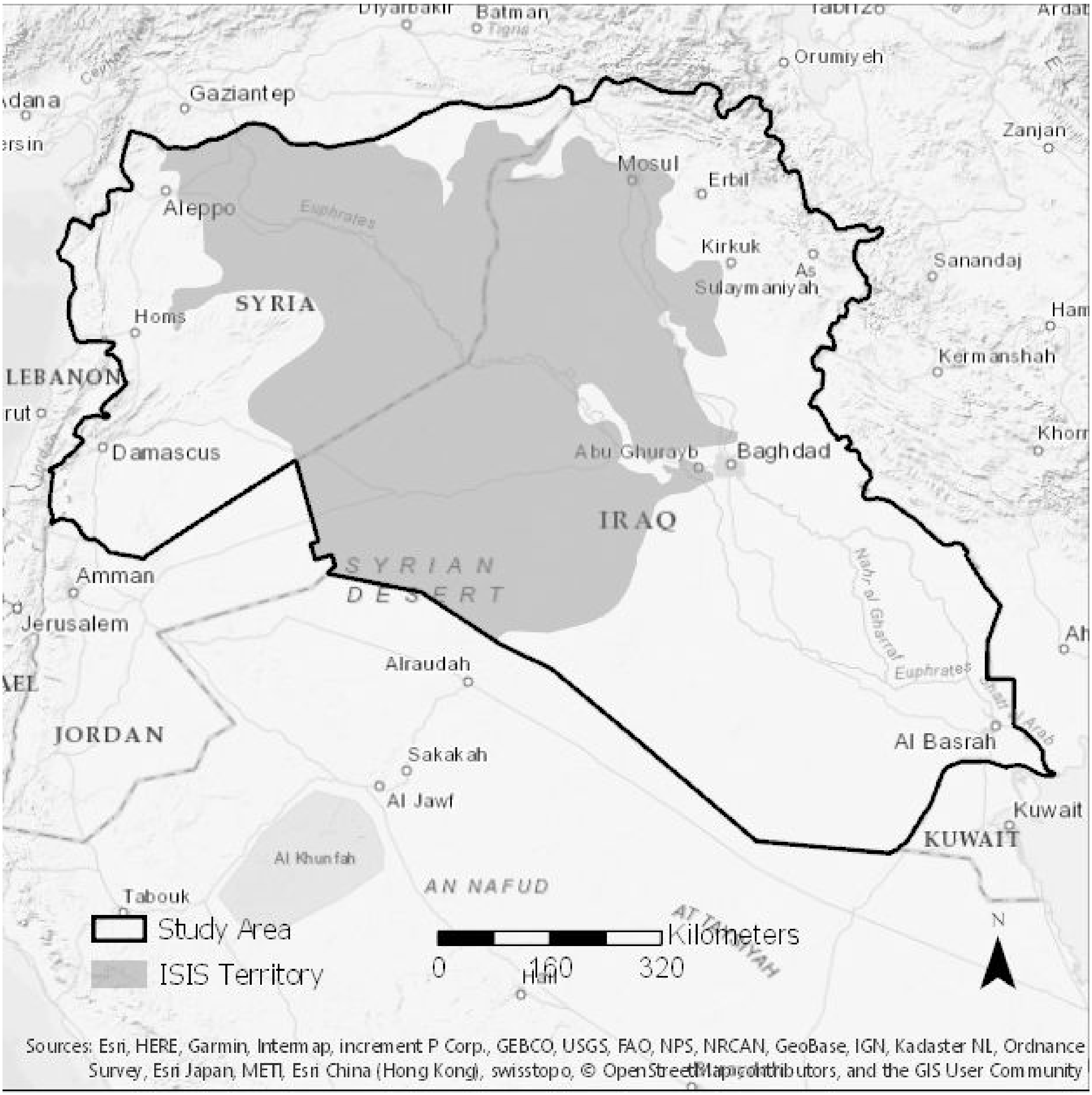

Figure 1. Map of study area

2. Materials and Methods

Because I would be comparing cropland area in ISIS territory in Iraq and Syria with non-ISIS territory in those two countries, I downloaded country boundary shapefiles for Iraq and Syria from the Environmental Systems Research Institute's (ESRI) ArcGIS Online World Countries data. World Countries is a detailed layer of country level boundaries which is best used at large scales. This dataset represents the world countries as they existed in January 2015.

To identify croplands, I used the land cover data gathered by the MODIS instrument operating on both the Terra and Aqua satellites. It views the entire surface of the Earth every one to two days. Its detectors measure 36 spectral bands and it acquires data at three spatial resolutions: 250-m, 500-m, and 1,000-m. MODIS has been in operation since 2001 [4].

The MODIS Land Cover Type product describes land cover properties derived from observations spanning a year's input of Terra- and Aqua-MODIS data. The MODIS Terra + Aqua Land Cover Type Yearly L3 Global 500 m SIN Grid product used for this paper incorporates five different land cover classification schemes, derived through a supervised decision-tree classification method [4]. Land Cover Type 5 is the Plant Functional Type (PFT) scheme includes 12 different classes that include water, four types of forest classifications, shrublands, grasslands, two types of croplands, urban and built up, snow and ice, and barren or sparsely vegetated. I used MODIS land cover data for years 2001 to 2017, the most recent data available, and combined the two cropland classes into one for a total area.

The spatial resolution of the MODIS land cover data is 500 m, meaning the data is organized into 500 m by 500 m cells [4]. Each cell contains one land cover classification. Obviously, that is too large to identify small fields that may be used for subsistence agriculture, but the resolution should be accurate enough to identify larger fields to answer the questions posed for this paper.

Finally, to determine the appropriate area to label as ISIS territory, I digitized a polygon that best fit the maximum extent of ISIS territory according to a map by the Institute for the Study of War [5].

The data was analyzed in ArcMap 10.5.1. ArcMap is a geographic information system specifically designed to analyze spatial data. By combining the Iraq and Syria country boundaries and the ISIS territory polygon with the land cover data, I was able to calculate cropland area for ISIS territory in both countries combined, ISIS territory in both countries combined, and non-ISIS territory in both countries combined.

Next, I entered the cropland area for each year for each territory described in the previous paragraph into a spreadsheet. The data was then grouped into four time periods: Pre-Drought (2001-2005), Drought (2006-2010), Instability (2011-2013), and ISIS (2014-2017). To better understand the importance of the different periods, a little context is needed. For example, the 2006 to 2010 drought has been described as one of the worst droughts ever recorded in the region, so severe that farmers were reported to have foregone planting operations [6]. Because the study area is limited to cultivation dependent upon irrigation from exotic rivers, it is important to consider the effects of low rainfall on river levels. During the drought, the mountains of Turkey saw so little rainfall and snow melt that the Tigris and Euphrates rivers dropped to nearly half their normal levels in many areas [7]. Therefore, comparing the Pre-Drought period to the Drought period should reveal a significant decrease in cropland area; however, it would be incorrect to assume the Pre-Drought period reflects "normal" conditions. For example, it is in the middle of the Pre-Drought period that allied forces invaded Iraq and food imports into Iraq resumed. Also, the Instability period corresponds to the Arab Spring and civil war in Syria and the first few years following the withdrawal of US troops from Iraq in 2011. Further, while ISIS existed in various forms prior to 2014, it was in that year they actually began controlling territory in the study area.

Finally, I used JMP Pro 13 for statistical analysis. According to Shapiro-Wilks test the data was parametric, and according to the Durbin-Watson test the data did not exhibit autocorrelation. Therefore, Analysis of Variance (ANOVA) was the ideal statistical test to compare cropland area across the four time periods. JMP was also used to perform correlation analysis on cropland area and other vegetated land cover classes such as forests, grasslands, shrublands, and barren to determine what becomes of cropland areas when they are no longer being used as croplands.

3. Results

For all periods within the total study area, cropland area ranged from a low of 71,561 km^2 to a high of 88,420 km^2 with a mean of 80,917 km^2. During the Pre-Drought period, cropland area ranged from a low of 80,000 km^2 to a high of 88,420 km^2 with a mean of 85,044 km^2. During the Drought period, cropland area ranged from a low of 71,561 km^2 to a high of 77,866 km^2 with a mean of 74,953 km^2. During the Instability period, cropland area ranged from a low of 76,218 km^2 to a high of 83,647 km^2 with a mean of 79,473 km^2. Finally, for the ISIS period, cropland area ranged from a low of 78,486 km^2 to a high of 87,381 km^2 with a mean of 84,296 km^2. The results of our statistical analysis were significant ($P < 0.01$, r^2 0.69), indicating significant differences between study periods. Figure 2 is a graph of the ANOVA results and Table 1 shows the similarities between periods according to the Student's t Test. Assuming that the Pre-Drought period represents "normal" conditions, and by comparing the cropland areas for other periods, it appears that the Drought period had a greater negative effect on cropland area than the two later periods. In fact, it appears that following the drought, cropland area slowly returned to figures similar to the Pre-Drought period.

Table 1. Student's t Test results for total study area

Period	Connecting Letters	Mean
Pre-Drought	A	85,044
Drought	C	74,953
Instability	BC	79,473
ISIS	AB	84,296

NOTE: Levels not connected by same letter are significantly different.

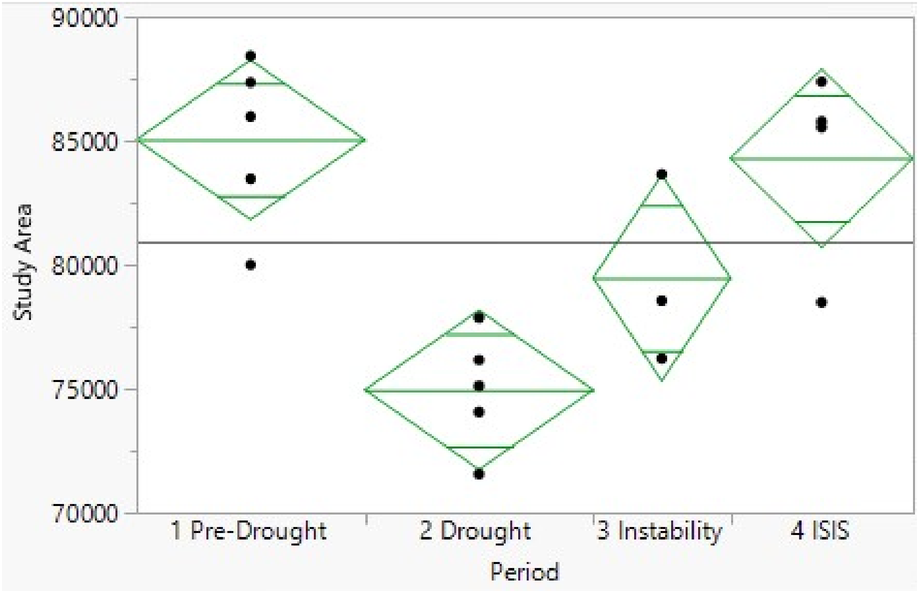

Figure 2. ANOVA results for total study area

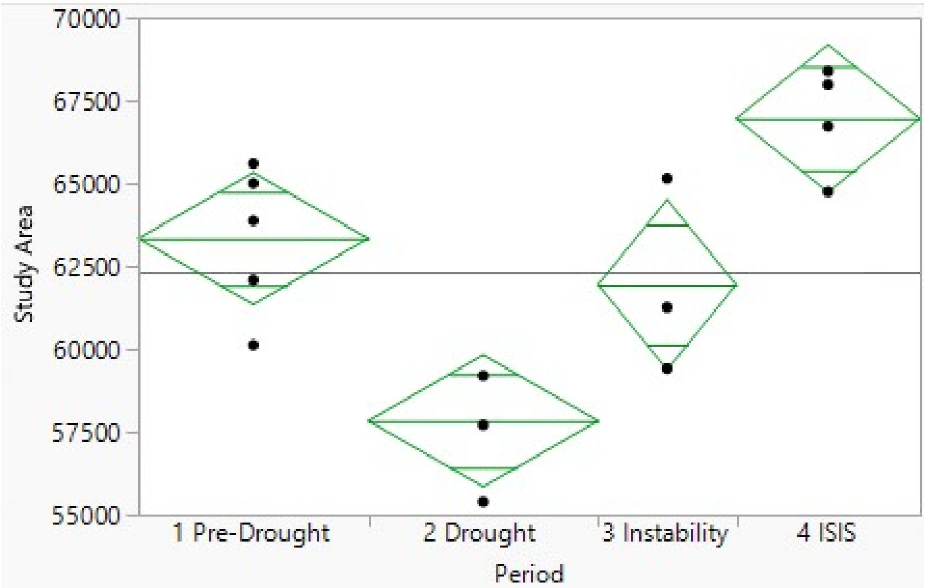

Figure 3. ANOVA results for Non-ISIS controlled territory

For all periods in non-ISIS controlled territory, cropland area ranged from a low of 55,391 km^2 to a high of 68,387 km^2 with a mean of 62,325 km^2. During the Pre-Drought period, cropland area ranged from a low of 60,126 km^2 to a high of 65,601 km^2 with a mean of 63,337 km^2. During the Drought period, cropland area ranged from a low of 55,391 km^2 to a high of 59,197 km^2 with a mean of 57,834 km^2. During the Instability period, cropland area ranged from a low of 59,414 km^2 to a high of 65,154 km^2 with a mean of 61,943 km^2. Finally, for the ISIS period, cropland area ranged from a low of 64,750 km^2 to a high of 68,387 km^2 with a mean of 66,961 km^2. The results of our statistical analysis were significant ($P < 0.001$, r^2 0.78), indicating significant differences between study periods. Figure 3 is a graph of the ANOVA results and Table 2 shows the similarities between periods according to the Student's t Test. In this case, by comparing the cropland areas for other periods, not only did cropland area recover following the severe drought, it rose to new highs during the ISIS period.

Table 2. Student's t Test results for Non-ISIS-controlled territory

Period	Connecting Letters	Mean
Pre-Drought	B	63,337
Drought	C	57,834
Instability	B	61,943
ISIS	A	66,961

NOTE: Levels not connected by same letter are significantly different.

For all periods in ISIS-controlled territory, cropland area ranged from a low of 13,736 km^2 to a high of 22,819 km^2 with a mean of 18,592 km^2. During the Pre-Drought period, cropland area ranged from a low of 19,875 km^2 to a high of 22,819 km^2 with a mean of 21,707 km^2. During the Drought period, cropland area ranged from a low of 16,171 km^2 to a high of 18,669 km^2 with a mean of 17,119 km^2. During the Instability period, cropland area ranged from a low of 16,804 km^2 to a high of 18,494 km^2 with a mean of 17,530 km^2. Finally, for the ISIS period, cropland area ranged from a low of 13,736 km^2 to a high of 18,994 km^2 with a mean of 17,335 km^2. The results of our statistical analysis were significant ($P < 0.001$, r^2 0.71), indicating significant differences between study periods. Figure 4 is a graph of the ANOVA results and Table 3 shows the similarities between periods according to the Student's t Test. Again, assuming that the Pre-Drought period represents "normal" conditions, and by comparing the cropland areas for other periods, it appears that instability and ISIS had a similar impact on cropland area as a devastating drought.

Table 3. Student's t Test results for ISIS-controlled territory

Period	Connecting Letters	Mean
Pre-Drought	A	21,707
Drought	B	17,119
Instability	B	17,530
ISIS	B	17,335

NOTE: Levels not connected by same letter are significantly different.

Correlation analysis of cropland area with other land cover classes within the ISIS-controlled territory revealed a statistically-significant, inverse relationship between cropland area and barren area ($P < 0.01$, $\rho = -0.66$) (Figure 5). No such relationship existed between cropland area and areas classified as forests, shrublands, or grasslands. The results indicate that when croplands are no longer being used to grow crops, they are left barren and natural vegetation does not replace the crops. Further, removal of vegetation in arid and semiarid regions greatly enhances the opportunity for desertification that can lead to loss of arable land and greater challenges for food security.

All comparisons reveal that outside of territory that was once controlled by ISIS, cropland area was significantly impacted by drought but recovered to reach new highs, but inside territory once controlled by ISIS, cropland area never returned to pre-drought levels. That means that ISIS had just as significant of an impact on cropland area as devastating drought. With that in mind, the following discussion takes a more critical geography approach to describe the effects of ISIS on cropland area.

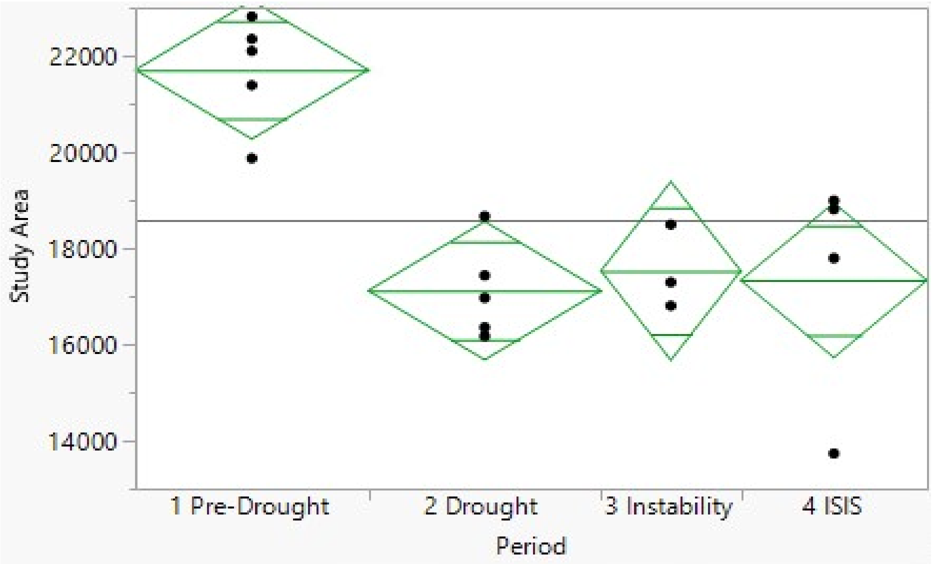

Figure 4. ANOVA results for ISIS-controlled territory.

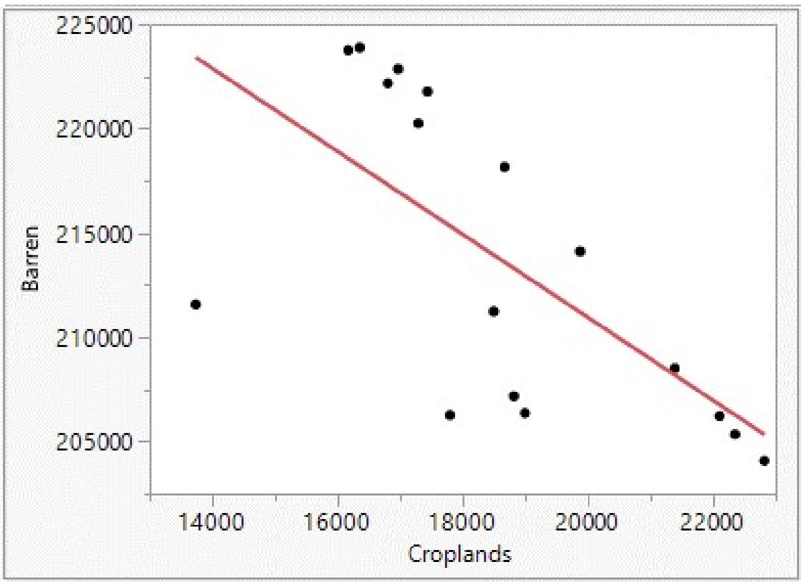

Figure 5. Bivariate fit of barren area by cropland area, 2001 to 2017

4. Discussion

Though for the purposes of this paper we combined the countries of Iraq and Syria into one entity, the two have very different histories of agriculture and political dissatisfaction that allowed ISIS to expand and control territory that affected cropland area. Iraq has a very long history of agriculture, dating back to the time of Mesopotamia some 10,000 years ago. However, its food security challenges began only a few decades ago with population growth that exceeded agricultural production, making the country more reliant on food imports [8]. When Saddam Hussein invaded Kuwait in 1990, many of the countries that had been exporting food to Iraq stopped doing so [9]. Between 1990 and 2003, the people of Iraq suffered from food shortages that led to hundreds of thousands of deaths per year from starvation and malnutrition, many of them infants and children [10]. In 2003, the US led a multinational force to remove Hussein from power, and once removed, food imports resumed almost immediately. Shortly thereafter, political challenges arose as the majority Shia population gained more political power following decades of repression by the minority Sunni population that had held power for decades [11]. When US troops withdrew from Iraq in 2011, the country was deeply divided politically and suffering economically [12]. Large numbers of refugees and internally displaced people strained Iraq's infrastructure, and these displaced individuals have caused decreased national gross domestic product, a paucity of public goods and services, and lower general incomes [13]. The lower incomes directly benefit ISIS. Although some of ISIS's recruits are drawn to the organization for ideological reasons, others are attracted by economic incentives. In some instances, ISIS is capable of paying its members more than the Iraqi government pays its workers [14].

Unlike neighboring Iraq, Syria had achieved food self-sufficiency. Syria was self-sufficient in wheat production until 2006, after which there were four consecutive years of drought [15]. In Syria, almost half of household income is spent on food [15]. During the drought, when food prices began to climb, bread riots spread through the region, including in Syria [16]. But Syria's instability actually began before the drought. In recent decades Syria began adopting neoliberal strategies that would eventually affect the amount of food the government provided its people [17]. For example, Syria voluntarily adopted measures that reduced government influence in favor of more-capitalistic economic policies in its quest to join the Euro-Mediterranean Free Trade Area [18]. As might be expected in an autocratic regime, Syrian capitalism resembled crony capitalism and did little to help the population [15]. In Syria, youths under twenty-five constitute a majority of the population, and as in the rest of the Arab world, youths in Syria make up the bulk of the unemployed [19]. In Syria, most college graduates spend at least four years looking for employment before finding a job [15]. The protests that began in the capital city of Damascus in March 2011 resembled protests that toppled autocrats in Tunisia and Egypt; however, when they failed to remove Bashar al-Assad, the protests spread throughout the country in response to ruthless regime violence [20]. When Syrian security forces arrested and tortured school-children and then murdered their irate parents and their neighbors by firing into a crowd, a rebellion that no one had anticipated ignited [21]. The same four factors that have made other regimes in the Arab world vulnerable during the Arab Spring—reneging on the ruling bargain, demography, a food crisis, regime brittleness—contributed to the civil war in Syria also [15].

Groups such as ISIS exploit dismal social and economic conditions by both challenging the ideology of the state and presenting a subversive alternative [22]. Although ISIS is simply one part of a greater jihadist movement in its ideology and worldview, its social origins are grounded in a specific Iraqi and Syrian context and the instability and discontent that has lingered in those two countries [23]. ISIS began as an extension of Al Qaeda in Iraq, which in itself was a jihadist response to the 2003 US-led invasion of Iraq and its aftermath [24]. After the invasion, when state institutions either dissolved or were dismantled, the power vacuum created reinforced divisions along ethnic and religious lines rather than national polity, creating an environment that was particularly favorable for the emergence and growth of groups such as AQI and ISIS. The fragmentation of the post-Saddam Hussein political establishment and its incapacity to articulate policies that emphasized a national identity fed inter communal distrust and worsened the Sunni-Shia divide [25,26]. The breakdown of state institutions in Syria and the country's descent into a full-blown war is a significant factor in the growth of ISIS [27]. AQI and ISIS could not have consolidated the gains it made without the Arab Spring uprisings in neighboring Arab countries [28]. Initially, the large-scale uprisings in Syria was socially and politically driven, originating in rural areas that were hit hard by years of drought and a decade of ever-changing government policies that redirected resources away from the pressed agricultural sector toward the services sector [22]. Following years of drought, economic decline, and the growing gap between cities and rural areas, farmers were all but forced to move from the countryside to the suburbs, abandoning their established support networks in search of economic opportunities [22]. ISIS benefited from the breakdown of state institutions and deepening urban-rural rifts, which have been wearing down Arab societies in the Fertile Crescent for decades [29].

The most likely cause of the decrease in cropland area during ISIS occupation is land abandonment. The brutal tactics and extremist views of ISIS led to a large number of internally-displaced persons. Because ISIS gains were in mostly rural areas in western Iraq and eastern Syria, the largest employment sector was in agriculture. When those people fled to escape hardship and death, there was no one left to cultivate the land. Even as ISIS has lost territory and by some measures been defeated, people have not returned to their homes and land, instead pursuing new economic opportunities either in their home countries or as refugees in foreign lands. Unfortunately, the croplands that were left behind are also the areas most likely to experience desertification and exacerbate food insecurity in the long run.

Iraq's environmental stability continues to be threatened by soil salinization and desertification [30]. Over the past twenty-five years, Iraq's soils have experienced drastic increases in salinity, and the increases can be attributed to mismanagement of resources by Iraqi farmers and government policies [31]. Iraq's irrigation and drainage systems are unable to keep up with the nation's cultivation techniques and results in large quantities of salts left on agricultural fields after the evaporation of flood irrigation. Lacking proper equipment, farmers have been unable to counter soil salinization and many have been forced to abandon their farms [31]. Further, desertification is so widespread throughout Iraq that it now affects 75 percent of the nation's land and is particularly severe in areas of arable land [32]. This condition results in the loss of about 100,000 km^2 of arable land in Iraq every year and has forced many Iraqis to abandon their land [32]. Currently, only 25 to 40 percent is being cultivated due to regional insecurity and other lands available for cultivation are being left untended and slowly added to the encroaching desert [33]. Desertification is especially impactful to Iraqi food security, as Iraq has to import 80 percent of its food from foreign countries [34].

The outlook for desertification in eastern Syria is just as bleak. Prior to the civil war, over 80% of irrigated lands used inefficient flood irrigation [35]. It is estimated that over 15 million people have been forced to leave their homes in Syria and Iraq due to the conflict, leading to abandonment of croplands [36]. Desertification and loss of biodiversity in Syria might get even worse due to climate trends and conflict conditions [37].

5. Conclusion

Satellite imagery-derived land cover data provide a valuable resource for studying food security in war torn and conflict-ridden areas of the world. I used MODIS land cover data to determine whether there was a significant change in cropland area in territory controlled by ISIS in western Iraq and eastern Syria when compared to periods before the rise of ISIS and compared to areas in the remainder of Iraq and Syria. Results revealed that within ISIS territory mean cropland area was largest during the Pre-Drought period, decreased during the Drought period, and remained at about drought levels during the Instability period and the ISIS period. Outside of ISIS territory but within the same affected countries, results revealed that mean cropland area was large during the Pre-Drought period, decreased during the Drought period, increased during the Instability period, and then reached new highs during the ISIS period. Statistical analysis with the ANOVA test revealed that the effects of ISIS on cropland area was similar to a devastating drought. Cropland area never returned to previous highs of the pre-drought period in ISIS territory but did return to previous highs in non-ISIS territory. The decrease in ISIS-controlled territory could be the result of internally-displaced persons who once farmed the land but fled during ISIS occupation and have not returned.

References

[1] Gibson, G. R., J. B. Campbell, and R. H. Wynne. 2012. Three decades of war and food insecurity in Iraq. *Photogrammetric Engineering and Remote Sensing*. 78, 885-95.

[2] Gibson, G. R., J. B. Campbell, and C. E. Zipper. 2015. Sociopolitical influences on cropland area change in Iraq, 2001-2012. *Applied Geography*. 62, 339-346.

[3] Gibson, G.R., N.L. Taylor, N.C. Lamo, and J. K. Lackey. 2017. Effects of Recent Instability on Cultivated Area Along the Euphrates River in Iraq. *The Professional Geographer*. 69, 163-176.

[4] National Aeronautics and Space Administration Land Processes Distributed Active Archive Center (NASA LP DAAC). 2017. Moderate resolution imagine spectroradiometer MOD12Q1 yearly L3 Global 500 m SIN grid land cover product. http://daac.ornl.gov/ (accessed 17 December 2018).

[5] Kranz, M. and S. Gould. 2017. These maps show how drastically ISIS territory has shrunk since its peak. *Business Insider*. https://www.businessinsider.com/maps-of-isis-territory-2014-2017-10/ (accessed 17 December 2018).

[6] Trigo, R. M., C. M. Gouveia, and D. Barriopedro. 2010. The intense 2007-2009 drought in the Fertile Crescent: Impacts and associated atmospheric circulation. *Agricultural and Forest Meteorology*. 150, 1245-1257.

[7] Sykes, H. 2009. Iraq's drought: Eden drying out. BBC News. http://news.bbc.co.uk/2/hi/middle_east/8279290.stm/ (accessed 19 November 2015).

[8] Schnepf, R. 2003. Iraq's agriculture: Background and status. Congressional Research Service Report for Congress. Washington, DC: Library of Congress.

[9] Alnasrawi, A. 2001. Iraq: economic sanctions and consequences, 1990-2000. Third World Quarterly. 22, 205-218.

[10] Ismael, S.T. 2007. The cost of war: the children of Iraq. *Journal of Comparative Family Studies*. 38, 337-357.

[11] Woertz, E. 2014. How long will ISIS last economically? CIDOB Notes Internacionales. 98, 1-5.

[12] Brennan, R. 2014. Withdrawal symptoms: the bungling of the Iraq exit. Foreign Affairs. 93, 25-30.

[13] Kulaksix, S. 2015. Kurdistan Regional Government (KRG): Economic and social impact assessment of the Syrian conflict and ISIS insurgency. World Bank. https://www.wdronline.worldbank.org/handle/10986/21628/ (accessed 19 November 2015).

[14] Al-Khateeb, M. A., N. Al-Ansari, and S. Knutsson. 2014. Sustainable university model for higher education in Iraq. *Creative Education*. 5, 318-28.

[15] Gelvin, James L. 2012. *The Arab Uprisings: What Everyone Needs to Know*. Oxford University Press.

[16] Werrell, C.E., F. Femia, and T. Sternberg. 2015. Did we see it coming?: state fragility, climate vulnerability, and the uprisings in Syria and Egypt. *SAIS Review of International Affairs*. 35, 29–46.

[17] Matar L., Kadri A. (2016) Investment and Neoliberalism in Syria, in: Kadri A. (eds) *Development Challenges and Solutions after the Arab Spring. Rethinking International Development Series*. Palgrave Macmillan, London, pp. 200-217.

[18] Zajac, J. 2015. The EU in the Mediterranean: between its international identity and member state's interests. *European Foreign Affairs Review*. 20, 65-82.

[19] Bagchi, A., and J.A. Paul. 2018. Youth unemployment and terrorism in the MENAP (Middle East, North Africa, Afghanistan, and Pakistan) region. *Socio-Economic Planning Sciences*. 64, 9-20.

[20] Droz-Vincent, P. 2014. "State of Barbary" (Take Two): from the Arab Spring to the return of violence in Syria. *The Middle East Journal*. 68, 33-58.

[21] Human Rights Council. 2011. Report of the independent international commission of inquiry on the Syrian Arab Republic. United Nations General Assembly Human Rights Council Seventeenth Special Session (A/HRC/S-17/2/Add.1).

[22] Gerges, Fawaz A. 2016. *ISIS: A History*. Princeton University Press.

[23] Gulmohamad, Z.K. 2014. The rise and fall of the Islamic State of Iraq and Al-Sham (Levant). *Global Security Studies*. 5, 1-11.

[24] Cronin, A.K. 2015. ISIS is not a terrorist group: why counterterrorism won't stop the latest jihadist threat. *Foreign Affairs*. 94, 87-98.

[25] Isakhan, B. 2011. Targeting the symbolic dimension of Baathist Iraq: cultural destruction, historical memory, and national identity. *Middle East Journal of Culture and Communication*. 4, 257-281.

[26] Younis, N. 2011. Set up to fail: consociational political structures in post-war Iraq, 2003-2010. *Contemporary Arab Affairs*. 4, 1-18.

[27] Natali, D. 2017. Syria's spillover on Iraq: state resilience. *Middle East Policy*. 24, 48-61.

[28] Al-Marashi, I. 2018. Iraq and the Arab Spring: from protests to the rise of ISIS, in: M.L. Haas and D.W. Lesch (Eds.), *The Araba Spring: The Hope and Reality of the Uprisings*. Routledge, New York, pp 147-164.

[29] Estes, R.J. and H. Tiliouine. 2016. Social development trends in the Fertile Crescent region: Jordan, Iraq, Lebanon, and Syria, in: R.J. Estes and H. Tiliouine (Eds.), *The State of Social Progress of Islamic Societies. International Handbooks of Quality-of-Life*. Springer, Cham, pp 179-210.

[30] Aenab, A., and S. K. Singh. 2012. Evaluation of drinking water pollution and health effects in Baghdad, Iraq. *Journal of Environmental Protection*. 3, 533-37.

[31] Wu, W. 2014. Mapping soil salinity changes using remote sensing in central Iraq. *Geoderma Regional*. 2, 21-31.

[32] Al-Saidi, A., and S. K. Al-Jumaiali. 2013. The economic costs and consequences of desertification in Iraq. *Global Journal of Political Science and Administration*. 1, 40-45.

[33] Al-Ansari, N. 2013. Management of water resources in Iraq: Perspectives and prognoses. *Engineering*. 5, 667-84.

[34] Murphy, K. 2013. Access to agricultural inputs, technology and information, communicating with farmers, and the role of women in agriculture: Perceptions of Iraqi extension agents. *Journal of International Agricultural and Extension Education*. 20, 6-18.

[35] FAO, 2012. Syrian Arab Republic Joint Rapid Food Security Needs Assessment (JRFSNA). United Nations Foreign Agriculture Office Report. http://www.fao.org/giews/english/otherpub/JRFSNA_Syrian2012.pdf/ (accessed 17 December 2018).

[36] Eklund, L., M. Degerald, M. Brandt, A.V. Prishchepov, and P. Pilesjö. 2017. How conflict affects land use: agricultural activity in areas seized by the Islamic State. *Environmental Research Letters*. 12, 1-10.

[37] Abdelali-Martini, M., K. Ibrahim, and D. Boubaker. 2016. Migrants from marginal dry areas in Syria: destinations, employment, and returns. *Journal of Development and Migration*. 5:23, 1-14.