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Version

NASA Making Earth System Data Records for Use in Research Environments (MEaSUREs) Global Food Security-support Analysis Data (GFSAD) @ 30-m of Australia, New Zealand, China, and Mongolia: Cropland Extent-Product (GFSAD30AUNZCNMOCE)

User Guide

Document History

Document Version	Publication Date	Description
1.0	September, 2017	Original
1.1	September, 2017	Modification made according to USGS reviewer comments
1.2	September 2017	Modifications made according to LPDACC reviewer comments

Contents

1.0 Dataset Overview

The goal of the Global Food Security-support Analysis Data @ 30-m (GFSAD30) is to provide highest resolution, objective cropland datasets to assist and address global food and water security issues of the twenty-first century. The project proposed developing cropland products using time-series Landsat and Sentinel satellite sensor data, machine learning algorithms, and cloud computing. The project is funded by the National Aeronautics and Space Administration (NASA) with supplemental funding from the United States Geological Survey (USGS). The project is led by USGS and carried out in collaboration with NASA AMES, University of New Hampshire (UNH), California State University Monterey Bay (CSUMB), University of Wisconsin (UW), NASA GSFC, and Northern Arizona University (NAU). There were a number of International partners, including The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).

This user guide provides guidelines of the GFSAD30 cropland extent product for the countries of Australia, New Zealand, China, and Mongolia (GFSAD30AUNZCNMOCE) at nominal 30m in 2015 (note: Landsat-8 16 day data was used for 2 to 3 years from 2013-2015, but the product is referred to as nominal 2015). The Coordinate Reference System (CRS) used for the GFSAD30AUNZCNMOCE is a geographic coordinate system (GCS) based on the World Geodetic System 84 (WGS84) reference ellipsoid. The legend is presented in Section 2. Datasets are provided in 10^o x 10^o raster grid (GeoTIFF) format. The year, resolution, tiling, and file name convention details are provided in section 2.0 and its sub-section of this document.

1.1 Background

Monitoring global croplands (GCs) is imperative for ensuring sustainable water and food security to the people of the world in the Twenty-first Century. However, the currently available cropland products suffer from major limitations such as: (a) Absence of precise spatial location of the cropped areas; (b) Coarse resolution nature of the map products with significant uncertainties in areas, locations, and detail; (c) Uncertainties in differentiating irrigated areas from rainfed areas; (d) Absence of crop types and cropping intensities; and (e) Absence of a dedicated web\data portal for the dissemination of cropland products. Therefore, our project aims to close these gaps through a Global Food Security support-Analysis Data @ 30-m (GFSAD30) product.

Satellite-derived cropland extent maps at high spatial resolution are necessary for food and water security analysis. Thereby, GFSAD30AUNZCNMOCE cropland extent products were produced at a resolution of 30-m for the countries of China, Australia, New Zealand, and Mongolia for the nominal year 2015 using Landsat-8 time-series data. These data are part of a global data release; thereby each region will be made publically available. Global cropland extent maps, indicating cropland and non-cropland areas, provide working baseline data to develop high-level products such as crop watering methods (irrigated or rainfed), cropping intensities (e.g., single, double, or continuous cropping), crop type mapping, cropland fallows, as well as assessment of cropland productivity (productivity per unit of land), and crop water productivity (productivity per unit of water or “crop per drop”). Uncertainties associated with cropland extent maps have a cascading effect on all higher-level cropland products.

Cloud-based geo-spatial computing platforms and satellite image inventory offer opportunities for producing precise and accurate maps of cropland extent and area that meet the spatial and temporal requirements of broad applications. Such maps can be a significant improvement compared to existing products, which tend to have coarser resolution, are often not representative of regions with highly dynamic change, and have a fixed set of cover classes. Cloud-based computing platforms such as Google Earth Engine and new earth-observing satellites like Landsat 8 have brought significant improvements to LULC mapping and agriculture monitoring. Specifically, the production of standard static maps of the past will be shifted to dynamic creation maps from massively large volumes of big data, crowd sourcing of training and validation samples, and implementing machine-learning algorithms on the cloud to serve more specific applications.

For a detailed description of the satellite and reference data, processing scheme, approaches, methods, results, and conclusions please refer to the algorithm theoretical basis document (ATBD) of GFSAD30AUNZCNMOCE.

2.0 Dataset Characteristics

Global Food Security-support Analysis Data @ 30-m cropland extent for the countries of Australia, New Zealand, China, and Mongolia (GFSAD30AUNZCNMOCE), datasets and characteristics are described below.

Note overlapping tiles: The following tile also covers part of another tile
in GFSAD30SEACE (Indonesia). Please ignore the Indonesian data in the following tile and keep only Australian part.
GFSAD30AUNZCNMOCE_2015_S20E120_001_2017286154500.tif

2.1 Global Food Security Support Analysis Data (GFSAD) 30-m V001

2.1.1 Collection Level

Short name	GFSAD30AUNZCNMOCE
Temporal Granularity	Static
Temporal Extent	2015, nominal
Spatial Extent	Australia, New Zealand, China, Mongolia
File size	~800 MB
Coordinate System	Geographic
Datum	WGS84
File Format	GeoTIFF

2.1.2 Granule Level

Number of Layers	1
Columns/Rows	307053 x 272312
Pixel Size	~30 m

2.1.3 Data Layer Characteristics

SDS Layer Name	Description	Units	Data Type	Fill Value	Valid Range	Scale Factor
Band 1	Crop Extent for Australia, New Zealand, China, Mongolia	N/A	8-bit unsigned integer	N/A	0,1,2	N/A

2.1.4 Data Layers Classification

Class Label	Class Name	Description
0	Water	Ocean and Water bodies
1	Non-Cropland	Non-Cropland areas
2	Cropland	Cropland and cropland fallows

2.1.5 Filename Convention

GFSAD30AUNZCNMOCE_2015_S16E120_001_2017261203010.tif
GFSAD30AUNZCNMOCE = Product Short name
30 = 30 m Spatial Resolution
AUNZCNMO = Australia, New Zealand, China, Mongolia
CE = Crop Extent
2015 = Nominal Year
S16E120 = 10 x 10 degree grid, starting at (S16, E120)
001 = Version
20172612030105 = Processing Date in YYYYJJJHHMMSS

3.0 Dataset Knowledge

The following questions address the user information regarding the **GFSAD30AUNZCNMOCE** collection.

3.1 Frequently Asked Questions

What is the accuracy of the GFSAD30AUNZCNMOCE product?

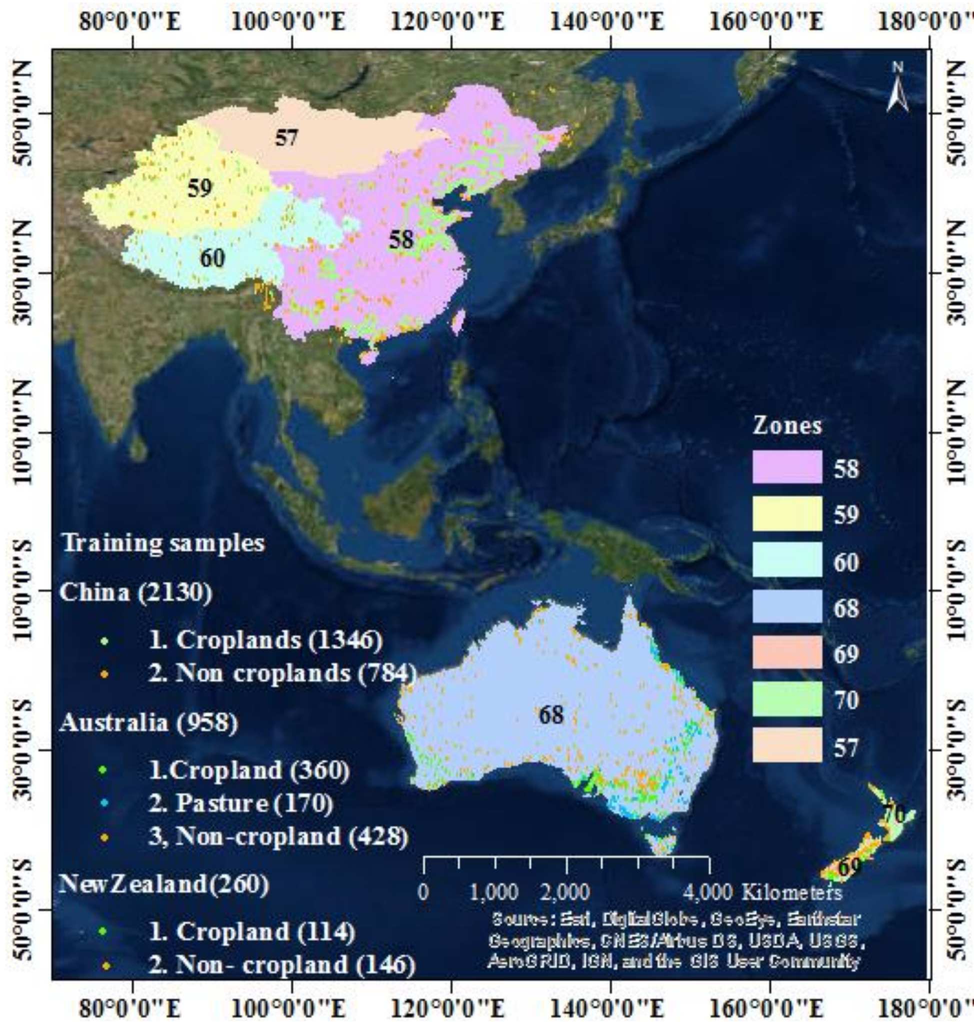
1. For the entire country of China, the overall accuracy was 94% (table below) with producer's accuracy of 80% and user's accuracy of 84.2%. When considering all three zones of China, 95% of total cropland areas of China was in zone #58, 4% of total cropland area of China is in zone #59, and only 1% of total cropland area of China is in zone #60. For more details, please see ATBD. Zone #58, which has 95% of all China's croplands, has producer's accuracy of 83.3% and user's accuracy of 84.2%. These results clearly imply the high level of confidence in differentiating croplands from non-croplands for China. High producer's accuracies across zones suggest that few croplands were omitted during the mapping process.
2. For all of Australia (zone #68), the overall accuracy was 97.6% with producer's accuracy of 98.8% and user's accuracy of 79.0%. Very high level of producer's accuracy indicate that almost all croplands of Australia have been mapped.
3. For all of New Zealand, the overall accuracy was 93.4% with producer's accuracy of 91.7% and user's accuracy of 82.7%. High levels of producer's accuracies imply that an overwhelming proportion of the croplands has been mapped.
4. For all of Mongolia, the overall accuracy was 98.4% with producer's accuracy of 75.0% and user's accuracy of 92.3 %. High levels of overall accuracy.

China		Reference Data			
		Crop	No-Crop	Total	User Accuracy
Map Data	Crop	272	51	323	84.2%
	No-Crop	68	1,581	1,649	95.9%
Total		340	1,632	1,972	
Producer Accuracy		80.0 %	96.9 %		**94.0%**

Australia		Reference Data			
		Crop	No-Crop	Total	User Accuracy
Map Data	Crop	79	21	100	79.0%
	No-Crop	1	799	800	99.9%
Total		80	820	900	
Producer Accuracy		98.8%	97.4%		**97.6%**

New Zealand		Reference Data			
		Crop	No-Crop	Total	User Accuracy
Map Data	Crop	110	23	133	82.7%
	No-Crop	10	357	367	97.3%
Total		120	380	500	
Producer Accuracy		91.7%	94.0%		**93.4%**

Mongolia		Reference Data			
		Crop	No-Crop	Total	User Accuracy
Map Data	Crop	12	1	13	92.3%
	No-Crop	4	293	297	98.7%
Total		16	294	310	
Producer Accuracy		75.0%	99.7%		**98.4%**



What do the GFSAD30AUNZCNMOCE product contain?
It is a cropland extent product for Australia, New Zealand, China, and Mongolia at nominal 30-m for the nominal year 2015. This product is produced using Landsat-8 time-series satellite sensor data for the 2013-2015 time period.

What is the definition of the crop extent?
For the entire Global Food Security-support Analysis Data at 30-m (GFSAD30) project, cropland extent was defined as: "*lands cultivated with plants harvested for food, feed, and fiber, including both seasonal crops (e.g., wheat, rice, corn, soybeans, cotton) and continuous plantations (e.g.,*

coffee, tea, rubber, cocoa, oil palms). Cropland fallows are lands uncultivated during a season or a year but are farmlands and are equipped for cultivation, including plantations (e.g., orchards, vineyards, coffee, tea, rubber)" (Teluguntla et al., 2015). Cropland extent includes all planted crops and fallowed lands. Non-croplands include all other land cover classes other than croplands and cropland fallows.

How to access the dataset?
All GFSAD30 products are downloadable through the Land Processes Distributed Active Archive Center (LP DAAC). The **GFSAD30AUNZCNMOCE** product, divided into 10x10 grids, is among them. You can also visualize these data at https://croplands.org by going to the "products" drop-down menu.

Is the data available through Google Earth Engine (GEE)?
No. Not at this time. LP DAAC is the only source of the 30-m cropland extent product. In the future, we may make the data available through GEE (please contact PI of the project: Prasad S. Thenkabail)

4.0 Dataset Access (Applicable Data Tools)

The **GFSAD30AUNZCNMOCE** dataset is available through the LP DAAC Data Pool and NASA Earthdata Search. GFSAD data visualization and information are also made available at our Global Croplands Website: https://croplands.org

5.0 Contact Information

LP DAAC User Services
U.S. Geological Survey (USGS)
Center for Earth Resources Observation and Science (EROS)
47914 252nd Street
Sioux Falls, SD 57198-0001

Phone Number: 605-594-6116
Toll Free: 866-573-3222 (866-LPE-DAAC)
Fax: 605-594-6963
Email: lpdaac@usgs.gov
Web: https://lpdaac.usgs.gov

For the Principal Investigators, feel free to write to:
Prasad S. Thenkabail at pthenkabail@usgs.gov

For the 30-m cropland extent product of Australia, New Zealand, China, and Mongolia, please contact:
Pardhasaradhi Teluguntla at pteluguntla@usgs.gov
Prasad S. Thenkabail at pthenkabail@usgs.gov
Jun Xiong at jxiong@usgs.gov

More details about the GFSAD30 project and products can be found at: **globalcroplands.org**

6.0 Citations

6.1 GFSAD30AUNZCNMOCE

Teluguntla, P., Thenkabail, P.S., Xiong, J., Gumma, M.K., Congalton, R.G., Oliphant, A.J., Sankey, T., Poehnelt, J., Yadav, K., Massey, R., Phalke, A., Smith, C. (2017). *NASA Making Earth System Data Records for Use in Research Environments (MEaSUREs) Global Food Security-support Analysis Data (GFSAD) Cropland Extent 2015 Australia, New Zealand, China, Mongolia 30 m V001* [Data set]. NASA EOSDIS Land Processes DAAC. doi: 10.5067/MEaSUREs/GFSAD/GFSAD30AUNZCNMOCE.001

7.0 Publications

7.1 Peer-reviewed publications relevant to this study

Teluguntla, P., Thenkabail, P.S., Oliphant, A., Xiong, J., Gumma, M., Congalton, R., and Yadav, K. (2017). 30-m Cropland Extent and Areas of Australia, New Zealand, China, and Mongolia for the Year 2015 Derived using Landsat-8 Time-Series Data for three years (2013-2015) using Random Forest Algorithm on Google Earth Engine Cloud Platform. In preparation.

Teluguntla, P., Thenkabail, P.S., Xiong, J., Gumma, M.K., Congalton, R.G., Oliphant, A., Poehnelt, J., Yadav, K., Rao, M., and Massey, R. 2017. Spectral matching techniques (SMTs) and automated cropland classification algorithms (ACCAs) for mapping croplands of Australia using MODIS 250-m time-series (2000–2015) data, International Journal of Digital Earth. DOI:10.1080/17538947.2016.1267269.IP-074181, http://dx.doi.org/10.1080/17538947.2016.1267269.

Teluguntla, P., Thenkabail, P., Xiong, J., Gumma, M.K., Giri, C., Milesi, C., Ozdogan, M., Congalton, R., Yadav, K., 2015. CHAPTER 6 - Global Food Security Support Analysis Data at Nominal 1 km (GFSAD1km) Derived from Remote Sensing in Support of Food Security in the Twenty-First Century: Current Achievements and Future Possibilities, in: Thenkabail, P.S. (Ed.), Remote Sensing Handbook (Volume II): Land Resources Monitoring, Modeling, and Mapping with Remote Sensing. CRC Press, Boca Raton, London, New York., pp. 131–160. Link.

Xiong, J., Thenkabail, P.S., Tilton, J.C., Gumma, M.K., Teluguntla, P., Oliphant, A., Congalton, R.G., Yadav, K. 2017. A Nominal 30-m Cropland Extent and Areas of Continental Africa for the Year 2015 by Integrating Sentinel-2 and Landsat-8 Data using Random Forest, Support Vector Machines and Hierarchical Segmentation Algorithms on Google Earth Engine Cloud. Remote Sensing Open Access Journal (in review).

Xiong, J., Thenkabail, P.S., Gumma, M.K., Teluguntla, P., Poehnelt, J., Congalton, R.G., Yadav, K., Thau, D. 2017. Automated cropland mapping of continental Africa using Google Earth Engine cloud computing, ISPRS Journal of Photogrammetry and Remote Sensing, Volume 126, April 2017, Pages 225-244, ISSN 0924-2716, https://doi.org/10.1016/j.isprsjprs.2017.01.019.

7.2 Peer-reviewed publications within GFSAD project

Congalton, R.G., Gu, J., Yadav, K., Thenkabail, P.S., and Ozdogan, M. 2014. Global Land Cover Mapping: A Review and Uncertainty Analysis. Remote Sensing Open Access Journal. Remote Sens. 2014, 6, 12070-12093; http://dx.doi.org/10.3390/rs61212070.

Congalton, R.G, 2015. Assessing Positional and Thematic Accuracies of Maps Generated from Remotely Sensed Data. Chapter 29, In Thenkabail, P.S., (Editor-in-Chief), 2015. Remote Sensing Handbook Volume I: Volume I: Data Characterization, Classification, and Accuracies: Advances of Last 50 Years and a Vision for the Future. Taylor and Francis Inc.\CRC Press, Boca Raton, London, New York. Pp. 900+. In Thenkabail, P.S., (Editor-in-Chief), 2015. "Remote Sensing Handbook" Volume I**: Remotely Sensed Data Characterization, Classification, and Accuracies**. Taylor and Francis Inc.\CRC Press, Boca Raton, London, New York. ISBN 9781482217865 - CAT# K22125. Print ISBN: 978-1-4822-1786-5; eBook ISBN: 978-1-4822-1787-2. Pp. 678.

Gumma, M.K., Thenkabail, P.S.,Teluguntla, P., Rao, M.N., Mohammed, I.A., and Whitbread, A.M. 2016. Mapping rice-fallow cropland areas for short-season grain legumes intensification in South Asia using MODIS 250 m time-series data. International Journal of Digital Earth, http://dx.doi.org/10.1080/17538947.2016.1168489

Massey, R., Sankey, T.T., Congalton, R.G., Yadav, K., Thenkabail, P.S., Ozdogan, M., Sánchez Meador, A.J. 2017. MODIS phenology-derived, multi-year distribution of conterminous U.S. crop types, Remote Sensing of Environment, Volume 198, 1 September 2017, Pages 490-503, ISSN 0034-4257, https://doi.org/10.1016/j.rse.2017.06.033.

Phalke, A. R., Ozdogan, M., Thenkabail, P. S., Congalton, R. G., Yadav, K., & Massey, R. et al. (2017). A Nominal 30-m Cropland Extent and Areas of Europe, Middle-east, Russia and Central Asia for the Year 2015 by Landsat Data using Random Forest Algorithms on Google Earth Engine Cloud. (in preparation).

Teluguntla, P., Thenkabail, P.S., Xiong, J., Gumma, M.K., Congalton, R.G., Oliphant, A., Poehnelt, J., Yadav, K., Rao, M., and Massey, R. 2017. Spectral matching techniques (SMTs) and automated cropland classification algorithms (ACCAs) for mapping croplands of Australia using MODIS 250-m time-series (2000–2015) data, International Journal of Digital Earth. DOI:10.1080/17538947.2016.1267269.IP-074181, http://dx.doi.org/10.1080/17538947.2016.1267269.

Teluguntla, P., Thenkabail, P., Xiong, J., Gumma, M.K., Giri, C., Milesi, C., Ozdogan, M., Congalton, R., Yadav, K., 2015. CHAPTER 6 - Global Food Security Support Analysis Data at Nominal 1 km (GFSAD1km) Derived from Remote Sensing in Support of Food Security in the Twenty-First Century: Current Achievements and Future Possibilities, in: Thenkabail, P.S. (Ed.), Remote Sensing Handbook (Volume II): Land Resources Monitoring, Modeling, and Mapping with Remote Sensing. CRC Press, Boca Raton, London, New York., pp. 131–160. Link.

Xiong, J., Thenkabail, P.S., Tilton, J.C., Gumma, M.K., Teluguntla, P., Oliphant, A., Congalton, R.G., Yadav, K. 2017. A Nominal 30-m Cropland Extent and Areas of Continental Africa for the Year 2015 by Integrating Sentinel-2 and Landsat-8 Data using Random Forest, Support Vector Machines and Hierarchical Segmentation Algorithms on Google Earth Engine Cloud. Remote Sensing Open Access Journal (in review).

Xiong, J., Thenkabail, P.S., Gumma, M.K., Teluguntla, P., Poehnelt, J., Congalton, R.G., Yadav, K., Thau, D. 2017. Automated cropland mapping of continental Africa using Google Earth Engine cloud computing, ISPRS Journal of Photogrammetry and Remote Sensing, Volume 126, April 2017, Pages 225-244, ISSN 0924-2716, https://doi.org/10.1016/j.isprsjprs.2017.01.019.

7.3 Web sites and Data portals:

http://croplands.org (30-m global croplands visualization tool)
http://geography.wr.usgs.gov/science/croplands/index.html (GFSAD30 web portal and dissemination)
http://geography.wr.usgs.gov/science/croplands/products.html#LPDAAC (dissemination on LP DAAC)
http://geography.wr.usgs.gov/science/croplands/products.html (global croplands on Google Earth Engine)
croplands.org (crowdsourcing global croplands data)

7.4 Other relevant past publications prior to GFSAD project

Biggs, T., Thenkabail, P.S., Krishna, M., GangadharaRao Rao, P., and Turral, H., 2006. Vegetation phenology and irrigated area mapping using combined MODIS time-series, ground surveys, and agricultural census data in Krishna River Basin, India. International Journal of Remote Sensing. 27(19):4245-4266.

Biradar, C.M., Thenkabail, P.S., Noojipady, P., Yuanjie, L., Dheeravath, V., Velpuri, M., Turral, H., Gumma, M.K., Reddy, O.G.P., Xueliang, L. C., Schull, M.A., Alankara, R.D., Gunasinghe, S., Mohideen, S., Xiao, X. 2009. A global map of rainfed cropland areas (GMRCA) at the end of last millennium using remote sensing. International Journal of Applied Earth Observation and Geoinformation. 11(2). 114-129. doi:10.1016/j.jag.2008.11.002. January, 2009.

Dheeravath, V., Thenkabail, P.S., Chandrakantha, G, Noojipady, P., Biradar, C.B., Turral. H., Gumma, M.1, Reddy, G.P.O., Velpuri, M. 2010. Irrigated areas of India derived using MODIS 500m data for years 2001-2003. ISPRS Journal of Photogrammetry and Remote Sensing. http://dx.doi.org/10.1016/j.isprsjprs.2009.08.004. 65(1): 42-59.

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Thenkabail, P. S.; Dheeravath, V.; Biradar, C. M.; Gangalakunta, O. P.; Noojipady, P.; Gurappa, C.; Velpuri, M.; Gumma, M.; Li, Y. 2009b. Irrigated Area Maps and Statistics of India Using Remote Sensing and National Statistics. Journal Remote Sensing. 1:50-67. http://www.mdpi.com/2072-4292/1/2/50.

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7.5 Books and Book Chapters

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Biradar, C.M., Thenkabail. P.S., Noojipady, P., Li, Y.J., Dheeravath, V., Velpuri, M., Turral, H., Cai, X.L., Gumma, M., Gangalakunta, O.R.P., Schull, M., Alankara, R.D., Gunasinghe, S., and Xiao, X. 2009. Book Chapter 15: Global map of rainfed cropland areas (GMRCA) and stastistics using remote sensing. Pp. 357-392. In the book entitled: “Remote Sensing of Global Croplands for Food Security” (CRC Press- Taylor and Francis group, Boca Raton, London, New York. Pp. 475. Published in June, 2009. (Editors: Thenkabail. P., Lyon, G.J., Biradar, C.M., and Turral, H.).

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