Land cover classification applying Sentinel imagery for Kavango Zambezi Transfrontier Conservation Area (KAZA TFCA)

Contract #13816

WWF GERMANY and EARTH OBSERVATION SOLUTIONS AND SERVICES (EOSS) GMBH

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Backgound

The Kavango Zambezi Transfrontier Conservation Area is the largest terrestrial transboundary conservation area in the world. KAZA is located at the confluence of five southern African countries - Angola, Botswana, Namibia, Zambia and Zimbabwe – and covers an area of 520,000 km2, or roughly the size of France. KAZA is a mixed land-use landscape with 20 National Parks, 85 Forest Reserves, 22 Conservancies, 11 Sanctuaries, 103 Wildlife Management Areas and 11 Game Management Areas. About 20% of the land falls under state protection and roughly 29% used for agriculture. KAZA is home to three UNESCO World Heritage Sites - the Victoria Falls, the Okavango Delta and the Tsodilo Hills. The KAZA TFCA vision of "Establishing a world-class transfrontier conservation area and tourism destination in the Okavango and Zambezi river basin regions within the context of sustainable development" is premised upon a concerted, five-country effort to harness the region's rich natural resources to promote economic development through conservation and tourism. Given KAZA's regional and ecological/conservation significance, WWF has been supporting it since inception.

Objectives

The overall goal is to perform a land cover classification for KAZA TFCA by applying Sentinel 2 data for the year 2020.

Tasks

I. Update 2005 land cover map for KAZA region based on high resolution Sentinel-2 data for the year 2020
    a. By applying the same scheme of classes that was used in 2005
II. Provide a land cover map in vector, raster, and tabular formats with results for the year 2020
III. Classification of agriculture fields:
    a. Test for crop differentiation based on training data provided by WWF
    b. Separate agriculture fields as per crop and size
IV. Accuracy assessment of each proposed class based on existing validation data and expert consultation
V. Technical documentation in form of a report, explaining each of the steps performed for the classification process
VI. Ensure that the method can be replicate in the future: provide full documentation of the product, production metadata and methods applied

Land cover mapping for Kavango Zambezi Transfrontier Conservation Area using Sentinel-2

Following paragraphs describe the data and methods applied for land cover mapping. The general workflow is given in the following figure.

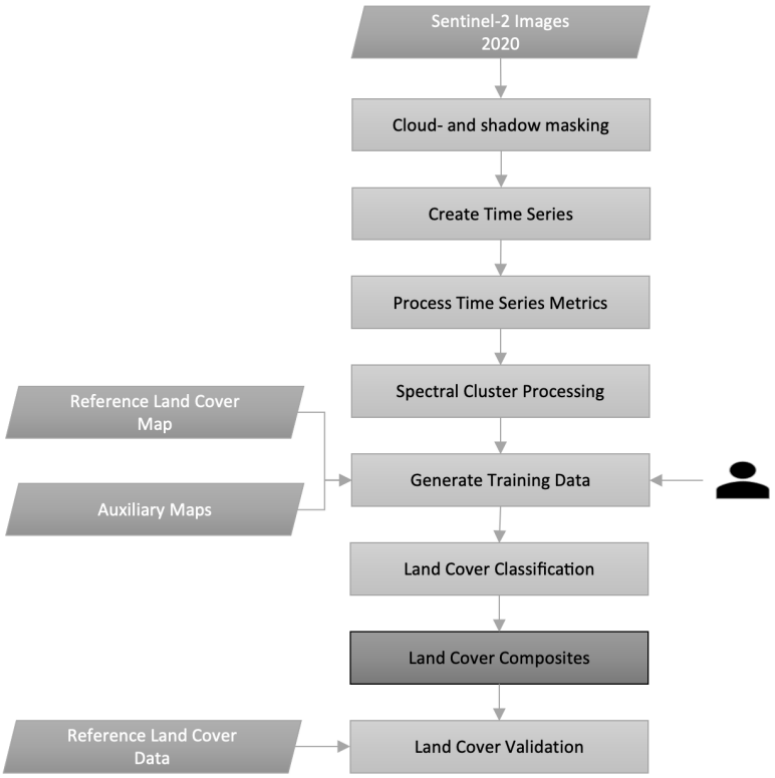


Figure 1. General Sentinel-2 Landcover mapping workflow

Data acquisition

Land cover mapping for the KAZA TFCA area is sourced by Landsat 8 satellite images. The area is covered by 92 Sentinel-2 granules. In total, 5719 scenes were collected for the year 2020. Required images were identified querying the EOSS data catalog API[1]. Sentinel-2 images have been acquired at levels 1C (reflectance above the atmosphere) and 2A (surface reflectance). Level 1-C data were acquired through Copernicus SciHub[2] and Level 2-A images were acquired through Sentinel-Hub[3].

[1] https://catalog.eoss.cloud/
[2] https://scihub.copernicus.eu/
[3] https://www.sentinel-hub.com/

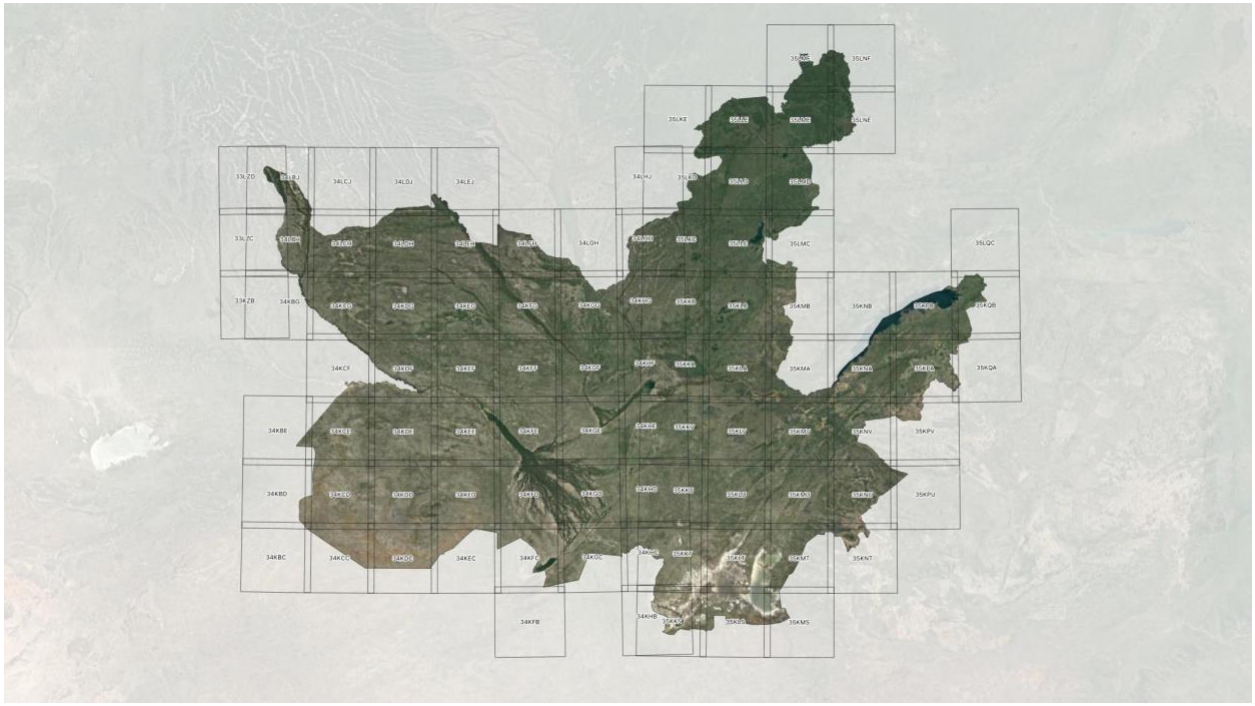


Figure 2. Sentinel-2 image granules in the KAZA TFCA project area

Time series generation

With the acquired Sentinel-2 Level-2A satellite imagery time series were generated for any given spectral band and additionally processed spectral indices (NDVI, NDWI). Thereby, pixels obscured by clouds and shadows were masked out. Cloud and cloud shadow masks have before been processed based on the Level-1C satellite data products using the FMASK[4] algorithm.
For any of the 92 granules, following 26 annual timeseries were processed, for any spectral band and spatial resolution and any calculated spectral index: *B01_60m, B02_10m, B02_20m, B02_60m, B03_10m, B03_20m, B03_60m, B04_10m, B04_20m, B04_60m, B05_20m, B05_60m, B06_20m, B06_60m, B07_20m, B07_60m, B08_10m, B09_60m, B11_20m, B11_60m, B12_20m, B12_60m, B8A_20m, B8A_60m, NDVI, NDWI*.
As an example, the annual 2020 timeseries for band 2 at 10 m resolution for granule 34KGC stores 82 image bands, each representing the spectral band 2 for any of the 82 distinct image acquisition in 2020. A timeseries is modeled as virtual raster format accompanied by an archive storing the individual acquisition dates.
In total, 2392 annual time series were generated (92 granules by 26 bands, indices).

Time series metrics processing

For any granule, spectral band at 10m or 20m resolution and spectral index time series metrics were processed on a pixel level, namely the descriptive statistics (median, count) and the 5th, 25th, 50th, 75th, and 95th percentiles. Thereby, pixels masked as cloud or cloud shadow were ignored.
As an example, for granule 33KZB time series metrics were processed for the following time series: *sentinel2_33KZB_B02_10m__2020, sentinel2_33KZB_B02_20m__2020, sentinel2_33KZB_B03_10m__2020, sentinel2_33KZB_B03_20m__2020, sentinel2_33KZB_B04_10m__2020, sentinel2_33KZB_B04_20m__2020, sentinel2_33KZB_B05_20m__2020, sentinel2_33KZB_B06_20m__2020, sentinel2_33KZB_B07_20m__2020, sentinel2_33KZB_B08_10m__2020, sentinel2_33KZB_B11_20m__2020, sentinel2_33KZB_B12_20m__2020, sentinel2_33KZB_B8A_20m__2020, sentinel2_33KZB_NDVI__2020, sentinel2_33KZB_NDWI__2020*.
For each of them, the 7 statistics were processed. As an example, the 10 m band 4 is represented by the following time series metrics: *sentinel2_33KZB_B04_10m__2020_count.tif,*

[4] http://www.pythonfmask.org/en/latest/

sentinel2_33KZB_B04_10m__2020_median.tif, sentinel2_33KZB_B04_10m__2020_p25.tif, sentinel2_33KZB_B04_10m__2020_p5.tif, sentinel2_33KZB_B04_10m__2020_p50.tif, sentinel2_33KZB_B04_10m__2020_p75.tif, sentinel2_33KZB_B04_10m__2020_p95.tif.

In total, 9660 metrics (92 granules, 15 bands in 10m or 20m resolution, and 7 statistic derivates) were processed.
An additional overall NDVI metric was calculated as the sum of the 5th, 25th, 50th, 75th, and 95th NDVI percentiles for each of the given granules.
Supporting image segmentation and metrics visualizations physical image stacks were processed for any granule using the 50th percentile metrics band for the 4 spectral bands available at 10-meter resolution.

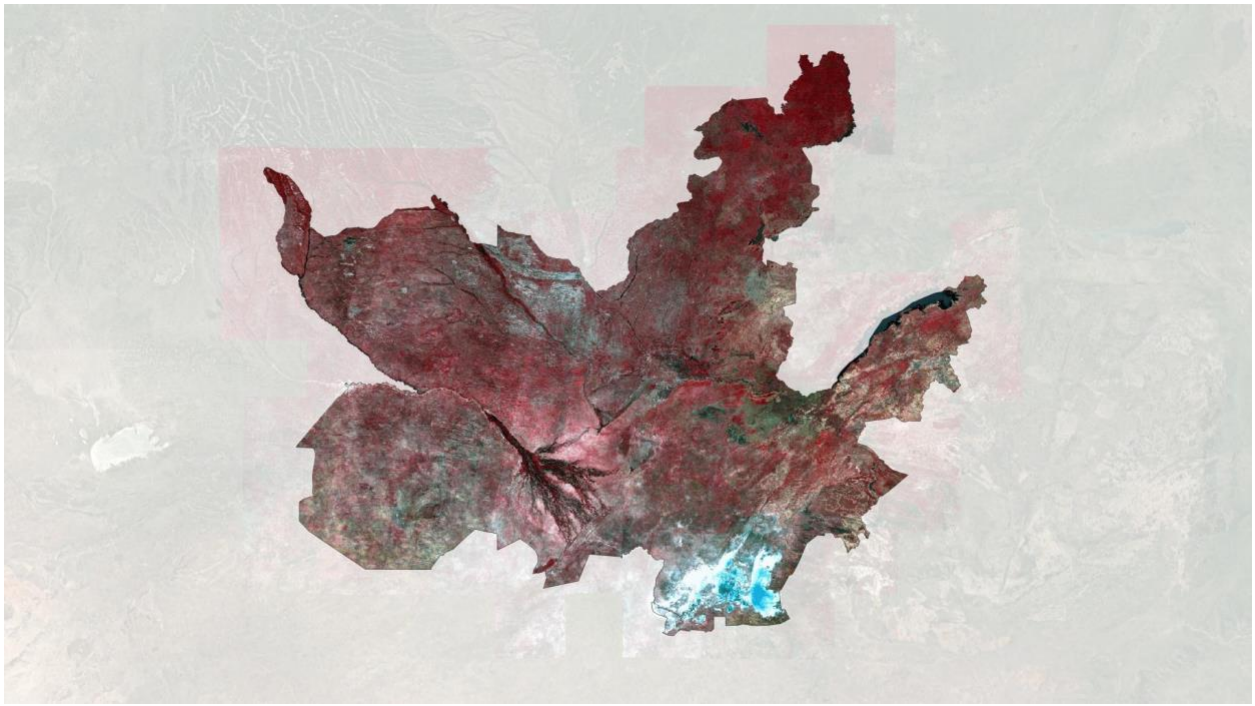


Figure 3: Sentinel-2 false-color composite 2020 based on the 50th percentile of the timeseries metrics of bands 8, 4, 3.

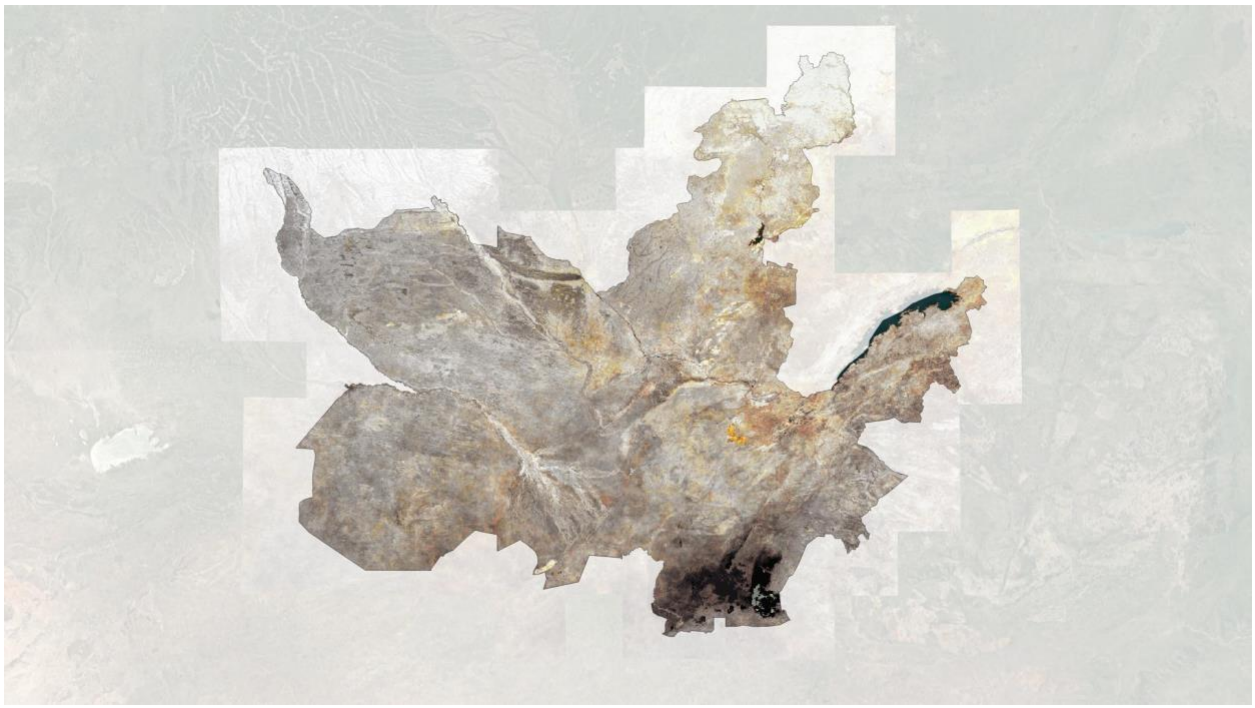


Figure 4: Sentinel-2 NDVI false-color composite 2020 based on the 95th, 75th and 50th percentile of the NDVI timeseries metrics

Spectral clustering

In support of data driven training data generation, an unsupervised object-oriented spectral clustering was performed for any given granule. Image segmentation was sources by Berkeley Image Segmentation software[5] and used the 10m band 4 metric stacks. For any segmented image object average statistics were calculated from the 50th percentile metrics of bands 2, 3, 4 and 8, the 50th, 75th and 95th NDVI percentiles, the 50th band 11 and band 12 percentiles and the TanDEM-X - Digital Elevation Model (DEM) and derived slope. Clustering was performed towards a set of 25 clusters per granule.
Clustering results were stored to vector and raster representation and calculated object features were stored as well.

[5] https://www.imageseg.com/

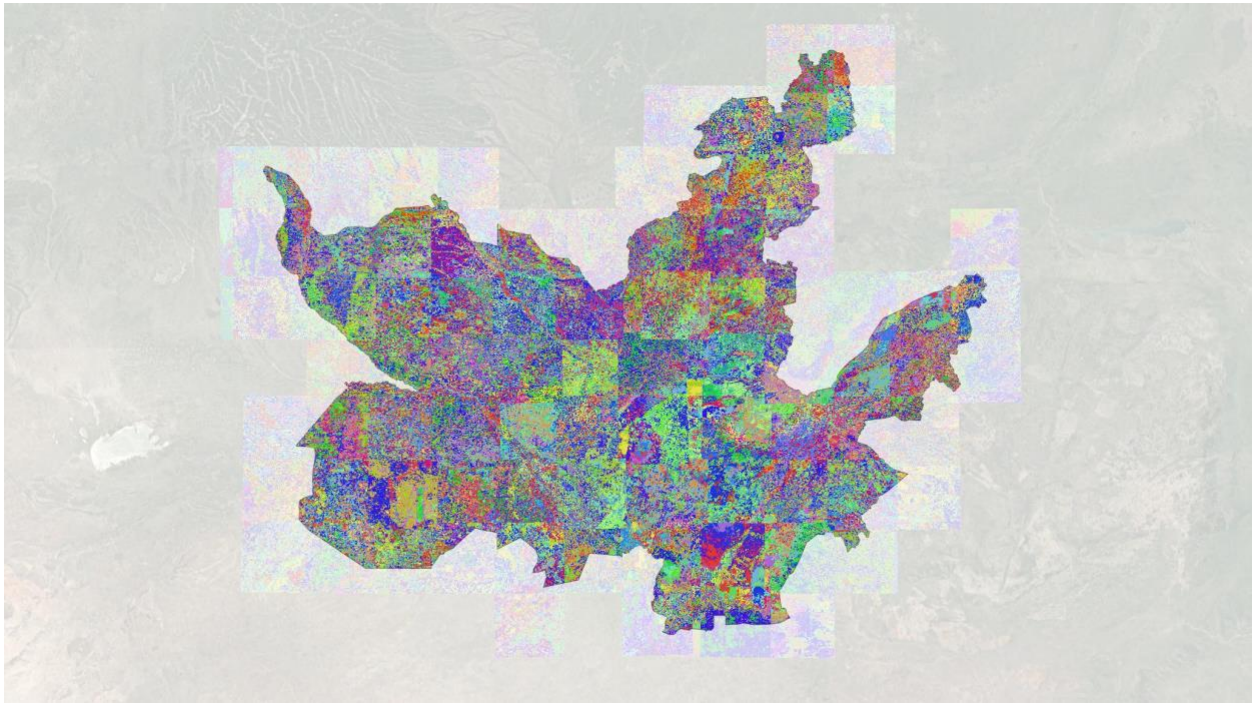


Figure 5: Results from unsupervised object-oriented spectral clustering

Generation of training data

In support of training data generation, the following land cover maps were acquired:

- the 2005 Kavango-Zambesi 30m land cover dataset provided by WWF
- the prototype high resolution land cover map at 20m over Africa based on 1 year of Sentinel-2A observations from December 2015 to December 2016 provided by ESRIN CCI[6]
- the moderate-resolution Copernicus Global Land Service land cover map of 2019[7]
- the infrastructure and water vector layers from Open Street Map[8]

[6] http://2016africalandcover20m.esrin.esa.int/
[7] https://zenodo.org/record/3939050#.YIkcxmixVzU
[8] http://download.geofabrik.de/africa.html

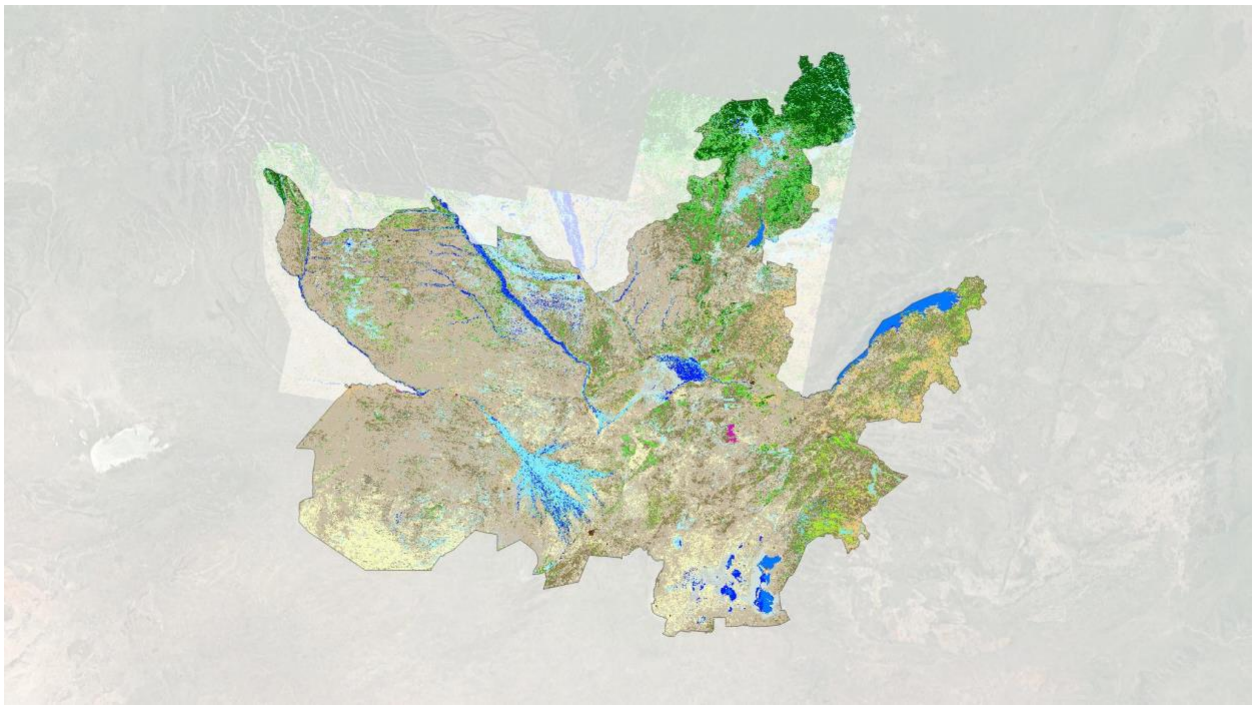


Figure 6: the 2005 Kavango-Zambesi 30m land cover dataset provided by WWF

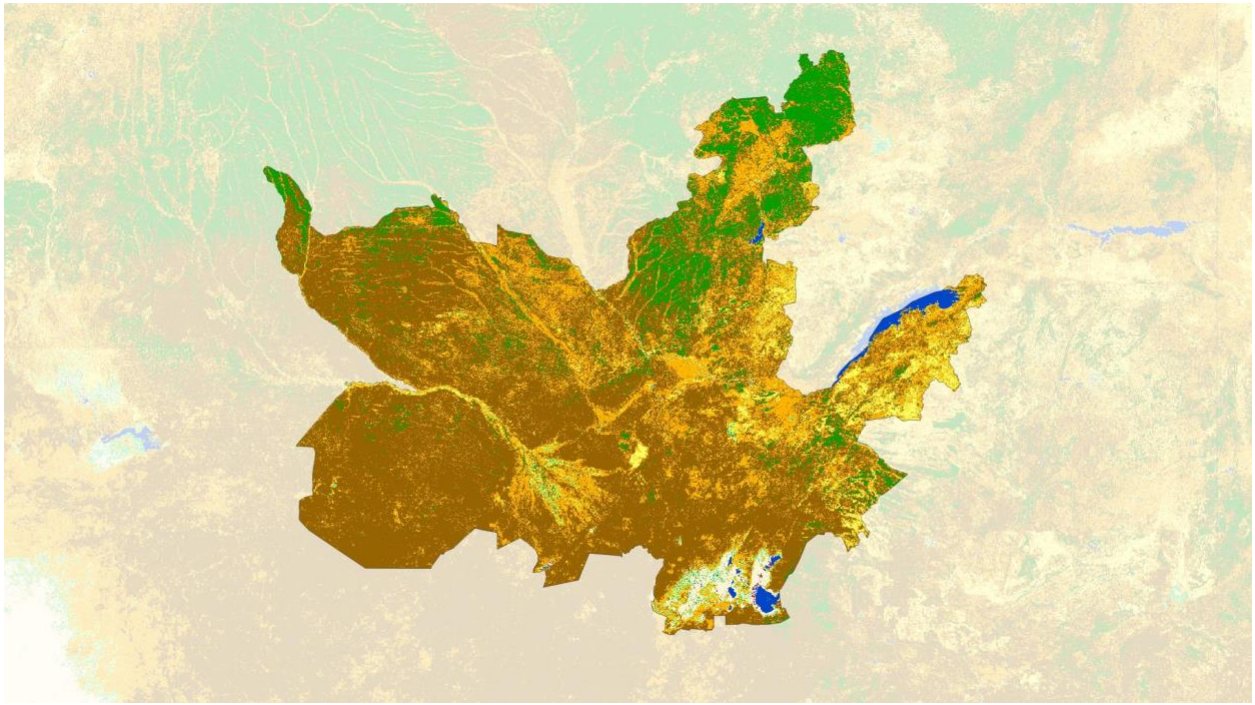


Figure 7: the 2019 prototype 20m resolution land cover map provided by ESRIN CCI

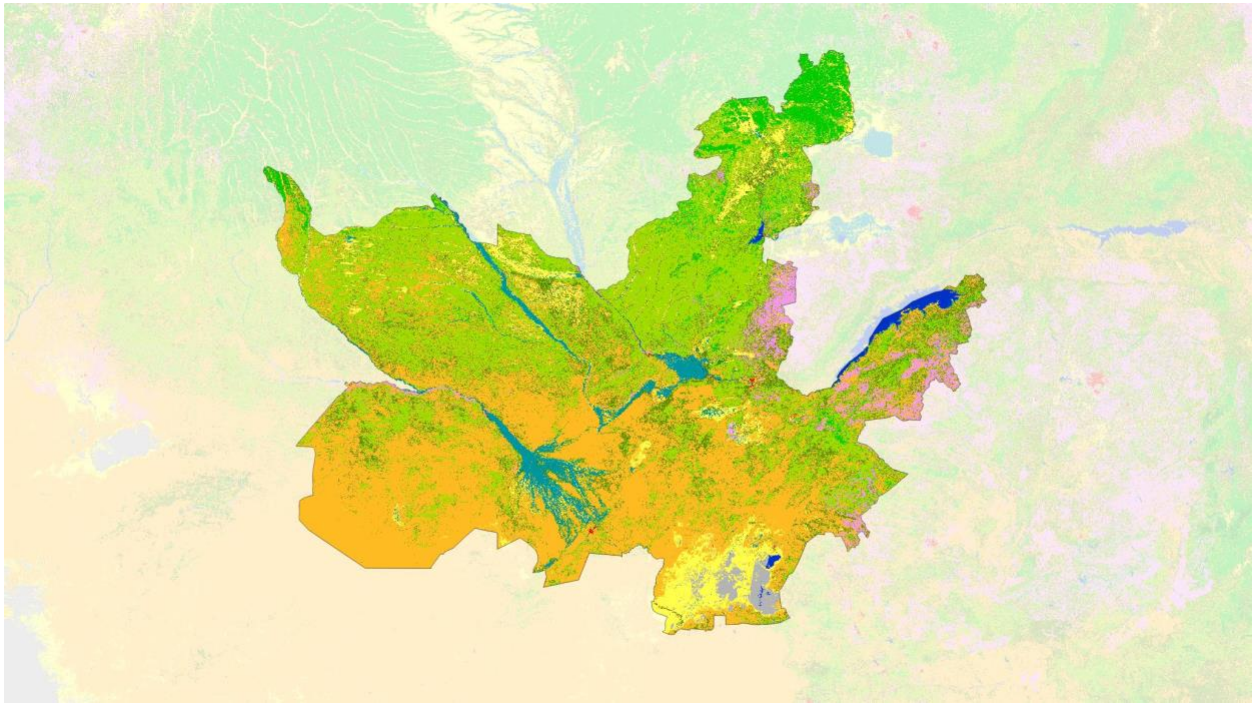


Figure 8: the 2016 100m resolution global land cover map provided by Copernicus Global Land Service

For any granule, image objects were labeled against each of the 3 reference land cover maps and the vectors derived from Open Street Map. A histogram-based analysis was performed summarizing for any of the 25 distinct cluster classes the proportion of land cover classes from the 3 reference maps that spatially intersect objects representing a distinct cluster. A set of rules was developed through iterative manual supervised object analysis. These rules were based primarily on the objects cluster value, the main land cover classes from reference maps within the cluster and the NDVI annual dynamics.
With focus on conserving the main land cover classes of the given 2005 WWF land cover map a first set of 20 land cover classes could be identified and a respective training dataset was created for the KAZA TFCA area.

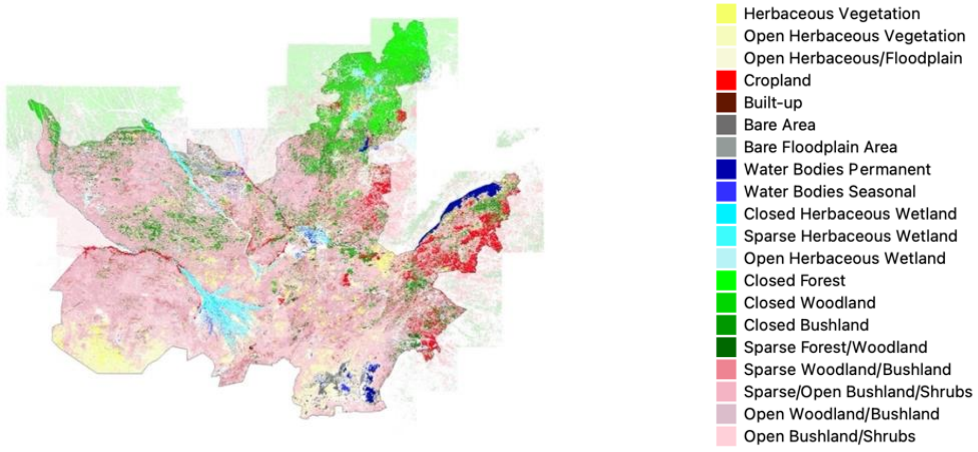


Figure 9: A first land cover training dataset describing 20 land cover classes for the KAZA TFCA

An object-oriented supervised land cover classification was applied for any given granule (path/row) using the first training data set. Image segmentation and feature extraction was sourced by the same inputs as used in spectral clustering. The classification algorithm featured a decision tree algorithm using 20 iterations. Each classifier training was performed by randomly splitting the training dataset with 70% of objects per class to be used for model training and the

remaining 30% for model validation. Final class assignment selected the most frequent class out of the 20 iterations for each image object.
An accuracy assessment was done on the conserved model validations. Classes that showed strong confusions and provided small producers accuracies were merged and a final set of 18 land cover classes was defined.

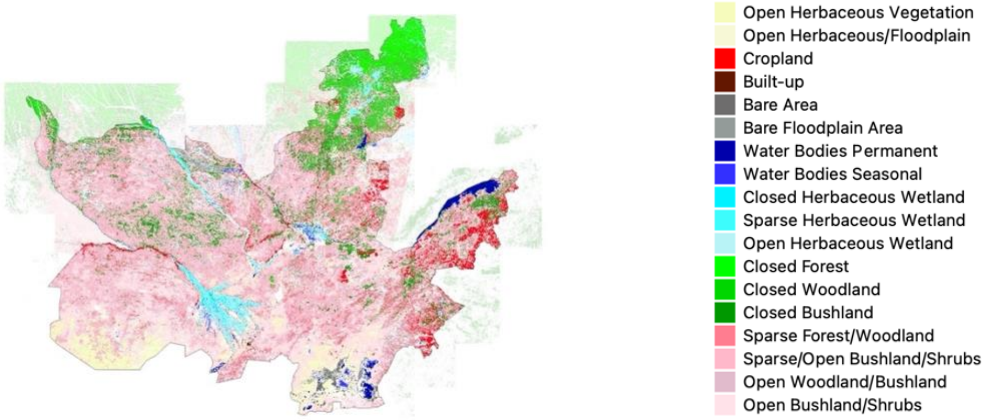


Figure 10: Final land cover training dataset describing 18 land cover classes for the KAZA TFCA

Land cover classification scheme

Based on the training data generated and with respect to the reference cartography and the terms of reference of the contract, the following classification scheme has been adapted.

Table 1: Land cover classification scheme for the KAZA TFCA

code	*class*
31	Open Herbaceous Vegetation
32	Open Herbaceous/Floodplain
40	Cropland
50	Built-up
60	Bare Area
61	Bare Floodplain Area
80	Water Bodies Permanent
81	Water Bodies Seasonal
90	Closed Herbaceous Wetland
91	Sparse Herbaceous Wetland
92	Open Herbaceous Wetland
110	Closed Forest
120	Closed Woodland
130	Closed Bushland
210	Sparse Forest/Woodland
222	Sparse/Open Bushland/Shrubs
231	Open Woodland/Bushland
232	Open Bushland/Shrubs

Supervised land cover classification for 2020

An object-oriented supervised land cover classification was applied for any given granule (path/row). Image segmentation was sourced by the spectral band's median metrics stack composite from year 2020. Object features were derived from the 10m and 20m percentile metrics from the spectral bands and the calculated indices (NDVI). In addition, a Digital Elevation Model and derived slope was introduced to the feature extraction.
As training data, the beforehand interpreted objects were used that have been converted to raster representation.
The classification algorithm featured a decision tree algorithm using 20 iterations. Each classifier training was performed by randomly splitting the training dataset with 70% of objects per class to be used for model training and the remaining 30% for model validation. Final class assignment selected the most frequent class out of the 20 iterations for each image object. A frequency measure provides an additional measure of object class stability.
Granule-based land cover classification results are stored to vector and raster representation. Model training and validation report as also the object features are conserved for further analysis. In total, 92 classification runs were performed yielding in the same amount of classification results.

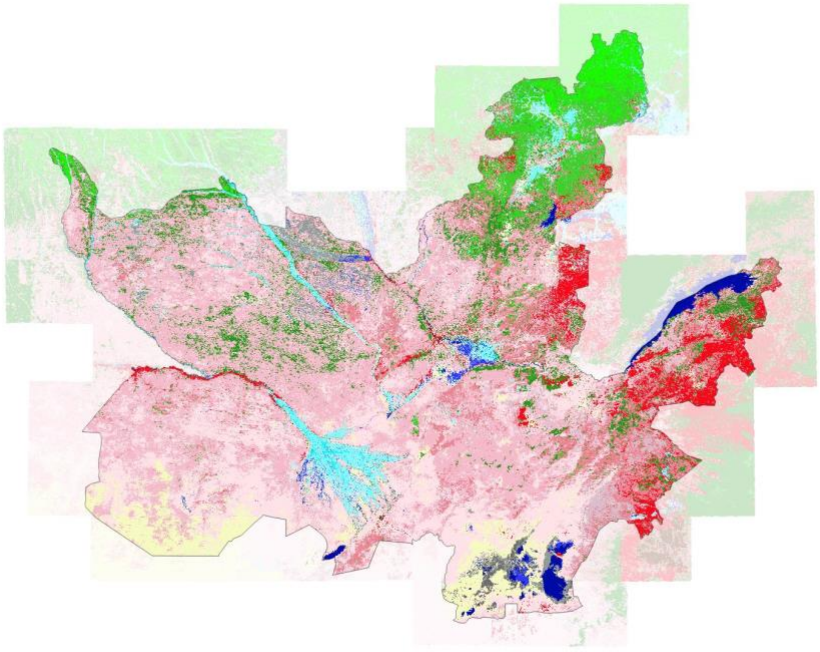


Figure 11: Granule-based Sentinel-2 land cover classification result

Land cover vector map composition

Sentinel-2 images are provided in the Military Grid Reference System (MGRS). Any grid cell (granule) represents an area of 110km by 110km overlaps its neighboring cell by 10km at any side. MGRS is derived from UTM (Universal Transverse Mercator) and hence provides granules representing different UTM zones. In consequence, following an object-oriented image classification approach, the granule-based vector datasets provide large overlapping redundant but geometrically inconsistent vector objects and different cartographic projections.
The granule-based land cover classification vector data sets were post-processed to remove overlapping objects and produce a unique, topologically clean vector database.
In addition, the polygons were cut against the country boundaries and vector composites have been processed for the KAZA TFCA area. Final land cover data sets are represented in vector and raster formats (based on converting the vector composites). The raster pixel values represent

the numeric class code according to the classification scheme. The final formats are GeoPackage and GeoTiff.

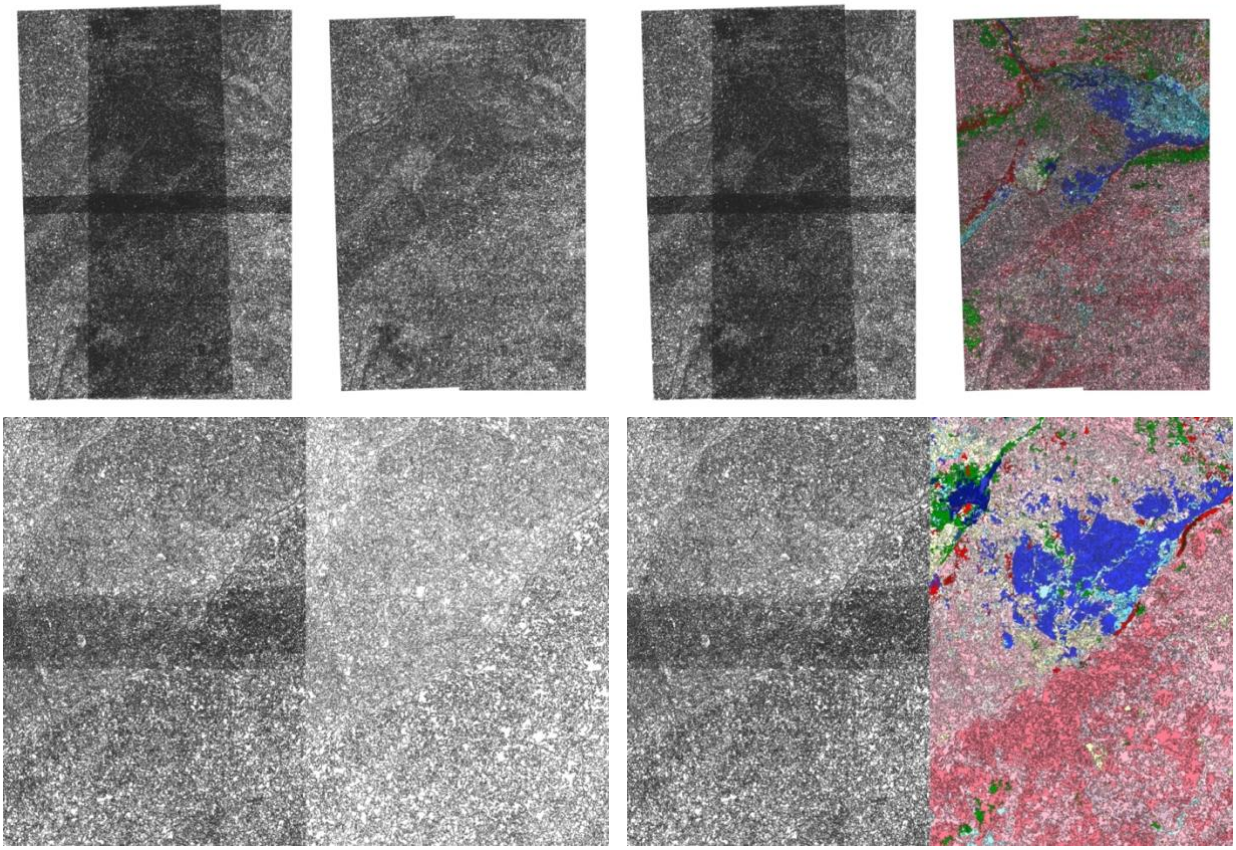


Figure 12. Vector map composition. Top left: Overlapping image objects based on different UTM zones and general MGRS grid overlapping and the cleaned objects. Top right: Overlapping image objects based on different UTM zones and general MGRS grid overlapping and the cleaned objects with assigned land cover class. Bottom left: Detail of overlapping image objects based on different UTM zones and general MGRS grid overlapping and the cleaned objects. Bottom right: Detail of overlapping image objects based on different UTM zones and general MGRS grid overlapping and the cleaned objects with assigned land cover class.

For the five southern African countries covering KAZA TFCA vector composites were created and stored to GeoPackage vector format. Following table summarizes main properties of each composite.

Table 2: Properties of the land cover vector composites

Country	Angola	Botswana	Namibia	Zambia	Zimbabwe
Projection	<Projected CRS: EPSG:32734> Name: WGS 84 / UTM zone 34S Axis Info [cartesian]: - E[east]: Easting (metre) - N[north]: Northing (metre) Area of Use: - name: Between 18°E and 24°E, southern hemisphere between 80°S and equator, onshore and offshore. Angola. Botswana. Democratic Republic of the Congo (Zaire). Namibia. South Africa. Zambia. - bounds: (18.0, -80.0, 24.0, 0.0) Coordinate Operation: - name: UTM zone 34S - method: Transverse Mercator Datum: World Geodetic System 1984 - Ellipsoid: WGS 84 - Prime Meridian: Greenwich				
Attributes	Oid: Unique object identifier Code: Numeric land cover class code Class: Land cover class name Area: Object area in square meters				
Objects	362,643	651,088	258,857	486,604	333,104
Area	91,169.82 km^2	153,870.08 km^2	71,342.31 km^2	132,794.97 km^2	72,239.18 km^2
File size	3.2 GB	5.1 GB	2.4 GB	4.1 GB	2.3 GB

Land cover raster map composition

For the five southern African countries covering KAZA TFCA vector composites were transformed to raster representation and stored to GeoTiff format. The resolution was set to 10m and the pixel value represents the numeric land cover class code. All GeoTiff share same coordinate reference system of UTM Zone 34 South. In addition, the raster representations were mosaiced to provide a single raster representation for the whole KAZA TFCA area.

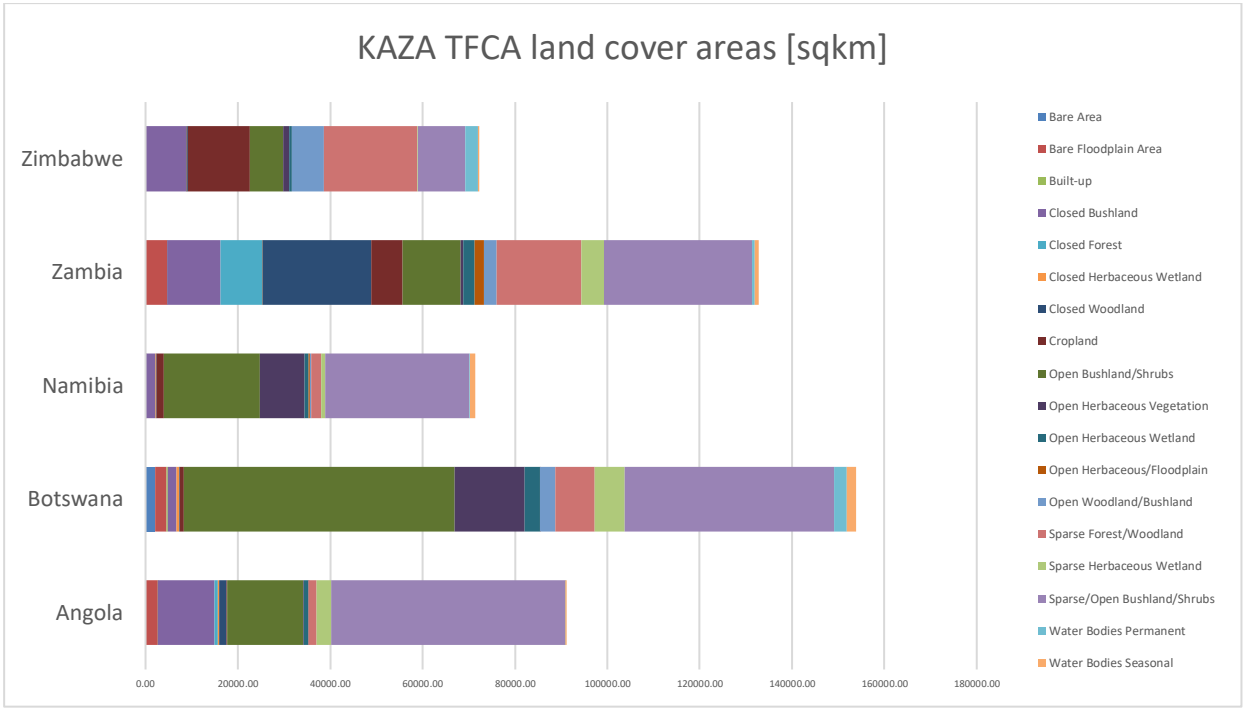
Land cover statistics

Based on the five vector composites following land cover area statistics were calculated.

Table 3: Land cover classes area (square kilometers) per country/region

Class	Angola	Botswana	Namibia	Zambia	Zimbabwe	TFCA
Bare Area	0.00	2140.61	0.00	0.00	0.00	2140.61
Bare Floodplain Area	2699.40	2429.34	26.26	4638.43	0.00	9793.43
Built-up	25.09	249.42	65.90	48.75	47.40	436.57
Closed Bushland	12278.82	1855.25	2052.71	11597.63	8783.73	36568.14
Closed Forest	617.98	0.00	0.00	9006.50	0.00	9624.48
Closed Herbaceous Wetland	254.62	660.02	45.56	18.85	1.33	980.38
Closed Woodland	1711.33	155.13	203.18	23530.29	267.55	25867.48
Cropland	107.57	759.41	1585.65	6760.24	13432.55	22645.41
Open Bushland/Shrubs	16406.01	58608.21	20703.85	12662.07	7310.01	115690.15
Open Herbaceous Vegetation	121.43	15249.53	9797.23	603.56	1304.92	27076.67
Open Herbaceous Wetland	1019.75	3265.02	821.64	2349.17	597.46	8053.04
Open Herbaceous/Floodplain	6.42	62.00	220.10	2124.42	0.00	2412.95
Open Woodland/Bushland	107.19	3270.34	344.89	2669.33	6879.71	13271.45
Sparse Forest/Woodland	1718.94	8509.33	2216.57	18355.21	20236.98	51037.04
Sparse Herbaceous Wetland	3117.15	6501.95	766.37	4985.08	147.72	15518.27
Sparse/Open Bushland/Shrubs	50668.94	45373.17	31291.97	31974.82	10158.10	169467.00
Water Bodies Permanent	15.84	2830.48	127.55	629.29	2777.62	6380.79
Water Bodies Seasonal	293.34	1950.86	1072.89	841.33	294.09	4452.51
Total	**91169.82**	**153870.08**	**71342.31**	**132794.97**	**72239.18**	**521416.37**

Figure 13: Land cover classes area (square kilometers) per country



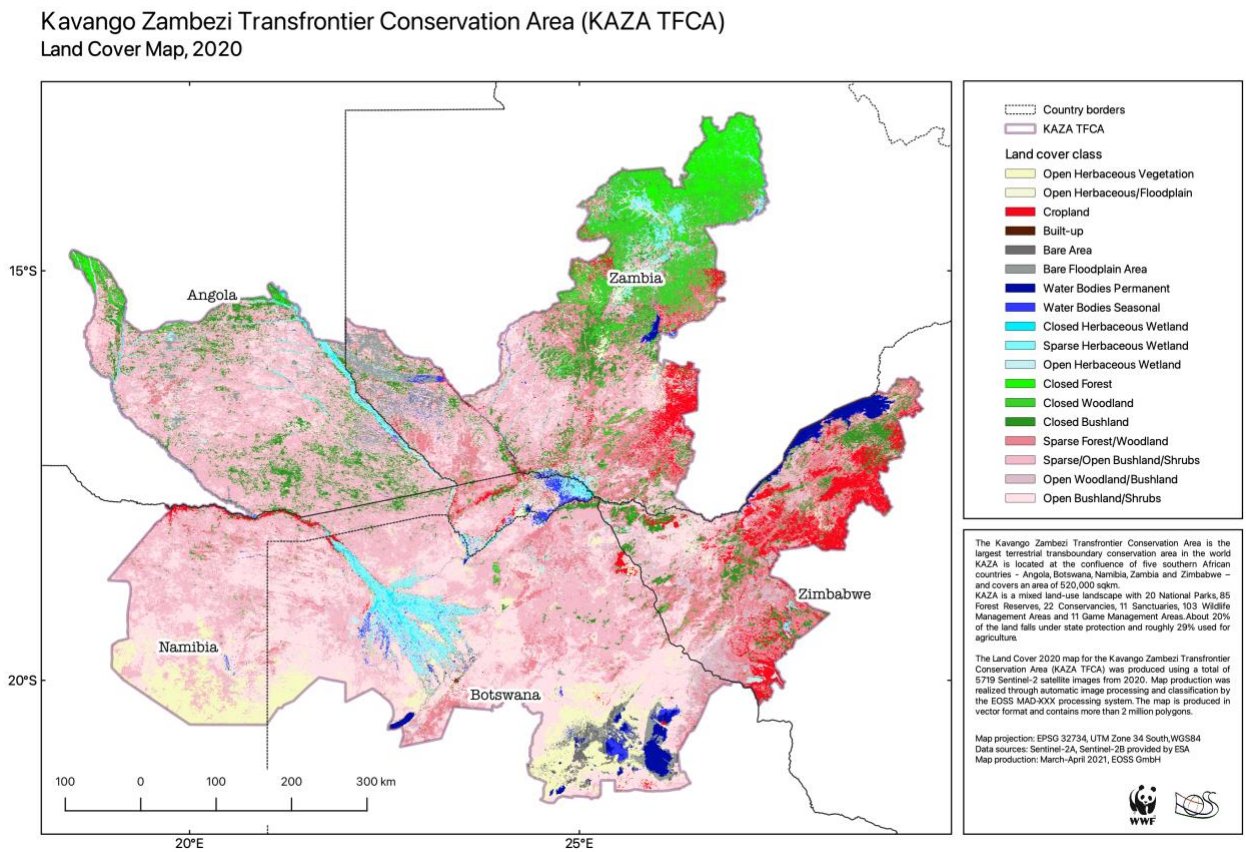


Figure 14: KAZA TFCA land cover map 2020

Accuracy assessment

In absence of independent land cover reference data, accuracy assessment was based on the 30% of objects that have not been used for classification model training. For the 92 classified granules in 20 iterations a set of 1840 model validations were combined to perform an overall accuracy assessment. Statistics were calculated using PyCM confusion matrix library[9]. Overall accuracy over all 18 land cover classes yielded in 75% with a Kappa of 0.71. Relative confusion matrix is given below as also the users and producers accuracies.

Table 4: Calculated land cover class accuracies

Class code	110	120	130	210	222	231	232	31	32	40	50	60	61	80	81	90	91	92
Users	0.96	0.92	0.92	0.5	0.81	0.36	0.8	0.53	0.26	0.75	0.27	0.69	0.83	0.77	0.89	0.91	0.77	0.51
Producers	0.97	0.91	0.91	0.56	0.75	0.5	0.76	0.63	0.31	0.74	0.4	0.69	0.81	0.81	0.86	0.9	0.78	0.61

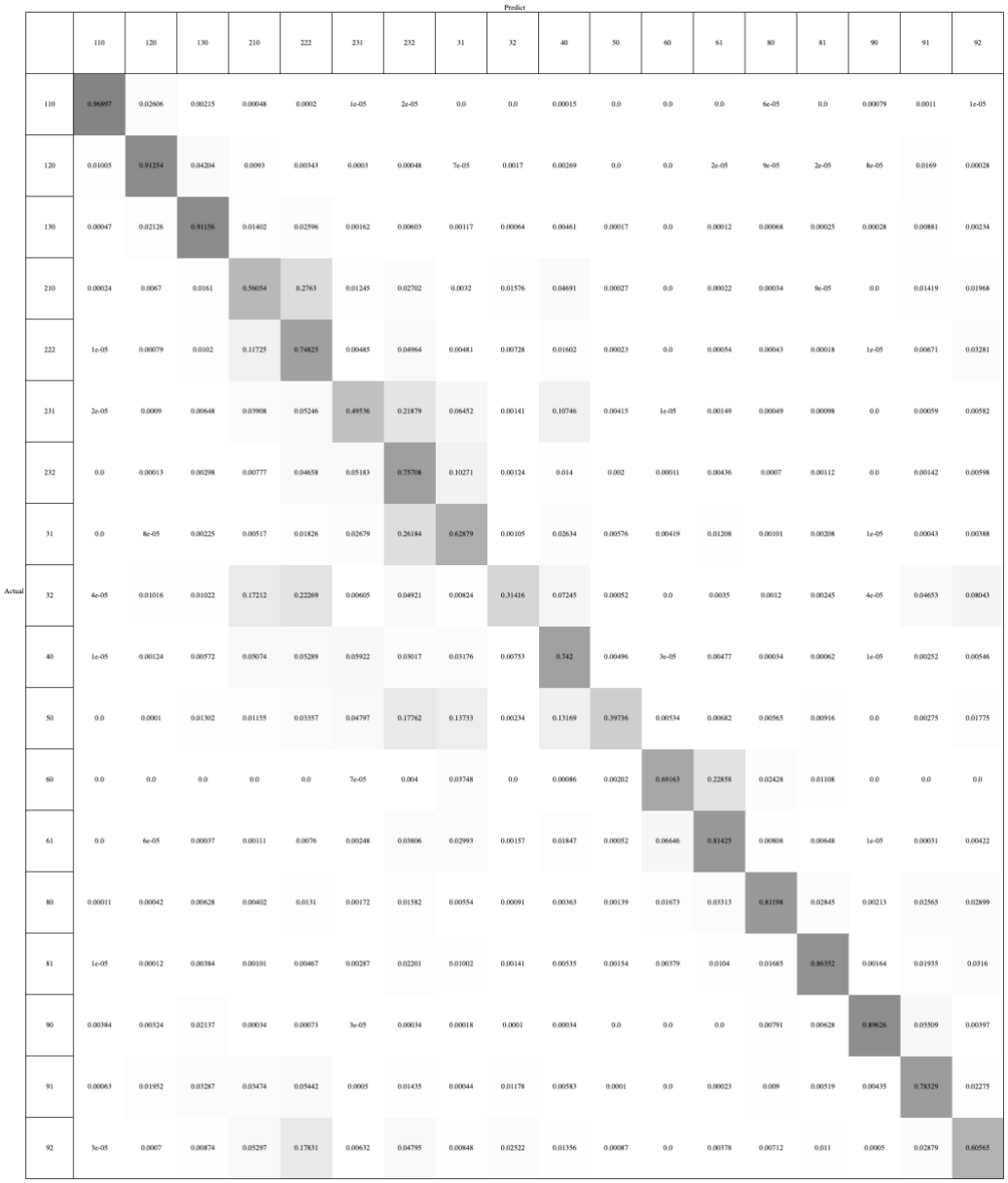


Figure 15: Relative confusion matrix of land cover validation

[9] https://www.pycm.ir/

Classification of agriculture fields

All objects classified as Agriculture have been extracted from the vector composites. With their given object features, retained from supervised land cover classification, an unsupervised spectral clustering was performed. Thereby, all objects over all granules have been used. Spectral clustering was performed towards 40 target clusters. Subsequently, the resulting cluster classes were used as training labels and a supervised Maximum-likelihood classification was applied. By doing so, a minimum class accuracy of 80% was defined. Classifier was trained with 70% of labeled data for training and 30% for validation. After training and model validation, all classes with calculated accuracies below the 80% threshold were removed and the model was trained again. This iterative step is repeated until all classes provide an accuracy higher than the provided threshold. By doing so, the number of classes was reduced to 22 classes.
The resulting dataset is not a crop type map. Missing reference data do not allow to. Instead, this map presents artificial classes in in the agriculture class domain, that, based on spectral and temporal features, provide to be separable. The given dataset of agricultural classes must be analyzed by experts supported by reference data, if available, for the same year of 2020 to make statements on actual crop types.

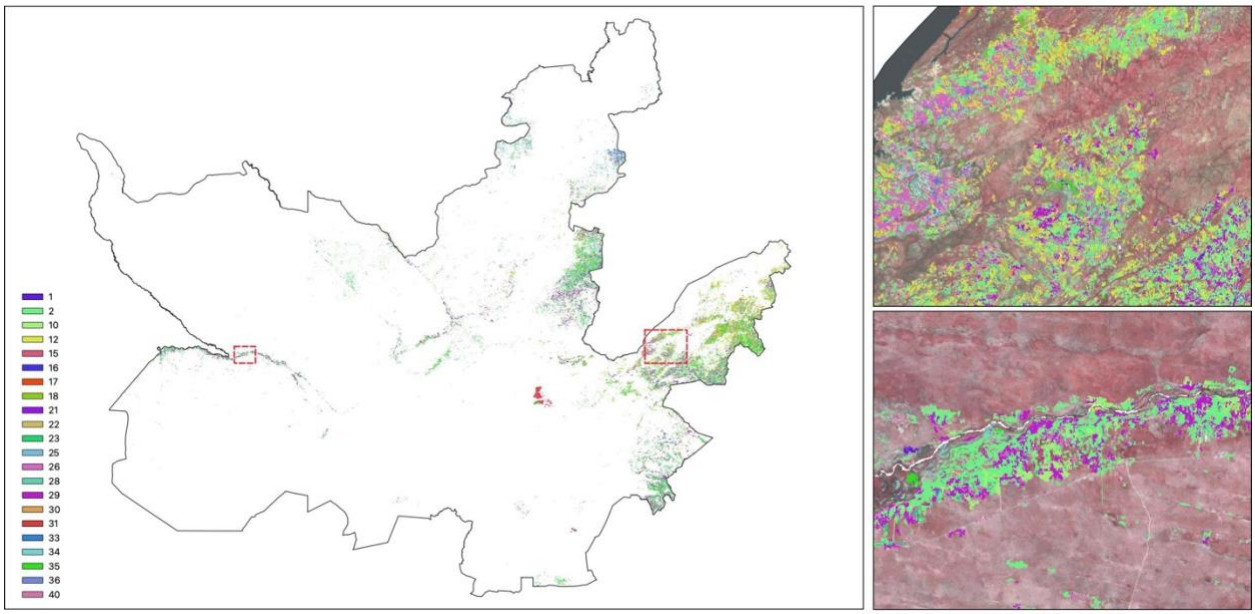


Figure 16: Classification of agricultural fields resulting map

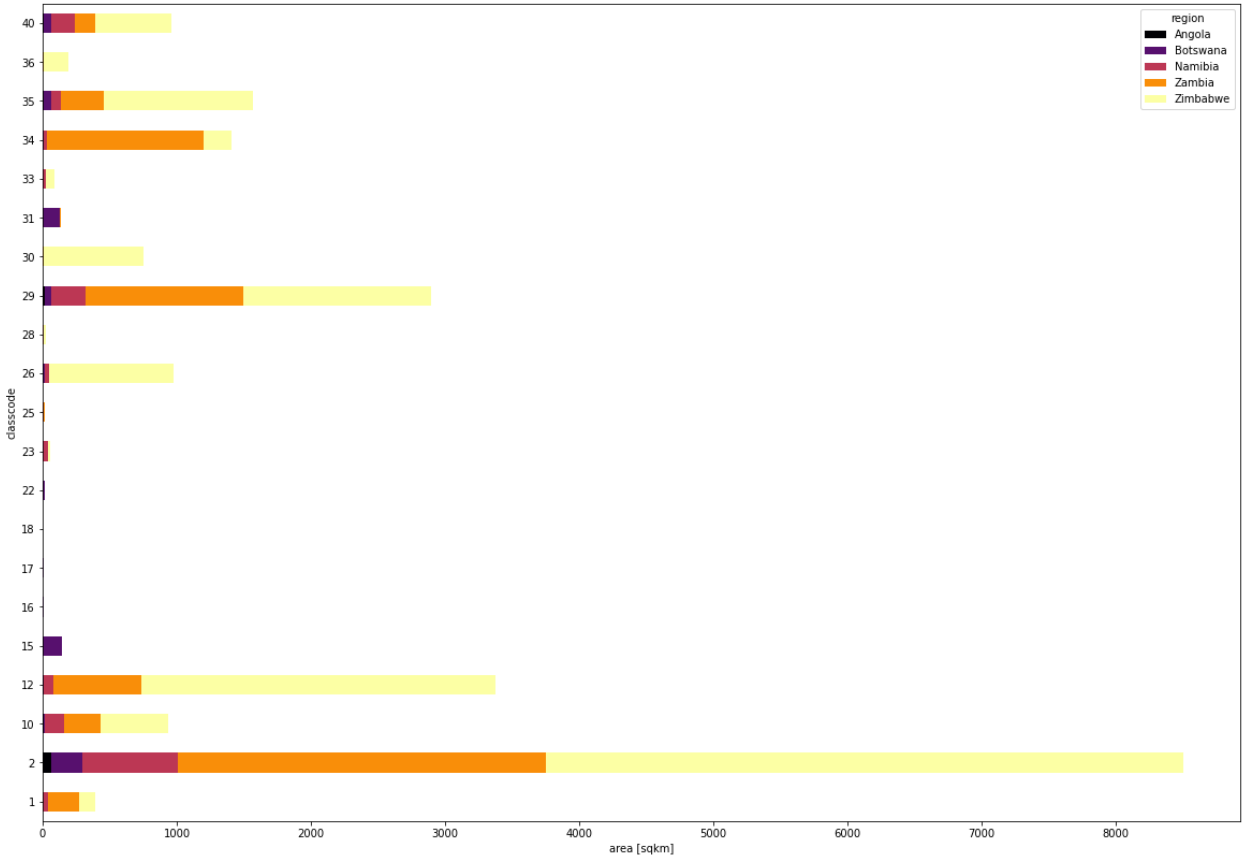


Figure 17: Classification of agricultural field area statistics

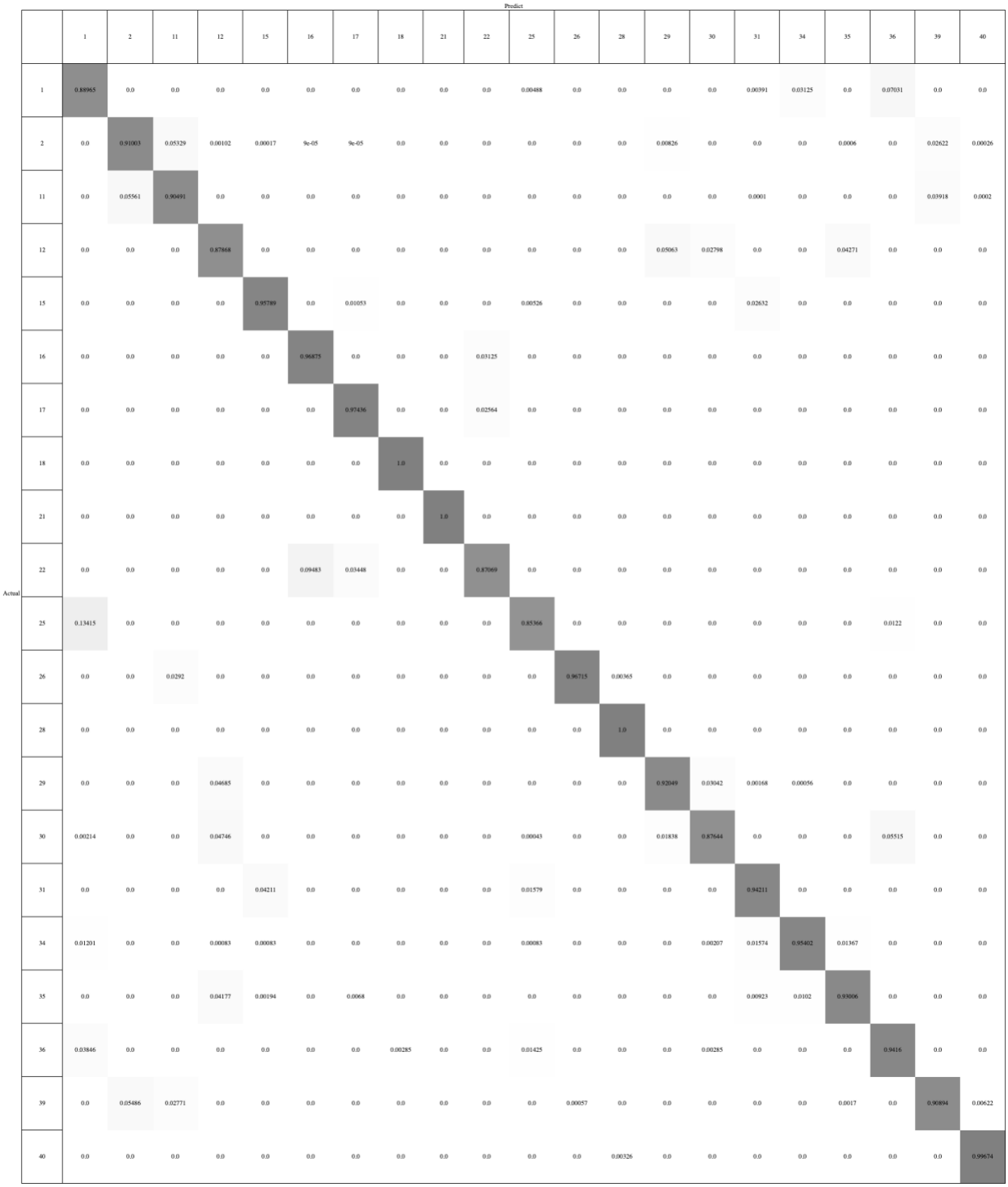


Figure 18: Confusion matrix derived from 30% validation data for classified agricultural fields

Datasets

Land cover datasets

Data are compressed to individual ZIP archives and are provided for download:
https://public.eoss.cloud/projects/wwf_kaza/web/products/eoss4wwf_kaza_landcover_Angola.zip
https://public.eoss.cloud/projects/wwf_kaza/web/products/eoss4wwf_kaza_landcover_Aux.zip
https://public.eoss.cloud/projects/wwf_kaza/web/products/eoss4wwf_kaza_landcover_Botswana.zip
https://public.eoss.cloud/projects/wwf_kaza/web/products/eoss4wwf_kaza_landcover_Namibia.zip
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https://public.eoss.cloud/projects/wwf_kaza/web/products/eoss4wwf_kaza_landcover_Zimbabwe.zip

Following table describes the content of each data archive.

Table 5: Kaza TFCA land cover datasets

DATASET DESCRIPTION	ARCHIVE
LAND COVER STATISTICS	Angola/eoss4wwf_kaza_angola_landcover_2020.csv
LAND COVER VECTOR DATASET	Angola/eoss4wwf_kaza_angola_landcover_2020.gpkg
LAND COVER VECTOR METADATA	Angola/eoss4wwf_kaza_angola_landcover_2020.gpkg.xml
LAND COVER RASTER DATASET	Angola/eoss4wwf_kaza_angola_landcover_2020.tif
LAND COVER RASTER METADATA	Angola/eoss4wwf_kaza_angola_landcover_2020.tif.xml
LAND COVER STATISTICS	Botswana/eoss4wwf_kaza_botswana_landcover_2020.csv
LAND COVER VECTOR DATASET	Botswana/eoss4wwf_kaza_botswana_landcover_2020.gpkg
LAND COVER VECTOR METADATA	Botswana/eoss4wwf_kaza_botswana_landcover_2020.gpkg.xml
LAND COVER RASTER DATASET	Botswana/eoss4wwf_kaza_botswana_landcover_2020.tif
LAND COVER RASTER METADATA	Botswana/eoss4wwf_kaza_botswana_landcover_2020.tif.xml
LAND COVER STATISTICS	Namibia/eoss4wwf_kaza_namibia_landcover_2020.csv
LAND COVER VECTOR DATASET	Namibia/eoss4wwf_kaza_namibia_landcover_2020.gpkg
LAND COVER VECTOR METADATA	Namibia/eoss4wwf_kaza_namibia_landcover_2020.gpkg.xml
LAND COVER RASTER DATASET	Namibia/eoss4wwf_kaza_namibia_landcover_2020.tif
LAND COVER RASTER METADATA	Namibia/eoss4wwf_kaza_namibia_landcover_2020.tif.xml
LAND COVER STATISTICS	Zambia/eoss4wwf_kaza_zambia_landcover_2020.csv
LAND COVER VECTOR DATASET	Zambia/eoss4wwf_kaza_zambia_landcover_2020.gpkg
LAND COVER VECTOR METADATA	Zambia/eoss4wwf_kaza_zambia_landcover_2020.gpkg.xml

LAND COVER RASTER DATASET	Zambia/eoss4wwf_kaza_zambia_landcover_2020.tif
LAND COVER RASTER METADATA	Zambia/eoss4wwf_kaza_zambia_landcover_2020.tif.xml
LAND COVER STATISTICS	Zimbabwe/eoss4wwf_kaza_zimbabwe_landcover_2020.csv
LAND COVER VECTOR DATASET	Zimbabwe/eoss4wwf_kaza_zimbabwe_landcover_2020.gpkg
LAND COVER VECTOR METADATA	Zimbabwe/eoss4wwf_kaza_zimbabwe_landcover_2020.gpkg.xml
LAND COVER RASTER DATASET	Zimbabwe/eoss4wwf_kaza_zimbabwe_landcover_2020.tif
LAND COVER RASTER METADATA	Zimbabwe/eoss4wwf_kaza_zimbabwe_landcover_2020.tif.xml
LAND COVER STATISTICS	TFCA/eoss4wwf_kaza_tfca_landcover_2020.csv
LAND COVER RASTER DATASET	TFCA/eoss4wwf_kaza_tfca_landcover_2020.tif
LAND COVER RASTER METADATA	TFCA/eoss4wwf_kaza_tfca_landcover_2020.tif.xml
LAND COVER CLASSIFICATION SCHEME	Aux/eoss4wwf_kaza_landcover_scheme.csv
LAND COVER RASTER STYLE	Aux/wwf_kaza_raster_20210416.qml
LAND COVER RASTER STYLE	Aux/wwf_kaza_raster_20210416.sld
LAND COVER VECTOR STYLE	Aux/wwf_kaza_vector_20210416.qml
LAND COVER VECTOR STYLE	Aux/wwf_kaza_vector_20210416.sld
LAND COVER VALIDATION REPORT	Validation/eoss4wwf_kaza_tfca_landcover_2020_validationreport.html

Agriculture datasets

Data are compressed to individual ZIP archives and are provided for download:
https://public.eoss.cloud/projects/wwf_kaza/web/products/eoss4wwf_kaza_agriculture_Angola.zip
https://public.eoss.cloud/projects/wwf_kaza/web/products/eoss4wwf_kaza_agriculture_Botswana.zip
https://public.eoss.cloud/projects/wwf_kaza/web/products/eoss4wwf_kaza_agriculture_Namibia.zip
https://public.eoss.cloud/projects/wwf_kaza/web/products/eoss4wwf_kaza_agriculture_TFCA.zip
https://public.eoss.cloud/projects/wwf_kaza/web/products/eoss4wwf_kaza_agriculture_Validation.zip
https://public.eoss.cloud/projects/wwf_kaza/web/products/eoss4wwf_kaza_agriculture_Zambia.zip
https://public.eoss.cloud/projects/wwf_kaza/web/products/eoss4wwf_kaza_agriculture_Zimbabwe.zip

Following table describes the content of each data archive.

Table 6: Kaza TFCA agriculture datasets

AGRICULTURE STATISTICS	**ANGOLA/EOSS4WWF_KAZA_ANGOLA_AGRICULTURE_2020.CSV**
	Angola/eoss4wwf_kaza_angola_agriculture_2020.dbf
	Angola/eoss4wwf_kaza_angola_agriculture_2020.prj
AGRICULTURE VECTOR DATASET	Angola/eoss4wwf_kaza_angola_agriculture_2020.shp
	Angola/eoss4wwf_kaza_angola_agriculture_2020.shx

AGRICULTURE RASTER DATASET	Angola/eoss4wwf_kaza_angola_agriculture_2020.tif
AGRICULTURE STATISTICS	Botswana/eoss4wwf_kaza_botswana_agriculture_2020.csv
	Botswana/eoss4wwf_kaza_botswana_agriculture_2020.dbf
	Botswana/eoss4wwf_kaza_botswana_agriculture_2020.prj
AGRICULTURE VECTOR DATASET	Botswana/eoss4wwf_kaza_botswana_agriculture_2020.shp
	Botswana/eoss4wwf_kaza_botswana_agriculture_2020.shx
AGRICULTURE RASTER DATASET	Botswana/eoss4wwf_kaza_botswana_agriculture_2020.tif
AGRICULTURE STATISTICS	Namibia/eoss4wwf_kaza_namibia_agriculture_2020.csv
	Namibia/eoss4wwf_kaza_namibia_agriculture_2020.dbf
	Namibia/eoss4wwf_kaza_namibia_agriculture_2020.prj
AGRICULTURE VECTOR DATASET	Namibia/eoss4wwf_kaza_namibia_agriculture_2020.shp
	Namibia/eoss4wwf_kaza_namibia_agriculture_2020.shx
AGRICULTURE RASTER DATASET	Namibia/eoss4wwf_kaza_namibia_agriculture_2020.tif
AGRICULTURE STATISTICS	Zambia/eoss4wwf_kaza_zambia_agriculture_2020.csv
	Zambia/eoss4wwf_kaza_zambia_agriculture_2020.dbf
	Zambia/eoss4wwf_kaza_zambia_agriculture_2020.prj
AGRICULTURE VECTOR DATASET	Zambia/eoss4wwf_kaza_zambia_agriculture_2020.shp
	Zambia/eoss4wwf_kaza_zambia_agriculture_2020.shx
AGRICULTURE RASTER DATASET	Zambia/eoss4wwf_kaza_zambia_agriculture_2020.tif
AGRICULTURE STATISTICS	Zimbabwe/eoss4wwf_kaza_zimbabwe_agriculture_2020.csv
	Zimbabwe/eoss4wwf_kaza_zimbabwe_agriculture_2020.dbf
	Zimbabwe/eoss4wwf_kaza_zimbabwe_agriculture_2020.prj
AGRICULTURE VECTOR DATASET	Zimbabwe/eoss4wwf_kaza_zimbabwe_agriculture_2020.shp
	Zimbabwe/eoss4wwf_kaza_zimbabwe_agriculture_2020.shx
AGRICULTURE RASTER DATASET	Zimbabwe/eoss4wwf_kaza_zimbabwe_agriculture_2020.tif
AGRICULTURE STATISTICS	TFCA/eoss4wwf_kaza_tfca_acriculture_2020.csv
	TFCA/eoss4wwf_kaza_tfca_agriculture_2020.dbf
	TFCA/eoss4wwf_kaza_tfca_agriculture_2020.prj
AGRICULTURE VECTOR DATASET	TFCA/eoss4wwf_kaza_tfca_agriculture_2020.shp
	TFCA/eoss4wwf_kaza_tfca_agriculture_2020.shx
AGRICULTURE RASTER DATASET	TFCA/eoss4wwf_kaza_tfca_agriculture_2020.tif

AGRICULTURE VALIDATION REPORT	Validation/eoss4wwf_kaza_tfca_agriculture_2020_validationreport.html