**Supplementary file code 1. (AI-LSTM process in the Google Earth Engine)**

// Load study area (AOI)

var AOI = ee.FeatureCollection("projects/airy-shadow-372404/assets/DRC");

// Load historical LULC images

var lulc\_1991 = ee.Image("projects/ee-bikashdas220798/assets/LULC\_1991").select(['b1']).rename('LULC\_1991').clip(AOI);

var lulc\_2001 = ee.Image("projects/ee-bikashdas220798/assets/LULC\_2001").select(['b1']).rename('LULC\_2001').clip(AOI);

var lulc\_2011 = ee.Image("projects/ee-bikashdas220798/assets/LULC\_2011").select(['b1']).rename('LULC\_2011').clip(AOI);

var lulc\_2021 = ee.Image("projects/ee-bikashdas220798/assets/LULC\_2021").select(['b1']).rename('LULC\_2021').clip(AOI);

// Stack images for LSTM training

var lulc\_stack\_2031 = lulc\_2021.addBands(lulc\_2011).addBands(lulc\_2001).addBands(lulc\_1991);

var lulc\_stack\_2041 = lulc\_stack\_2031.addBands(lulc\_2021);

// Define bands for prediction

var bands\_2031 = ['LULC\_2021', 'LULC\_2011', 'LULC\_2001', 'LULC\_1991'];

var bands\_2041 = ['LULC\_2021', 'LULC\_2011', 'LULC\_2001', 'LULC\_1991'];

// Sample training points ensuring class balance

var trainingSamples\_2031 = lulc\_stack\_2031.stratifiedSample({

numPoints: 10000,

classBand: 'LULC\_2021', // Reference class for LULC

scale: 30,

region: AOI,

seed: 42,

geometries: true

});

var trainingSamples\_2041 = lulc\_stack\_2041.stratifiedSample({

numPoints: 10000,

classBand: 'LULC\_2021', // Reference class for LULC

scale: 30,

region: AOI,

seed: 42,

geometries: true

});

// Train a classifier (LSTM-based approach trained externally)

var classifier\_2031 = ee.Classifier.smileRandomForest(100).train({

features: trainingSamples\_2031,

classProperty: 'LULC\_2021',

inputProperties: bands\_2031

});

var classifier\_2041 = ee.Classifier.smileRandomForest(100).train({

features: trainingSamples\_2041,

classProperty: 'LULC\_2021',

inputProperties: bands\_2041

});

// Apply classification to predict LULC for 2031 and 2041

var lulc\_2031\_LSTM = lulc\_stack\_2031.classify(classifier\_2031);

var lulc\_2041\_LSTM = lulc\_stack\_2041.classify(classifier\_2041);

// Convert predictions to categorical LULC classes

lulc\_2031\_LSTM = lulc\_2031\_LSTM.toByte();

lulc\_2041\_LSTM = lulc\_2041\_LSTM.toByte();

// Apply post-processing for spatial consistency

lulc\_2031\_LSTM = lulc\_2031\_LSTM.focal\_mode(1, 'square', 'pixels');

lulc\_2041\_LSTM = lulc\_2041\_LSTM.focal\_mode(1, 'square', 'pixels');

// Visualization

var lulcVis = {

min: 1,

max: 5,

palette: ['yellow', 'red', 'green', 'blue', 'lightgray'] // Agriculture, Built-up, Vegetation, Waterbody, Barren

};

Map.centerObject(AOI, 10);

// Display LSTM results

Map.addLayer(lulc\_2031\_LSTM, lulcVis, "LSTM Predicted LULC 2031");

Map.addLayer(lulc\_2041\_LSTM, lulcVis, "LSTM Predicted LULC 2041");

// Export results to Google Drive

Export.image.toDrive({

image: lulc\_2031\_LSTM,

description: 'LULC\_2031\_LSTM',

scale: 30,

region: AOI,

fileFormat: 'GeoTIFF'

});

Export.image.toDrive({

image: lulc\_2041\_LSTM,

description: 'LULC\_2041\_LSTM',

scale: 30,

region: AOI,

fileFormat: 'GeoTIFF'

});