Ancient Trails of the Surigao Gold District: A Preliminary Baseline Predictive Model

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Abstract

The paper will present a macroscale baseline model of possible ancient trails connecting Jabonga- Kitcharao and Placer to the Balangay sites in Butuan utilizing geographic information systems (GIS) analysis of digital elevation models (DEM). The paper also taps into available natural band combinations and infrared band combination imageries to further provide the mesoscale context of the sites. This baseline data may be used in a secondary analysis that will involve tapping on a multiscalar method that will utilize enhanced macro scale satellite data, mesoscale and microscale remotely piloted aerial systems (RPAS) data, and ground-truthed data.

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Introduction

Main gold-producing districts in the Philippines have been generalized into five zones, including the Baguio-Mankayan gold district, the Paracale gold district, the Masbate gold district, the Masara gold district, and the Surigao gold district (Gabo-Ratio et al. 2020). The Butuan prehistoric port, within the Surigao gold district, has received some research for its role as an ancient port from archaeologists, geologists, and historians (Bolunia and Hontiveros 2009:3). Initial documentation of the ancient gold working assemblage of Butuan dating to 15 th to 16 th c has been presented by Estrella (2016: 17-34). Part of the transhipment of gold is through the ancient boat Balangay. The Balangay has been the focus of historical studies (Abrera 2017) as well as maritime archaeological studies (Lacsina 2014, Salcedo 1998). Primary documents on ancient warfare utilizing maritime vessels at Spanish contact have been surveyed by Rodriguez (2003). Interestingly, Butuan has been highlighted as a primary candidate in understanding ancient maritime trade links of the Philippines due to six factors and has been proposed for continuing longitudinal research in five areas notably long-term regional studies (Bolunia and Hontiveros 2009: 10-11). This paper will seek to enter the academic discourse with a contribution towards regional understanding of Butuan within the Surigao gold district with a baseline ancient gold trail model.

Methods

The author has undertaken regional scale studies on ancient gold trails of the purported Baguio Mankayan gold district of Luzon (see Canilao 2020). Similar approaches are being considered in terms of the Suirigao gold district. The preliminary baseline model presented in this paper is based on physical variables that are fed into a geographic information systems (GIS) analysis known as least cost path modelling. Remote sensing (RS) data also serve as interlocutors to this GIS-derived baseline model.

The shuttle radar topography mission (SRTM) digital elevation model (DEM) was utilized in the research (SRTM is a product of NASA) (Figure 1). The Philippine Earth Data Resource Observation Center also provided Planetscope imagery access to the author, specifically, red green blue and near-infrared (RGB and NIR) multispectral bands at 3-meter spatial resolution.

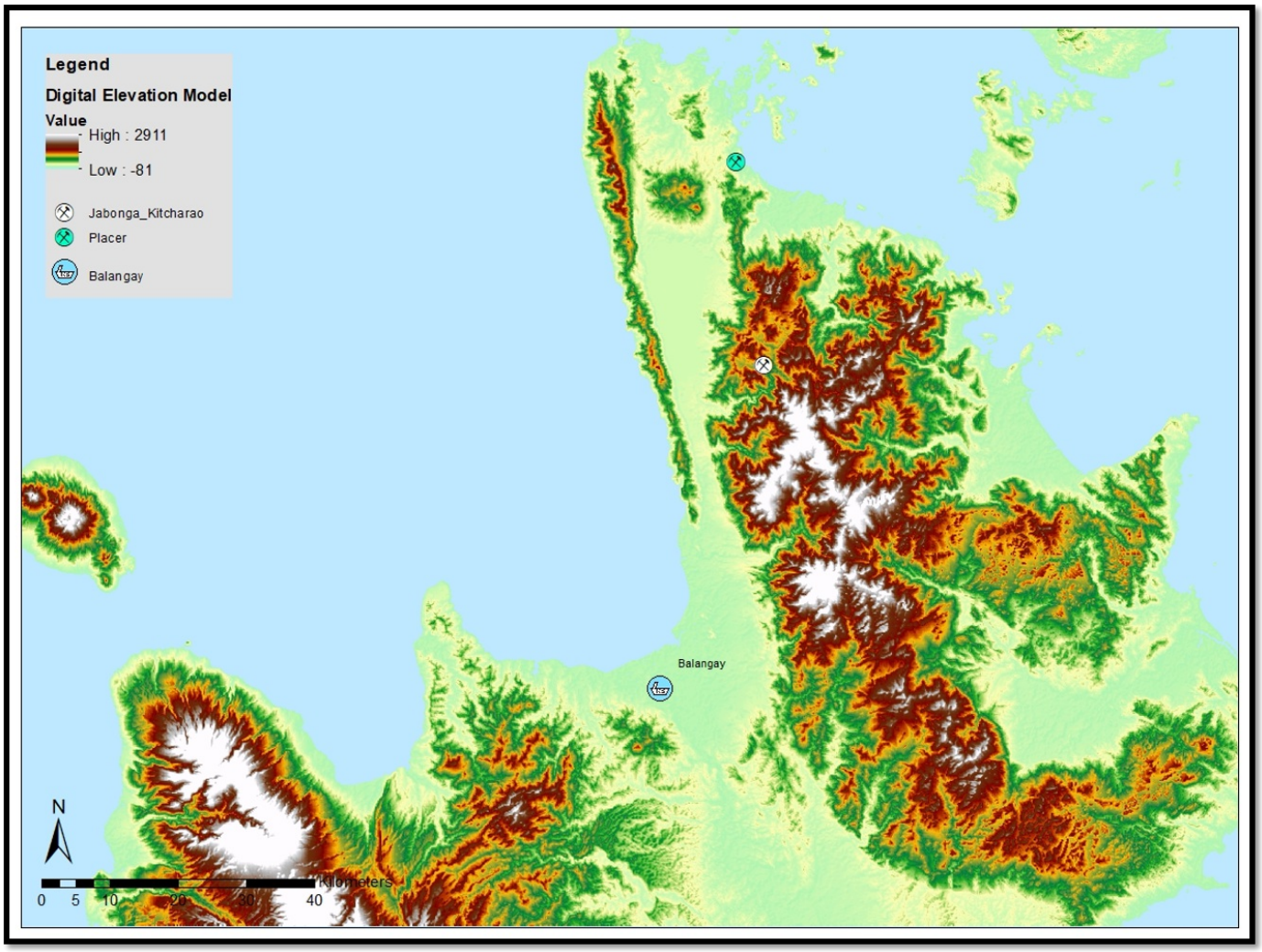

Figure 1. Digital elevation model (DEM) of the research area in WGS 1984 (SRTM is a product of NASA)

The first step was to create generalized point shapefiles to be used in the least Cost Path (LCP) analysis for the port of Butuan (Balangay), and the gold mines of Jabonga-Kitcharao and Placer in the Surigao gold district. The three general points were also presented in both natural band combinations as well as Near Infrared band combinations. The Balangay site is based on the actual Balangay site. The gold mines point shapefile was generalized based on the intersection of two datasets namely the Mining Tenements Control Map of the Mines and Geosciences Bureau of the Department of Environment and Natural Resources (MGB-DENR 2021) and the map of “major deposits/ groups with current or historically major mines operations in Northeast Mindanao by Tagibao and Takahashi (2018).

The second step was to prepare the raster variables to be used in the LCP analysis. The DEM was converted into a slope raster (Figure 2). The slope raster was used in creating a backlink (Figure 3) and cost distance raster (Figure 4). The cost distance and backlink were then used to delineate the LCP polylines for both Jabonga- Kitcharao and Placer.

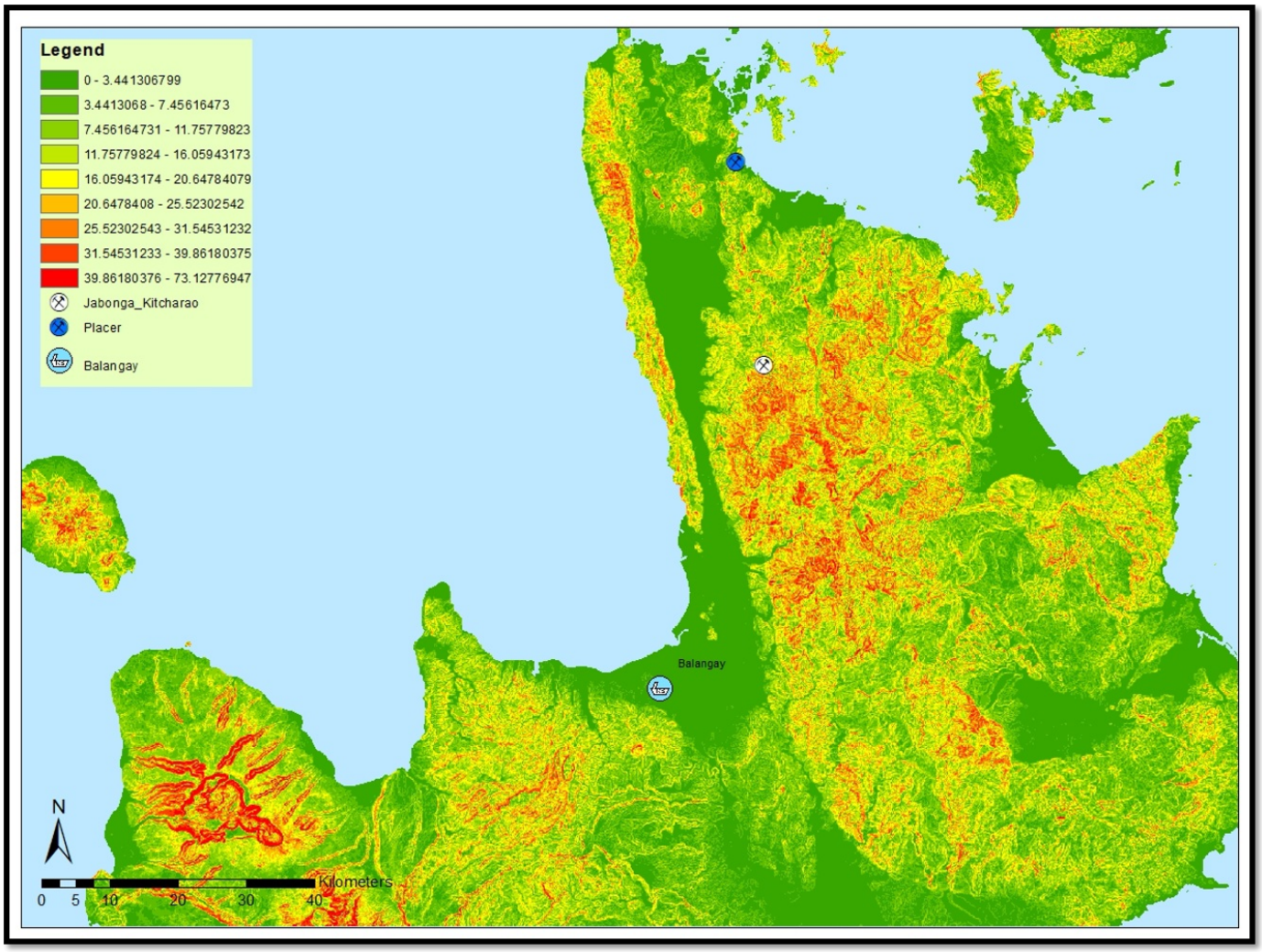

Figure 2. Slope raster of the research area in WGS 1984 (SRTM is a product of NASA)

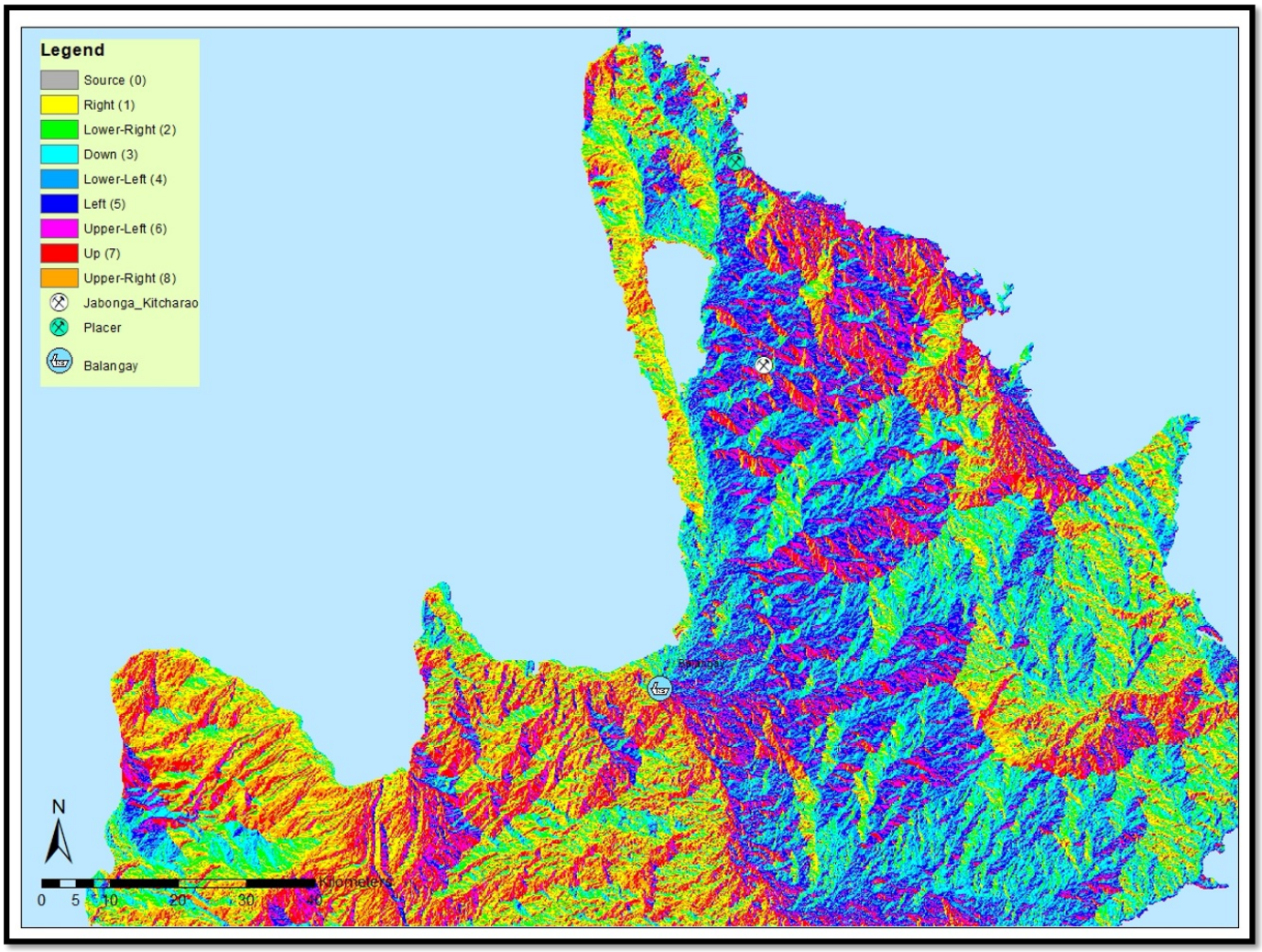

Figure 3. Backlink raster of the research area in WGS 1984 (SRTM is a product of NASA)

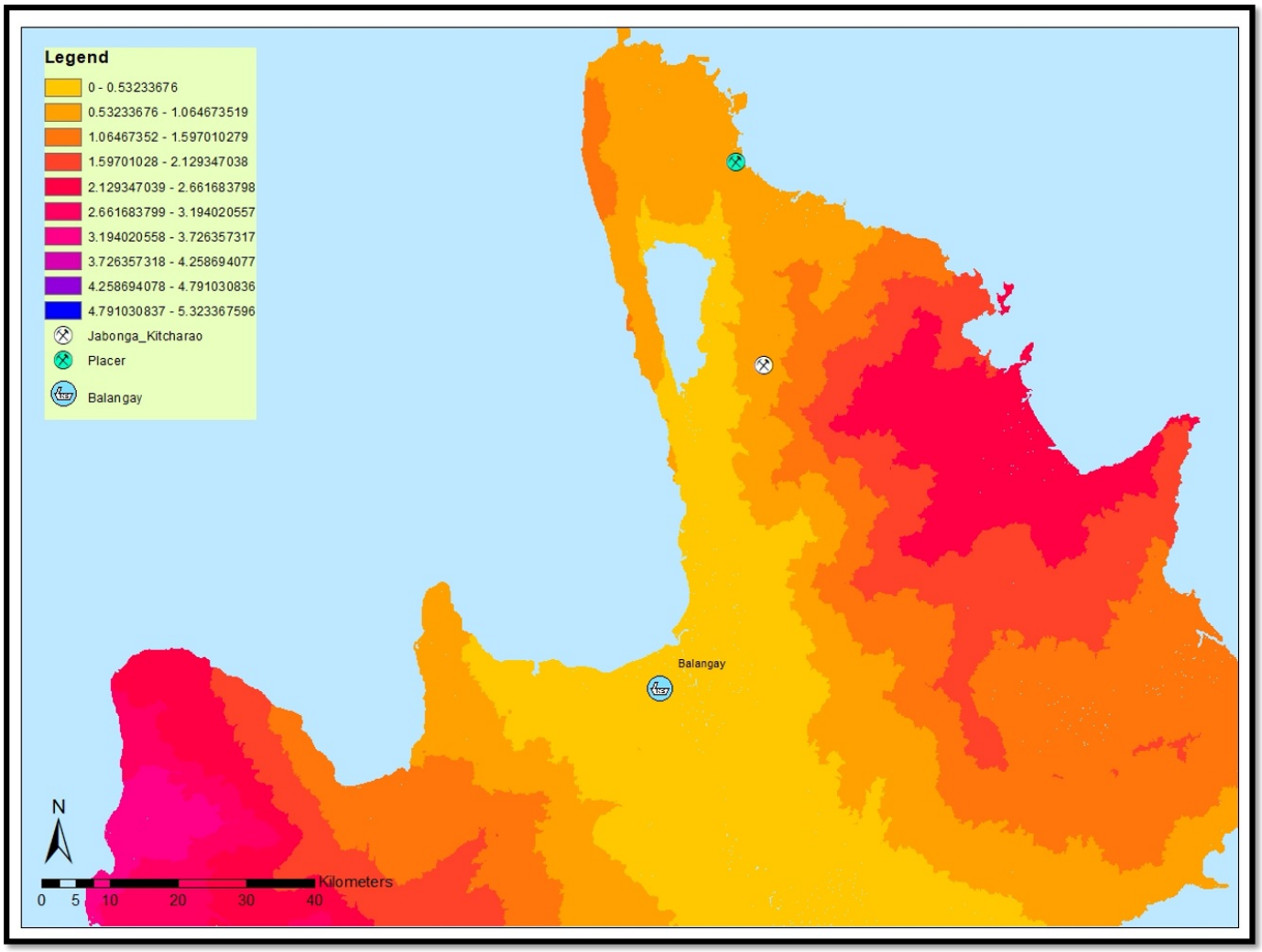

Figure 4. Cost distance raster of the research area in WGS 1984 (SRTM is a product of NASA)

Results

The conjunction of both natural band combinations and Near-infrared band combinations show the extent of mining activities in the mining areas of Placer (Figure 5 and 6) and Jabonga-Kitcharao (Figure 7 and 8). The same band combination also clearly show that the Balangay location is at the apex of a triangular wetlands area in Butuan and would have been the best location for a Balangay port (Figure 9 and 10). The least cost path polylines for Jabonga-Kitcharao to Butuan and Placer to Butuan were created through GIS also showed that the trails were the best (optimal) routes to utilize based on the cost distance raster (Figure 11).

Figure 5. Natural band combination (bands red- green-blue) showing Placer in WGS 1984 (Sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community)

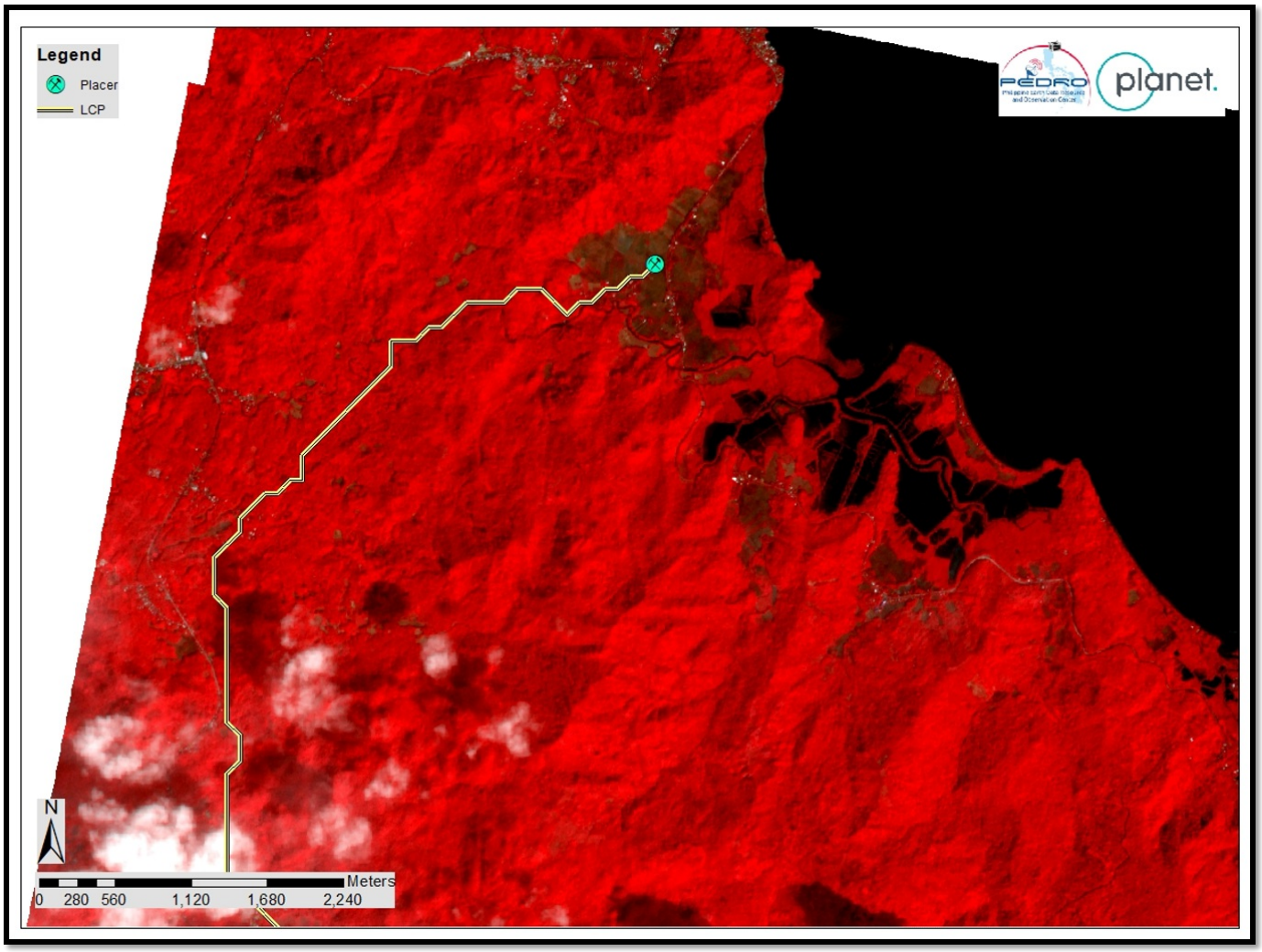

Figure 6. Near Infrared band combination (bands Near infrared- green-blue) showing Placer in WGS 1984 (Philippine Copyright 2021 by DOST-ASTI)

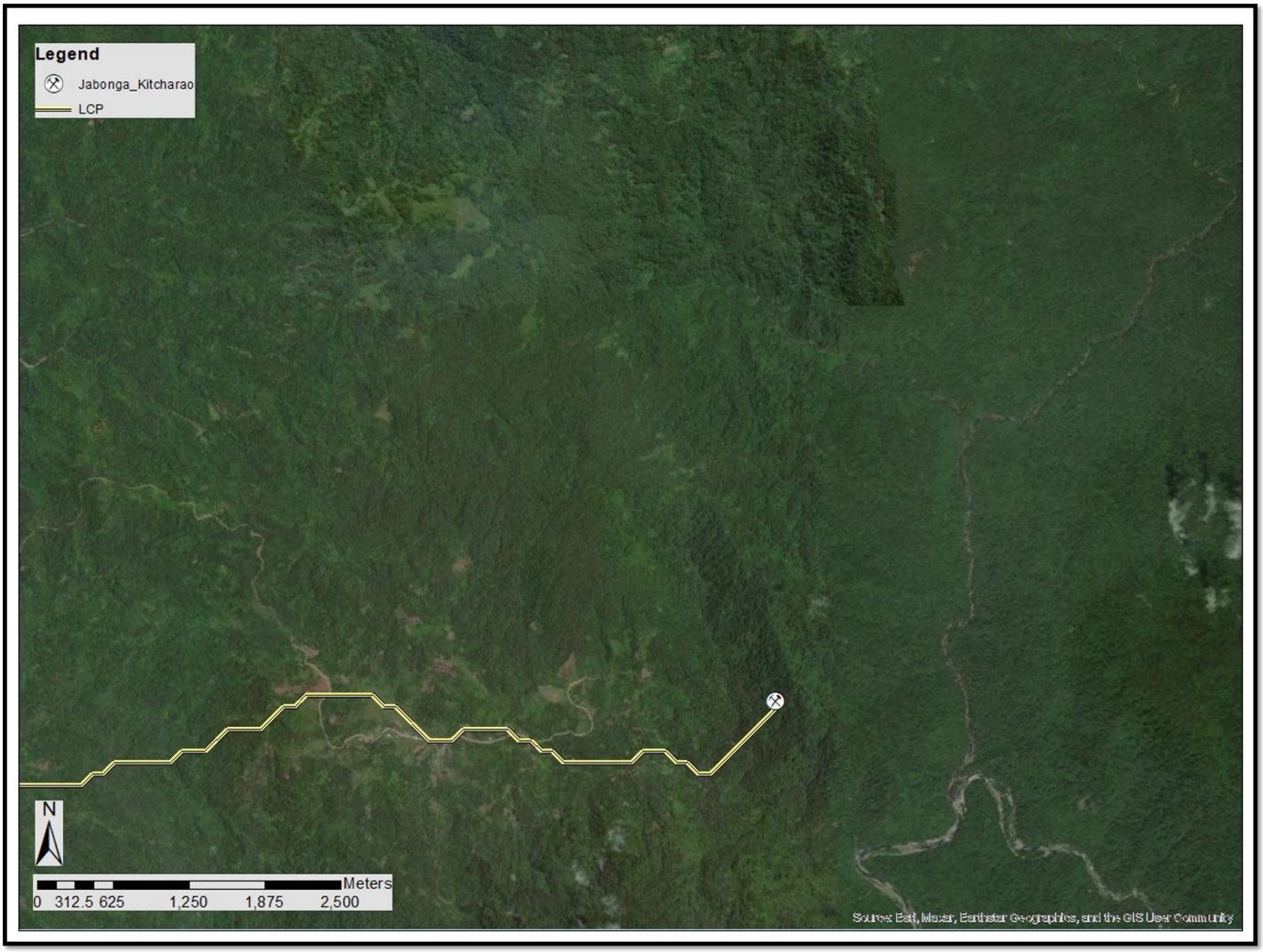

Figure 7. Natural band combination (bands red- green-blue) showing Jabonga and Kitcharao in WGS 1984 (Sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community)

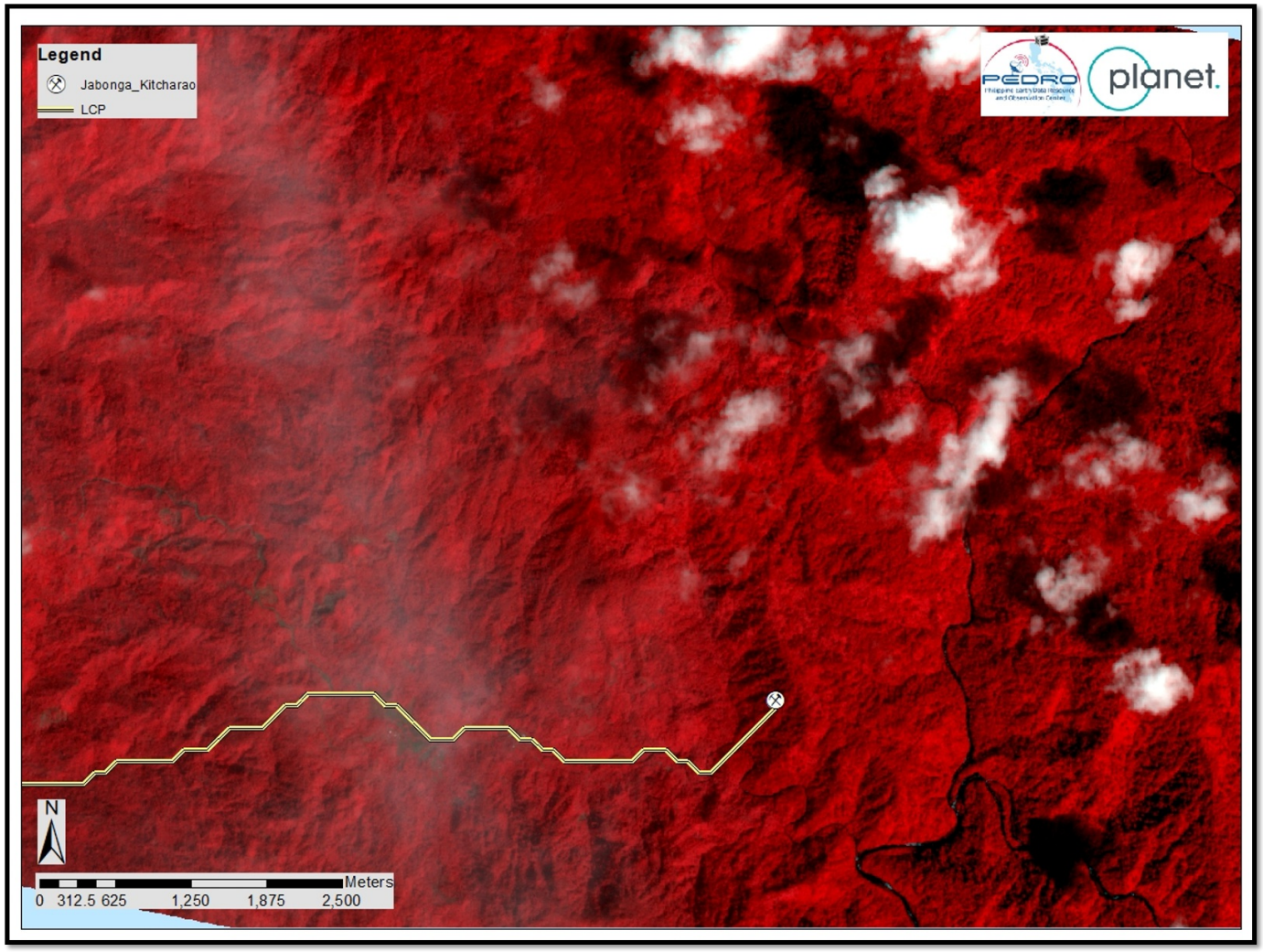

Figure 8. Near Infrared band combination (bands Near infrared- green-blue) showing Jabonga and Kitcharao in WGS 1984 (Philippine Copyright 2021 by DOST-ASTI)

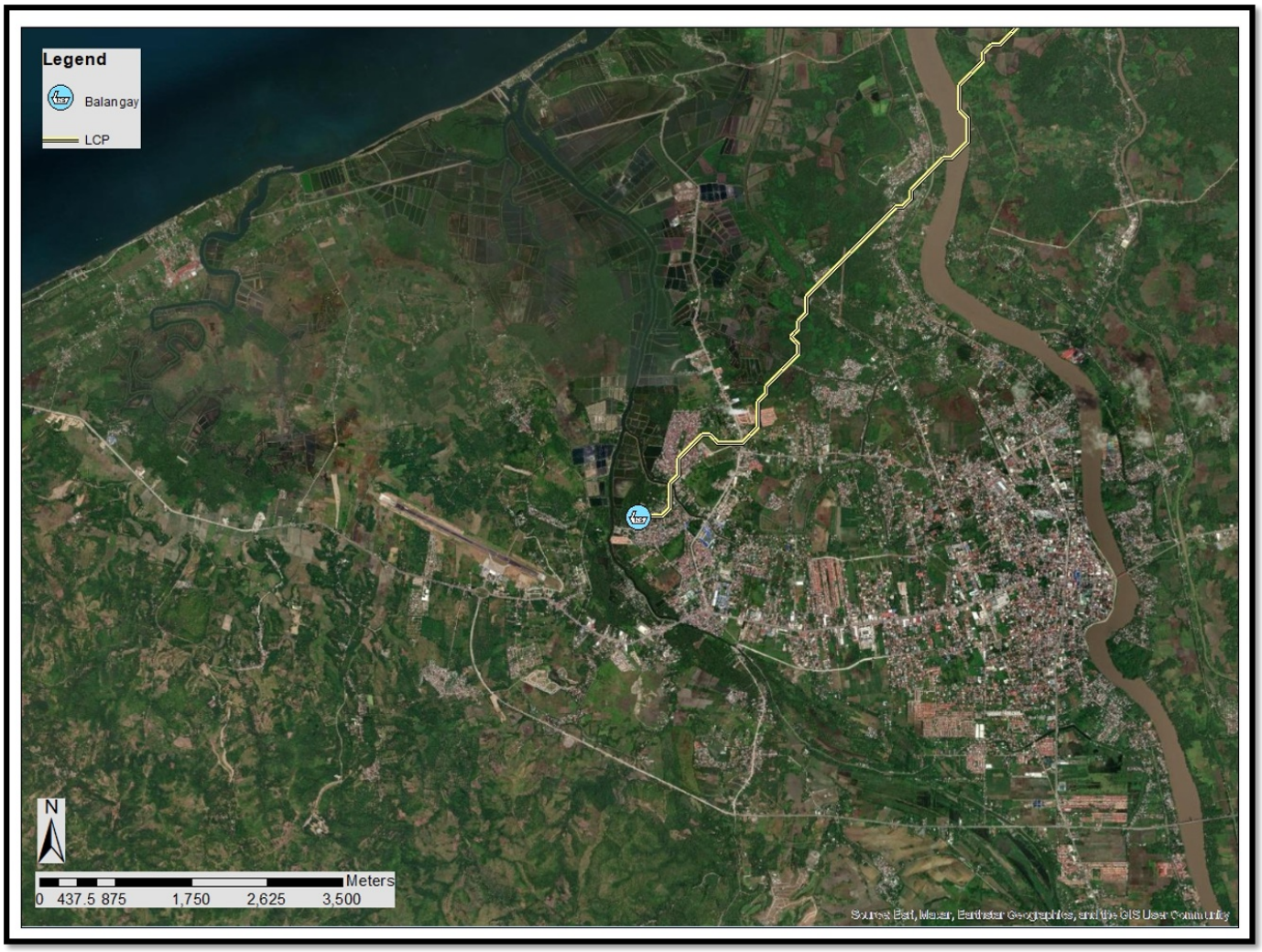

Figure 9. Natural band combination (bands red- green-blue) showing Butuan in WGS 1984 (Sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community)

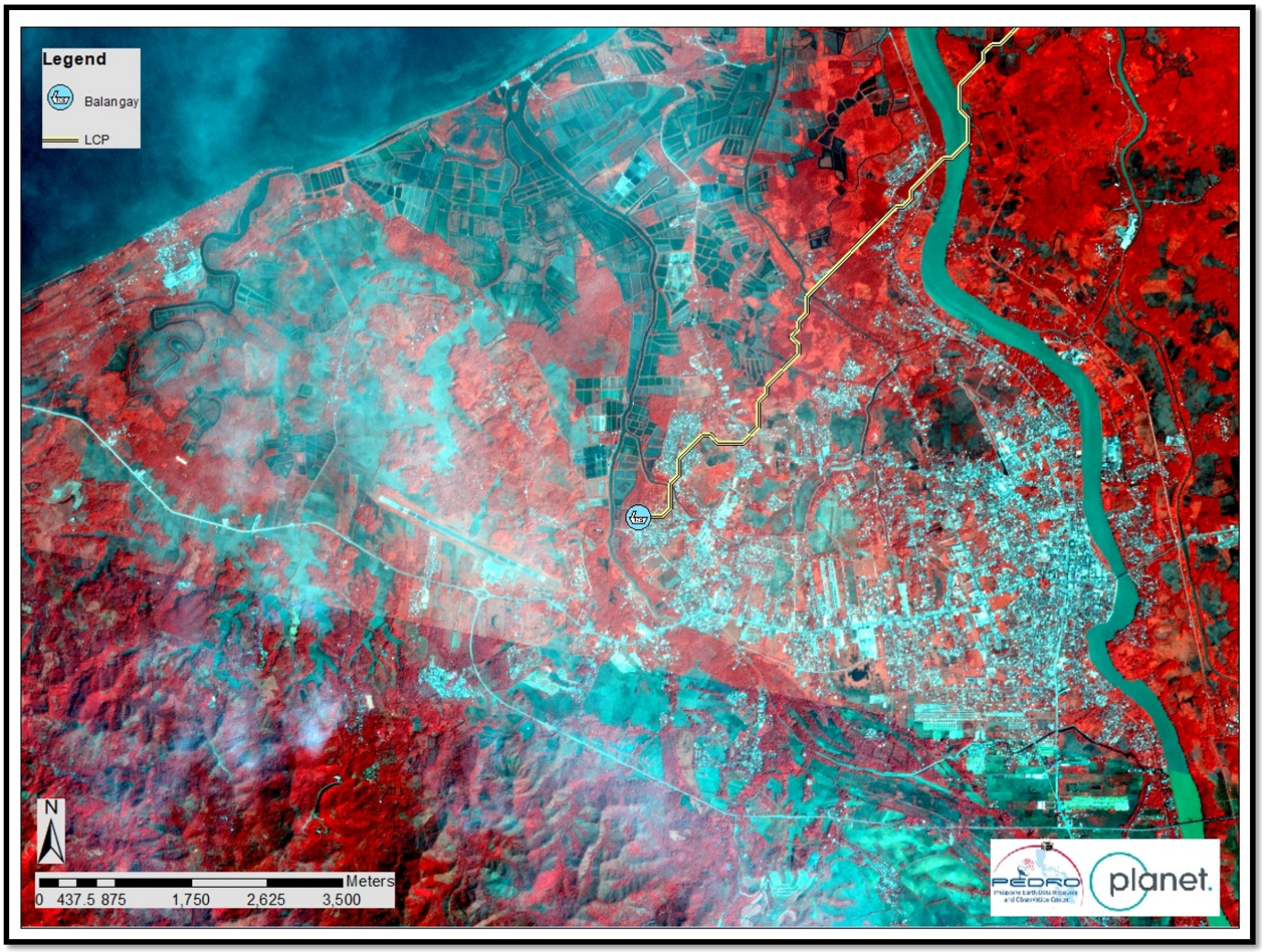

Figure 10. Near Infrared band combination (bands Near infrared- green-blue) showing Butuan in WGS 1984 (Philippine Copyright 2021 by DOST-ASTI)

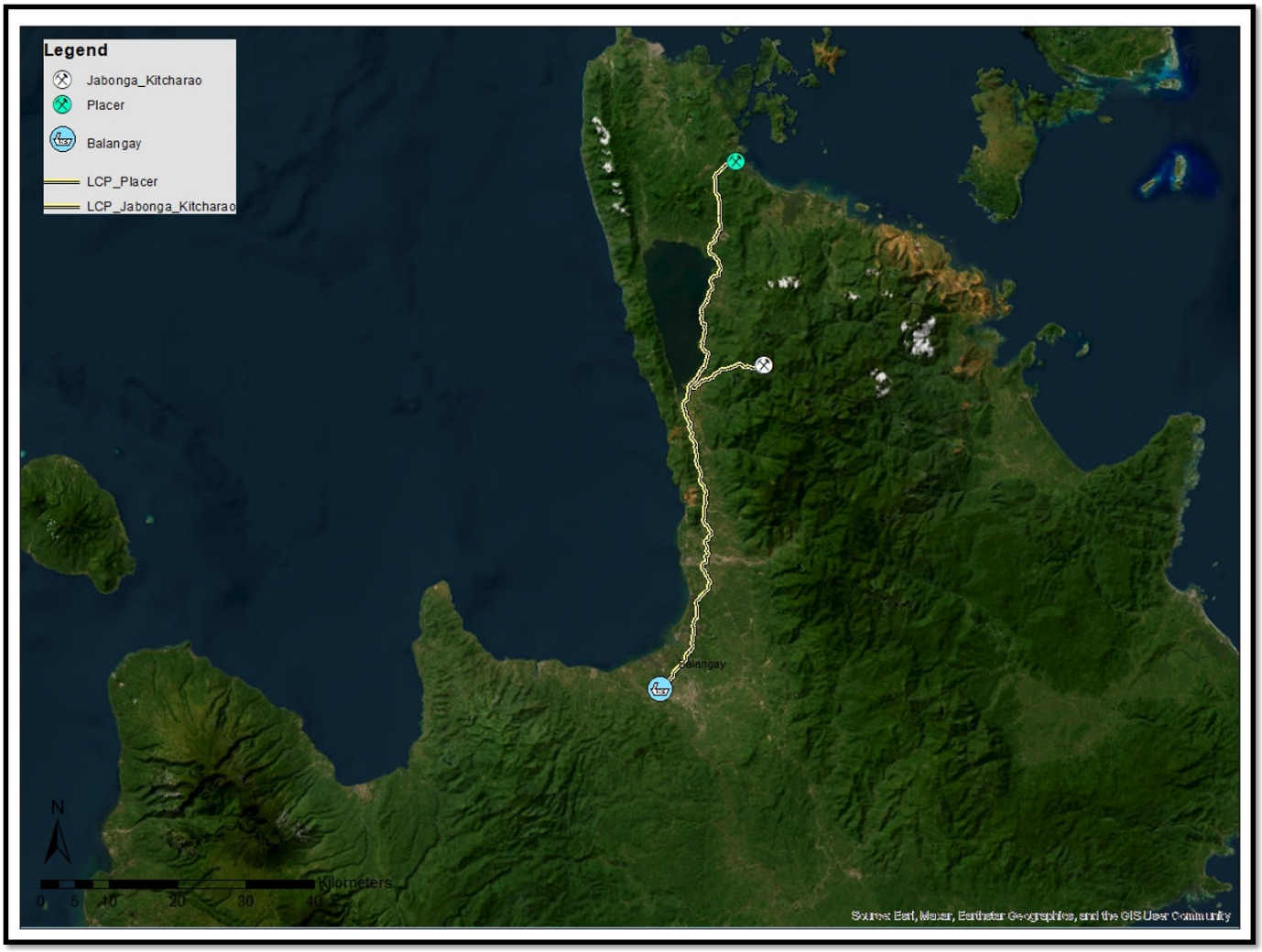

Figure 11. Baseline model of trails that traverse relatively gently sloping and plains areas rather than scaling steep slopes and cliffs in WGS 1984 (Sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community)

Figure 12. Baseline model of possible transhipment or gold bulking points in WGS 1984 (Sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community)

Discussion

A preliminary baseline model showing a least-cost path trail from Placer to Butuan and Jabonga-Kitchrao to Butuan was created using GIS. This baseline model was created based on an algorithm that processed a cost distance raster in tandem with a backlink raster, which determined the path of least cost from the source point to the destination point. While this is a computer-generated model some points can be raised.

The model indeed seems to present a land travel trail that traverses relatively gently sloping and plains areas rather than scaling steep slopes and cliffs (see Figure 11). This assumes that ancient travelers did not intentionally utilize slopes and cliff paths as part of their itinerary. It should be noted that defensive as well as offensive maneuvers would have also entailed utilizing slopes and cliffs which were excluded from the analysis.

The model shows the two paths joining just south of Lake Mainit (Figure 12) before proceeding to Butuan. This is a good baseline model of transhipment or gold bulking points along the route. The areas where the two trials meet is the primary

candidate for further archaeological investigations.

Overall, the research has taken a preliminary step in a more longitudinal process towards understanding the regional archaeology of the ancient gold trade in the Surigao district. The baseline data is to be utilized for verification on the ground.

Secondary Analysis

This paper just presented a baseline computer-generated model. The next step is to test this baseline on other datasets. Future direction will also tap more extensive macroscale data using satellites, to generate mesoscale to microscale data utilizing remotely piloted aircraft systems (RPAS) and to conduct systematic archaeological exploration (ground truthing) on targeted sites, based on the macro scale and mesoscale data. There is also a need to research oral histories and oral traditions of ethnolinguistic groups as well as primary and secondary historical sources that discuss the Surigao gold district.

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