Analysis of the Socio-Environmental Impacts of the Proposed Transboundary Highway between Pucallpa, Peru and Cruzeiro do Sul, Brazil

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Introduction

- The Amazon Biome
  - Over 25% of the world's terrestrial species (Malhi et al., 2011, Plotkin, 2020)
  - Almost 15% of planet's freshwater (Ghai et al., 2011)
  - Nearly 50% of global tropical forest carbon stocks (Saatchi et al., 2011)
  - Approximately 20% of planet's terrestrial carbon (Plotkin, 2020)
- Sierra del Divisor region
  - Southwestern Amazon
  - Borderlands of Peru (Ucayali) and Brazil (Acre)
  - Biodiversity hotspot; 20 mammal species considered 'threatened' (Vriesendorp et al., 2006; Plotkin, 2020)
  - High levels of cultural diversity: nomadic Isconahua, Asháninka, Nawa, rubber tappers, ribereños, farmers, and miners (Salisbury et al., 2013)
  - Forests and watersheds particularly vulnerable to roads and infrastructure development
    - In neighboring Madre de Dios, Southworth et al. (2011) found strong influences of deforestation within 18km of the Interoceanic Highway and related roads
- The governments of Brazil (Acre) and Peru (Ucayali) have intensified their promotion of a road bridging the Sierra del Divisor, following previous attempts since 1943 (Salisbury et al., 2013)
- Ecosystem services
  - Indigenous tribes in voluntary isolation or initial contact draw 100% of their sustenance from the forests
  - Rural people living in or near tropical forests usually derive more than 20% of their household income from timber, non-timber forest products, or fish (Plotkin, 2020)

Impacts of Roads

Environmental	Social	Hydrological
• Degrades flora, fauna, and waters of tropical rainforests (Laurance et al., 2009) • Within 20 km, 75% of deforestation (83%) and degradation (66%) occurs (Oliveira et al., 2007)	• Loss of cultural traditions (Sawyer, 2005) • Spread of outside diseases to Indigenous peoples with limited immunity (Napolitano, 2007) • Facilitate illegal trafficking of drugs, weapons, wild animals, resources, and land titles (Young, 2004; Suarez et al., 2009)	• Decreased water quality (Figueiredo et al., 2020; Riskin et al., 2017) • Increased stream temperature (Figueiredo et al., 2010) • Increased sediment concentrations (Abe et al., 2018) • Changing structure and function of streams (Deegan et al., 2010; Thomaz et al., 2020)

Roads beget other roads, magnifying impacts throughout tropical forest road networks.

Limited research exists on the relationship between deforestation and waterways in the western Amazon (Rios-Villamizar et al., 2017, Thomaz et al., 2020), and even less connecting roads, deforestation, and streams.

Data and Methods

Sources
GTASO Database
RAISG
HydroRIVERS Database
HydroBASINS Database

Table 1. Summary of data used in hydrological and administrative analyses (also see map sources).

- Mixed methods included geospatial analysis (ESRI ArcGIS Pro Version 2.7); data cataloging and refinement; meta-analysis of previous studies on the impact of roads in tropical forests.
- The Brazilian and Peruvian governments each proposed a transboundary road route from Pucallpa, Peru to Cruzeiro do Sul, Brazil; but the roads do not connect
  - We thus analyzed the potential transboundary continuation of both routes: Brazil (north road, Fig. 1), and Peru (south road, Fig. 2)
- Created a 20 km impact zone around each route and intersected it with
  - HydroRIVERS (class 1-8) and HydroBASINS (level 8 sub-basins)
  - Various administrative units (Fig. 3)

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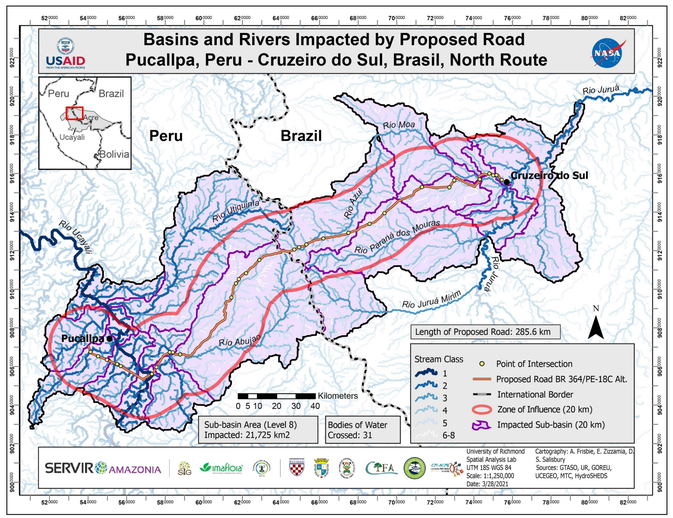


Figure 1. Analysis of potential impacts on rivers and watersheds from the proposed road BR-364/PE-18C Alt. (north/Brazilian-based route) within a 20 km impact zone (highlighted in red).

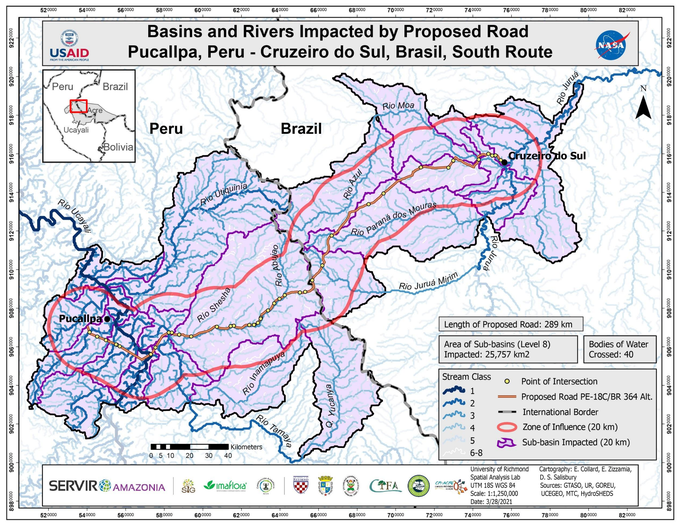


Figure 2. Analysis of potential impacts on rivers and watersheds from the proposed road BR-364/PE-18C (south/Peruvian-based route) within a 20 km impact zone (highlighted in red).

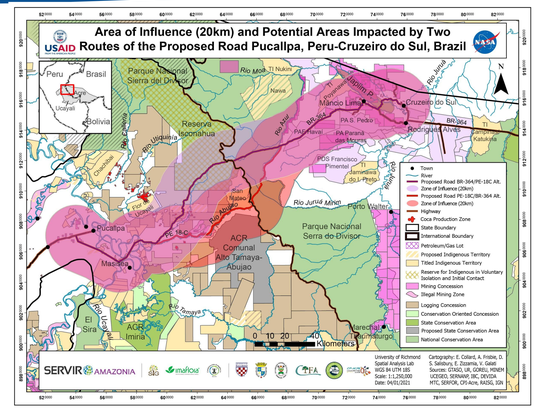
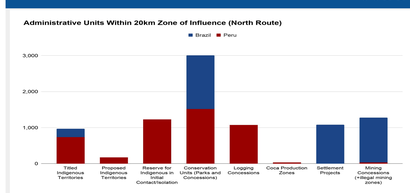
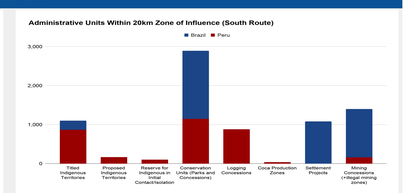


Figure 3. Analysis of potential impacts on administrative units from the North and south routes of a proposed road connecting Pucallpa, Peru and Cruzeiro do Sul, Brazil (BR-364/PE-18C) within 20 km impact zones (highlighted in pink and purple)

Results





Stream Class	# Intersections (South Route)	# Intersections (North Route)
1	1	1
2	3	3
3	9	8
4	20	13
5	5	5
6	2	1
Total	40	31

Figure 4 (top left). Total area (km^2) of administrative units located within the 20km impact zone of the proposed road BR-364/PE-18C Alt. (north/Brazilian-based route) in Brazil and Peru.

Figure 5 (top right). Total area (km^2) of administrative units located within the 20km impact zone of the proposed road BR-364/PE-18C (south/Peruvian-based route) in Brazil and Peru.

Table 2 (left). Count of stream crossing by stream class (classical ordering) for each proposed route.

Discussion

- The use of spatial analysis allows for an objective representation of the consequences of road building for stakeholders, informing local community members and policy makers.
- This road continues to remain a talking point for Brazilian and Peruvian governments, thus requiring persistent and renewed analysis and discussion.
- The disconnect and lack of foresight in the road planning between both governments further exposes a lack of cooperation and information on both sides regarding this road proposal.
- As roads through remote Amazonian regions continue to be proposed, further research is necessary to explore the potential cultural and ecological impacts of road-building in these areas.

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