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Cuando la vida era tranquila:
Land use and livelihood changes following the construction of the Chan 75 dam in Nance del Risco, Bocas del Toro

Patrick McKenzie
School for International Training: Panama
Spring 2018
Abstract

The Ngobe are Panama’s most populous indigenous group. While the Ngobe that live in the comarca have land and resource rights, those that live immediately outside of it do not. This issue has been exacerbated by the creation of Palo Seco Forest Reserve which has removed all land rights from the Ngobe living within it. In order to meet its growing demand for energy, Panama is expanding its hydroelectric sector. One such hydroelectric dam built by AES is Chan 75. However, Chan 75 has had a controversial history, especially regarding its treatment of the Ngobe people of the corregimiento Nance del Risco. The purpose of this study was to examine how land use has changed since the construction of the Chan 75 dam and how dam construction has impacted the livelihoods of community members in Nance del Risco. To assess this, vegetation change and forest loss analyses were run using Landsat satellite imagery. Additionally, a case study of the impacts of the dam on the Garcia family, who lived in Valle el Rey and were relocated by AES, was completed through interviews with 9 family members. Interviews were also conducted with community members from 6 other families impacted by the dam. It was found that vegetation near the reservoir and forest across Nance del Risco have decreased since the construction of the Chan 75 dam. Moreover, the dam has decreased the quality of life for the Garcia family, causing issues of transportation, money, and food availability which have in turn caused them to expand their agricultural land use. Similar problems were reported by the other families. Now, as more and more dams are planned and under construction across Panama, it is time to rethink the effects of hydroelectric dams on the communities that they are built in.
Acknowledgements

First and foremost, I would like to thank the Garcia family, without whom this project never would have been possible. They welcomed me into their farms, their homes, and their lives. Thank you for enduring my endless questions. I would especially like to thank En. Garcia who acted as my guide, mentor, and occasionally translator for 10 days. Without you I never would have survived sliding down mountains on muddy trails, a scorpion sting, a hive of bee stings, and giardia. Thank you for teaching me a bit of Ngabere and a lot about life in Nance del Risco. I would also like to thank Osvaldo Jordan and Aly Dagang. Without your help and support, I would have been lost. Thank you for your patience and assistance at every step of the way. Thank you to all of the families in Nance del Risco that shared their food, homes, and thoughts with me. I would also like to thank Carlos Doviaza. Your endless wealth of GIS knowledge and resources carried me through this project. Finally, I would like to thank the Stamps Foundation and the University of South Carolina who made it possible for me to study abroad in Panama in the first place.
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Introduction

History of the Ngobe

The Ngobe are the most populous, fastest growing, and most impoverished of Panama’s indigenous groups (Stoike 2009). As of the 2010 census, there were 277,242 Ngobe in Panama, and it was projected that there would be 344,443 Ngobe by 2020 (Instituto Nacional de Estadística y Censo 2010). Further, the Ngobe population quadrupled from 1960 to 2000. According to the Government of Panama, 86% of Ngobe live in extreme poverty (Stoike 2009). Traditionally, the Ngobe have relied on subsistence agriculture, hunting, fishing, and the gathering of wild plants to survive (Del Rosario 2011). Historically, the arrival of Europeans to the continent and warfare among indigenous groups during the 16th century drove the Ngobe into the mountainous regions of Western Panama that they largely inhabit today (Wickstrom 2003). Specifically, the largest Ngobe populations are found in the provinces of Bocas del Toro, Chiriqui, and Veraguas and the Ngobe-Bugle Comarca (Lux 2010).

The Ngobe-Bugle Comarca was created by the National Assembly of Panama under Law 10 in 1997. With the comarca status came collective land ownership and legal recognition of Ngobe ethnic-cultural institutions for the territory (Del Rosario 2011). In 1998, Law 41, the General Environmental Law, further guaranteed the right of indigenous people to control and develop lands and resources within comarcas. Although the Ngobe received comarca status for 650,000 hectares, that is only half of their traditional territory (Wickstrom 2003). Further, an estimated 40% of Ngobe live outside of the designated comarca (Barber 2008). However, Article 2 of Law 10 proposed the creation of annex areas that would have similar collective ownership and traditional representation rights as the comarca. These included 15 expressly named annex areas and any communities inhabited by more than 300 Ngobe. These areas were meant to be demarcated 20 months after the law was passed in 1997, but the extents still have not yet been described (Lux 2010).

Creation of Palo Seco Forest Reserve

Palo Seco Forest Reserve is a 167,410-hectare protected area that was created in 1983. It was created to act as a buffer to protect La Amistad International Park from land invasion and for the development of hydropower resources (Lux 2010). However, it was created from territory claimed by indigenous communities, including the Ngobe, and there were existing settlements within the area. Despite this, indigenous groups were not consulted during the creation of the protected area (Mayhew et al. 2009). In 2006, there were approximately 5,144 Ngobe living in Palo Seco, and the Ministerio de Ambiente was aware that these communities buy, sell, and lease land within the protected area. However, the Ministerio de Ambiente claims that legal possessions and titles do not exist within Palo Seco (Lux 2010). Much of the land in Palo Seco Forest Reserve is encompassed by the Changuinola-Teribe watershed, a watershed that is almost entirely in the province of Bocas del Toro (Barber 2008).
Development of Bocas del Toro

The Ngobe have traditionally been the main inhabitants of the province of Bocas del Toro, mostly living in the archipelago and on the mainland around the city of Changuinola. Historically, the province has been isolated, in turn isolating the Ngobe that lived there. However, political stability following the end of the Noriega regime in 1989 has made Panama a center for foreign investment. This stability and investment have changed the Bocas del Toro archipelago into a popular tourist destination (Lux 2010). This tourism began relatively spontaneously towards the end of the 1990s (Claiborne 2010). Now, relatively recent tourism laws have incentivized tourism-related property purchases. Additionally, all non-titled inhabitants of the archipelago are required to purchase property rights at market price or vacate their homes to create space for further development (Stein 2008).

Although these laws only apply to land in the archipelago, land competition in Palo Seco Forest Reserve has increased as former inhabitants of the islands are forced to leave (Stein 2008). This rapid development and displacement has continued without respect for traditional Ngobe land rights or annex areas (Lux 2010). Additionally, there has been significant movement of Ngobe to urban areas in Bocas del Toro, mainly Changuinola (Thampy 2013). As of 2007, 20.3% of all Ngobe living in urban areas lived in Changuinola (Del Popolo et al. 2007). This migration can be partially explained by the rapid population growth of the Ngobe and the lack of other education and job opportunities (Thampy 2013). Between growing tourism and urbanization, the increasing demand for land, water, and electricity has put pressure on natural resources across Bocas del Toro (Lux 2010). Now, the Panamanian government has focused on developing hydroelectric dams across the province of Bocas del Toro.

Hydroelectric Dams in Panama

Hydroelectric dams are often promoted as clean alternatives to fossil fuels. Currently, hydroelectricity is the main source of power across Central America. Given the anticipated rapid growth in electricity demand in the region over the coming decades, the development of the power sector is necessary to ensure the efficiency and security of power. Much of this development is occurring in the hydroelectric sector (Barbosa et al. 2017). Another strategy for combating this demand was the construction of the Interconnected Electric System of Central American Countries (SIEPAC). SIEPAC, completed in 2013, connected transmission lines to one power grid from Guatemala to Panama, allowing these countries to sell power to each other (Kathuria et al. 2015). Although one goal was to provide energy for growing demands, Panama already produced more energy annually than they used and intended to sell additional power, especially from current hydroelectric projects (Barber 2008). Between June 2013 and December 2015, Panama made $22 million exporting energy through SIEPAC (Echevarria et al. 2017).

Although, hydroelectric dams have proven able to meet the growing electricity demand thus far, they also have been criticized for creating other environmental and social issues. In terms of environmental impacts, dams often flood natural habitats, change downriver hydrology, release greenhouse gases, and cause the loss of both aquatic and terrestrial wildlife. In terms of social impacts, dams frequently reduce water quality, increase water-related diseases, cause loss of cultural property, and result in the involuntary displacement of previous inhabitants (World
Commission on Dams 2000). As of 2000, between 40 and 80 million people had been relocated for hydroelectric dams globally. However, this displacement is more than physical and often causes social, cultural, and livelihood disruption for those impacted (Finley-Brook and Thomas 2010).

In Panama, 57.4% of power generation is supplied by hydroelectric plants (Secretaria Nacional de Energia 2016). As of 2008, hydroelectric dams generated approximately 800 MW of power, and 3 dams produced 86% of the hydroelectric power in Panama. These dams were Fortuna at 300 MW, Bayano at 260 MW, and Esti at 120 MW. At the time, there were further plans for 23 potential hydroelectric plants across Panama with the highest power potential in the provinces of Bocas del Toro, Chiriqui, and Veraguas (Giardinella et al. 2011). Since 2008, Panama has completed some of these planned hydroelectric dams, including the 33 MW Bonyik dam and the 223 MW Chan 75. Currently, hydroelectric dams generate 1,623 MW of power. The Panamanian government now plans to expand this capacity to 2,389.1 MW through 95 identified new hydroelectric projects (Secretaria Nacional de Energia 2016).

However, these dams have not been without controversy in Panama. The Bayano dam, for example, was Panama’s first major dam and was completed in 1976 (Scudder 2005). Although prior to dam construction it was estimated that only 450 people would need to relocate, in actuality 4,500 were forced to relocate. These included 1,500 Kuna and 500 Embera, two of Panama’s indigenous groups. The proposed total compensation for landholders was only $200,000. Many Kuna, the most organized and persistent group during negotiations, received only $4,500 each (Finley-Brook and Thomas 2010). By 1989, both indigenous groups had become marginalized, losing both economic and social status to new migrants (Scudder 2005). In 2013, Panama was found in violation of the American Convention on Human Rights by the Inter-American Commission on Human Rights (IACHR) for its handling of the construction of the Bayano dam (IACHR 2013). Likewise, the Bonyik dam was built on the Bonyik River within Palo Seco Forest Reserve, but it was built in the indigenous Naso territory. The construction of this dam created a schism in the Naso community in 2004 when the king gave permission to the Panamanian government and a Colombian firm to build it. It is also suspected that the construction of the dam played a role in the failure of the Naso to gain comarca status in 2005 (World Bank Inspection Panel 2010). The construction of the Chan 75 dam has similarly had a history of controversy.

History of Chan 75

The Chan 75, or Changuinola I, dam was built by AES, a Fortune 500 Company based in Arlington, Virginia, United States. AES produces and distributes electricity in 29 different countries and, as of 2008, made 83% of its revenue outside of the United States (Finley-Brook and Thomas 2010). AES is also the largest energy provider in Panama, controlling 33% of power generation in Panama as of 2008 (Giardinella et al. 2011). As of 2010, AES owned four dams in Panama (including the Bayano dam) and were acquiring a fifth (Finley-Brook and Thomas 2010). Currently, AES is also building a 381 MW natural gas power plant in Colon, Panama (Secretaria Nacional de Energia 2016).
In 1981, the Panamanian state-run electric company described the hydroelectric generation potential of the Changuinola River, and these descriptions influenced the delineation of Palo Seco Forest Reserve. In 2004, as potential corporate interest for a project grew, the first community response was issued with 14 communities surrounding the dam releasing a joint declaration against it. In 2005, Hydro Teribe completed an Environmental Impact Assessment, and it was approved by the Ministerio de Ambiente despite opposition. Hydro Teribe was then bought out by AES, and AES assumed the project (Barber 2008).

In 2007, the Ministerio de Ambiente granted AES a 6,215-hectare concession to build a hydroelectric dam along the Changuinola River in the Palo Seco Forest Reserve (Barber 2008). The Panamanian government claimed that, because the annex demarcations were never actually agreed upon, this concession was not within an annex area and thus does not have the rights of a comarca (Lux 2010). Further, because the dam concession for Chan 75 and the surrounding communities were located within the Palo Seco Forest Reserve, the Panamanian government claimed that the local populations had no land rights and their consent was unnecessary for the concession or construction of the dam (Finley-Brook and Thomas 2010). However, if, annex areas had been properly addressed and delimited, the Ngobe would have been in a better position to negotiate the terms and conditions of the concession (World Bank Inspection Panel 2010; Map 1).

The Panamanian government supported and continues to support the construction of Chan 75 because Bocas del Toro suffers from regular blackouts, the dam increases Panama’s position in the Central American electrical market, and the dam can displace 600,000 tons of carbon dioxide compared to thermal plants (Finley-Brook and Thomas 2010). Additionally, as a part of the concession contract, AES must pay the Ministerio de Ambiente $550,000 every year for the contract and $200,000 every year to maintain Palo Seco Forest Reserve. The contract was for 20 years with the ability to be renewed for periods of 20 more years (Anaya 2009).

Originally, it was estimated that the dam would flood approximately 750 hectares (Stein 2007). It was also estimated that approximately 1,000 people, mostly Ngobe, would be displaced and 3,500 would be otherwise affected by the construction and inundation (Stoike 2009). AES estimated that 178 households over four communities in Nance del Risco needed to be resettled for the construction of the dam (Finley-Brook and Thomas 2010). Despite Ngobe resistance in the forms of petitions, protests, and blockading, the dam was completed (Stoike 2009). The four displaced communities were Valle el Rey, Charco la Pava, Guayabal, and Changuinola Arriba, and they were resettled without free, prior, and informed consent. According to the concession, AES was responsible for negotiating, relocating, and compensating community inhabitants that were directly or indirectly affected by the project (Anaya 2009).
Map 1: Map of the Chan 75 reservoir within Palo Seco Forest Reserve and Bocas del Toro. Green represents protected areas in Panama.

Nance del Risco

Corregimientos are the smallest political units in Panama, and Nance del Risco is the corregimiento that both the Chan 75 dam and the displaced communities are in (Map 2). The corregimiento of Nance del Risco was created in 2009 by Law 18. Before that, these communities were part of the larger corregimiento of Valle del Risco (Republica de Panama 2009). According to the 2010 census, Nance del Risco covers 1,052.4 km² and has a population of 1,760. 96.31% of this population is Ngobe. On average, there are 6.4 habitants per home. The median age is 14, and the reported median monthly income for people older than 10 is $433. 70.6% of habitants over 10 reported having no economic activity. Out of the 271 households in the corregimiento, 53.9% do not have potable water, and 75.6% do not have electricity (Instituto Nacional de Estadística y Censo 2010).

Between the four displaced communities, there are 612 habitants across 93 households. Of these households, 39.8% do not have potable water, and 69.9% do not have electricity. 98.9% of the population of these four communities are Ngobe. Only 379 (or 61.9%) of the habitants of these communities are older than 10, and of these, 69.9% reported having no economic activity. On average, there are 6.8 habitants per house. Finally, the reported median monthly income for people older than 10 is $476 for habitants of Charco la Pava and Valle el Rey, $400 for habitants of Changuinola Arriba, and $100 for habitants of Guayabal (Instituto Nacional de Estadística y Censo 2010). However, these statistics do not account for community members staying outside of the communities for school, seasonal work, or other reasons.
Map 2: 2010 census map of the corregimiento of Nance del Risco.

The implications and predicted impacts of the Chan 75 dam on these communities and Nance del Risco were studied before and during the construction of the Chan 75 dam. However, no research has been conducted on the actual land use and livelihood changes following the construction of the Chan 75 dam on the nearby Ngobe communities in the corregimiento of Nance del Risco.

Research Question

Has land use changed since the construction of the Chan 75 dam, and how has dam construction impacted the livelihoods of the Garcia family and other community members in Nance del Risco, Bocas Del Toro?

Research Objectives

- To examine broad land use changes and patterns from before and after the construction of the Chan 75 dam in the Nance del Risco corregimiento
- To examine one specific case of land use and livelihood changes from before and after the construction of the Chan 75 dam in Nance del Risco through the Garcia family and their neighbors
Methods

Vegetation Change and Forest Loss

To examine broad land use changes and patterns, vegetation change and forest loss were assessed from before and after the construction of Chan 75. The corregimiento Nance del Risco was used as the study area because it is the smallest Panamanian political unit that contains the Chan 75 dam and reservoir. Within the corregimiento, analyses were also conducted on the area of the current reservoir, the area within one kilometer of the current reservoir, the area between one and two kilometers of the current reservoir, and all area in the corregimiento beyond two kilometers of the current reservoir (Map 3).

Using United States Geological Survey Landsat satellite imagery, Normalized Difference Vegetation Index (NDVI) values were calculated and used to represent vegetation density (Tucker 1979). Comparing NDVI values from different periods can be used to examine vegetation change in tropical forests (Horton et al. 2017). 4 images were selected from the Landsat-7 Enhanced Thematic Mapper Plus (ETM+) archive from before the dam (Table 1). 4 images were also selected from the Landsat-8 Operational Land Imager (OLI) archive from after the dam (Table 2). All images were from Path 14 Row 54 of each satellite’s orbit. Images selected had less than 10% land cloud cover and were taken between December and January to minimize temporal differences. Images from before the dam were taken in 2001 or 2006. Images from after the dam were taken between 2013 and 2017.
**Landsat-7 ETM+ Selected Images**

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<tr>
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<td>LE07_L1TP_014054_20061215_20170105_01_T1</td>
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Table 1: Identifications for the 4 selected Landsat-7 ETM+ images used for NDVI calculations from before the dam.

**Landsat-8 OLI Selected Images**

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<tr>
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<tr>
<td>LC08_L1TP_014054_20131226_20170427_01_T1</td>
</tr>
</tbody>
</table>

Table 2: Identifications for the 4 selected Landsat-8 OLI images used for NDVI calculations from after the dam.

Landsat-7 ETM+ and Landsat-8 OLI provide 30 m resolution images for the bands of interest. For each pixel, NDVI calculations were completed using the formula

\[
NDVI_{Landsat-7 \ ETM+} = \frac{\text{Band 4} - \text{Band 3}}{\text{Band 4} + \text{Band 3}}
\]

for Landsat-7 ETM+ images or

\[
NDVI_{Landsat-8 \ OLI} = \frac{\text{Band 5} - \text{Band 4}}{\text{Band 5} + \text{Band 4}}
\]

for Landsat-8 OLI images (Li et al. 2014).

After NDVI values were calculated for each pixel, the images from each satellite were merged. Overlapping pixels were selected based on the maximum NDVI value. This process was used to eliminate cloud interference from the images (Holben 1986). Finally, the average NDVI and standard deviation were calculated for each area of interest from the merged images from before and after the dam. All calculations were done in QGIS 3.0.1.

To assess forest loss, global forest change data from Hansen/UMD/Google/USGS/NASA was used. This data is available through Global Forest Watch and can be used to assess tropical forest loss (Bikié et al. 2000). For this data, approximate area of forest loss is available for each year from 2001 to 2016. The data defines forest loss as a change from a forest to non-forest state. Only pixels classified as having greater than 30% canopy density were considered forest for this calculation. The data has 30 m resolution, and each pixel has been assigned a value of either 0 for no loss or 1-16 representing what year the loss was detected (Hansen et al. 2013). For each area of interest, the hectares of forest loss were calculated for each year. Then, the hectares of forest loss were divided by the total hectares of the area of interest. This provided a measure of the percent of forest loss in the area.
Community Member Interviews

The full extent of land use and livelihood changes caused by the construction of the Chan 75 dam are complex and intertwining. It was quickly apparent that it would be impossible to understand the full breadth of these changes from satellite imagery alone. To examine land use and livelihood changes on individuals and families, members of impacted communities were interviewed about their experiences before and after the construction of the Chan 75 dam. All interviewees lived in the corregimiento of Nance del Risco before the construction of the dam. Interviewees were divided into two groups: the Garcia family and other families.

Case studies are useful when the research question asks “how” and “why” things have occurred, when the question does not require control over behavioral events, and when the question focuses on contemporary events (Yin 1994). This is the case for this research because the question is about how the Chan 75 dam has changed these communities and why these changes have occurred. Further, the story of the Garcia family is a useful case because they lived in one of the relocated communities, negotiated with AES, received compensation, and have had their lives greatly altered by the construction of the dam. This allows the changes caused by the Chan 75 dam to be “transparently observable” (Eisenhardt 1989). Thus, the Garcia family was used as a case study to understand life before and after the dam.

The heads of the Garcia family are F. Garcia (age 75) and his wife Ev. Garcia (60). They have 5 daughters: Sa. Garcia (44), O. Garcia (42), Ma. Garcia (41), Mi. Garcia (29), and C. Garcia (26). They also have 4 sons Si. Garcia (36), En. Garcia (32), A. Garcia (23), and J. Garcia (15). F. Garcia and Ev. Garcia have 2 grandchildren and 2 greatgrandchildren. These grandchildren range in age from 1 to 23 years old, and the greatgrandchildren are both 1 year old. Before the construction of the Chan 75 dam, the entire family lived on one farm and largely in one house in Valle el Rey. Now, the family is scattered across Panama. 9 members of the Garcia were interviewed: F. Garcia, Sa. Garcia, A. Garcia, En. Garcia, Si. Garcia, Ma. Garcia, O. Garcia, Mi. Garcia, & Ev. Garcia. The Garcia family’s houses in Valle el Rey, San Juan, Changuinola, Soledad de Risco, Nance Risco, and Valle del Risco were visited. Their farms in Valle el Rey, San Juan, and Soledad de Risco were also visited.

Community members from 6 other families were also interviewed. These interviews were conducted to support the case study of the Garcia family by expanding the scope of the research. Only one member of each family was interviewed. Their houses and farms were not visited. All of their families lived in the corregimiento of Nance del Risco before Chan 75 was built and still live within the corregimiento today. Community members 1, 2, and 3 lived in Valle el Rey before the dam. Community member 4 lived in Nance Risco. Community member 5 lived in Changuinola Arriba. Community member 6 lived in Guayabal. All of these interviewees had been impacted by the construction of the dam.

In order to ensure safe research design and to protect interviewees, the research proposal and interview guide were reviewed and approved by a Local Review Board (LRB). The interview guide has been annexed in both Spanish and English (Appendix I). Before each interview, verbal consent was obtained. All interviews were conducted in Spanish. No minors were interviewed. All interviews were semi-structured (Kalio et al. 2016). All names have been
changed to protect the anonymity of the interviewees. All interviewees were found through the assistance of the Garcia family and were conducted in April 2018.

**Results**

*Vegetation Change and Forest Loss*

In terms of vegetation, the average NDVI value before the dam was 0.38 (standard deviation 0.22) for the area of the lake, 0.48 (0.08) for within 1 kilometer of the lake, 0.47 (0.08) for between 1 and 2 kilometers of the lake, and 0.43 (0.09) for beyond 2 kilometers of the lake. The average NDVI value for the entire corregimiento of Nance del Risco before the dam was 0.43 (0.09). After the dam, the average NDVI value was 0.02 (0.13) for the lake, 0.46 (0.10) for within 1 kilometer of the lake, 0.47 (0.13) for between 1 and 2 kilometers of the lake, and 0.43 (0.07) for beyond 2 kilometers of the lake. The average NDVI value for the entire corregimiento of Nance del Risco after the dam was 0.43 (0.08). These results are visualized in Figure 1. NDVI maps for Nance del Risco are shown from before the dam (Map 4) and after the dam (Map 5).

![Average NDVI Value for Each Area](image)

Figure 1: The average NDVI value for each area of interest before and after the construction of the Chan 75 dam. Lake represents the current area of the lake created by the Chan 75 dam in Nance del Risco. 1 km represents the area within 1 kilometer of the current lake area in Nance del Risco. 2 km represents the area between 1 and 2 kilometers of the current lake area in Nance del Risco. > 2 km represents the area beyond 2 kilometers of the lake in Nance del Risco. Error bars represent one standard deviation.
Map 4: NDVI map of Nance del Risco before the construction of the Chan 75 dam.

Map 5: NDVI map of Nance del Risco after the construction of the Chan 75 dam.

In terms of forest loss, from 2001 to 2016, the corregimiento of Nance del Risco lost 1,089.6 hectares of forest. 883.6 of these hectares were lost after 2007. The number of hectares of forest lost for the corregimiento each year is shown in Figure 2. Disaggregating the data into the areas of interest, the lake in Nance del Risco lost 121.4 hectares of which 112.3 hectares were lost after 2007. From 2001 to 2016, within one kilometer of the lake in Nance del Risco 169.7 hectares of forest were lost, and 149.4 of these hectares were lost after 2007. From 2001 to 2016, 105.7 hectares of forest loss occurred between 1 and 2 kilometers of the lake in Nance del Risco, and 84.1 of these hectares were lost after 2007. For the area beyond 2 kilometers, 692.8 hectares of forest were lost between 2001 and 2016, and 537.8 of these hectares were lost after 2007. The number of hectares of forest lost for each area of interest each year is shown in Figure 3.
The calculated area for each area of interest in Nance del Risco is as follows: 587 hectares for the lake, 2,396 hectares for within 1 kilometer of the lake, 2,314 hectares for between 1 and 2 kilometers of the lake, 99,796 hectares for beyond 2 kilometers of the lake, and 105,093 hectares for the entire corregimiento of Nance del Risco. The hectares of forest loss were divided by the area of each of these for each year to calculate the percent of forest loss that year. These results are displayed in Figure 4. For the area of the lake, 20.7% of hectares lost forest from 2001 to 2016 of which 19.1% occurred after 2007. For the area within 1 kilometer of the lake, 7.08% of hectares lost forest from 2001 to 2016 of which 6.23% occurred after 2007. For the area between 1 and 2 kilometers of the lake, 4.57% of hectares lost forest from 2001 to 2016, 3.63% of which occurred after 2007. For the area beyond 2 kilometers of the lake, 1.23% of hectares lost forest from 2001 to 2016, and 1.08% of this occurred after 2007. Finally, for the entire corregimiento of Nance del Risco, 1.04% of hectares lost forest between 2001 and 2016, and of this, 0.84% occurred after 2007. A map of the forest loss data for the corregimiento is shown in Map 6.

Figure 2: The hectares of forest loss each year for the entire corregimiento of Nance del Risco.
Figure 3: The hectares of forest loss each year for each area of interest. Lake represents the current area of the lake created by the Chan 75 dam in Nance del Risco. 1 km represents the area within 1 kilometer of the current lake area in Nance del Risco. 2 km represents the area between 1 and 2 kilometers of the current lake area in Nance del Risco. > 2 km represents the area beyond 2 kilometers of the lake.

Figure 4: The percent of forest loss each year for each area of interest. Lake represents the current area of the lake created by the Chan 75 dam in Nance del Risco. 1 km represents the area within 1 kilometer of the current lake area in Nance del Risco. 2 km represents the area between 1 and 2 kilometers of the current lake area in Nance del Risco. > 2 km represents the area beyond 2 kilometers of the lake.
18

Map 6: Map of forest loss from 2001 to 2016.

**Garcia Family**

In 1980, F. García bought an 83-hectare farm along the Changuinola River. In 1996, F. García, his wife Ev. García, and their children moved to the farm with the intentions of living there permanently. In 2001, F. García was one of the five founders of the community Valle el Rey which his farm became a part of (F. García 4/20). F. García had two houses: one in the community so younger children could go to school and one large house on the farm where most of the family lived. Sa. García often stayed in the house in the community to take care of the children (Sa. García 4/21). Only Ma. García had a separate house on the farm for her own family (Ma. García 4/25).

Their farm had two main sections: the plains and the mountains. They lived and worked in the plains because they were relatively flat and near the river. The river was beautiful, and they used it for many things. For example, they bathed and washed their clothes in the river (F. García 4/20). It had many fish that were an important part of their diet. En. García listed 10 different species of fish that they used to be able to find in the river along with shrimp. In the plains, they had both pasture and agriculture. In the pasture, they had 16-18 cows, 4-5 horses, 12-14 pigs, and 80-90 chickens. For agriculture, they grew a wide variety of plants including bananas, plantains, taro, yucca, pineapple, yams, yampee, cacao, coconuts, oranges, and other vegetables. They also had 7-8 “huacas,” or large archaeological artifacts made by the Ngobe long ago. On the other hand, they conserved the forests in the mountains because they needed the animals, wood, and water from the mountains (En. García 4/21).

During that time, it was a 4 to 5 hour walk to leave the community, but this could be sped up by taking a boat or horse (Sa. García 4/21). There was sufficient space, sufficient water, and sufficient food then for the entire family. The family could even trade bananas, fish, and other foods for goods that they needed, and that was easy (En. García 4/23). Many of the family members interviewed used the same word to describe life before the dam came: “tranquila” (F. García 4/20, Sa. García 4/21, En. García 4/23, & Ev. García 4/27). Similarly, many of the family

Between 2005 and 2006, AES sent representatives to visit community members in the area. They visited the Garcia family and spoke with F. Garcia. They described the dam that would be built and that he would need to move. However, they promised him that he and his family would receive a better life. They promised F. Garcia that he could continue working his current farm and that he would receive a new, better farm. They promised him new, better houses that they would own with running water and free electricity. They promised the family a motor boat for transportation to their current farm after the lake was filled. On top of that, they promised him money as compensation. For the community of Valle el Rey, they promised there would be a new center of health, a new, better school, and a road to the community (En. Garcia 4/24).

In 2007, construction of the Chan 75 dam began. In 2008, F. Garcia was brought to Panama City for formal negotiations with AES. AES did not negotiate with any of the other members of the Garcia family (F. Garcia 4/20). Because the reservoir would flood the community of Valle el Rey, AES moved the community to the mountains to the east within the concession. After negotiations, F. Garcia received a new house in this new community and money (F. Garcia 4/20). Sa. Garcia also received a new house there (Sa. Garcia 4/21). Ma. Garcia received money for a new house (Ma. Garcia 4/25). En. Garcia also received some money (En. Garcia 4/22). Finally, Si. Garcia received a very small amount of money (Si. Garcia 4/24). Ev. Garcia received nothing because wives were not considered (Ev. Garcia 4/27). O. Garcia, Mi. Garcia, C. Garcia, A. Garcia, J. Garcia, and any grandchildren received nothing because they were too young at the time (A. Garcia 4/22, En. Garcia 4/22, O. Garcia 4/27, & Mi. Garcia 4/27). They then received these compensations. For the two houses in Valle el Rey, temporary wooden houses were provided until the completion of the replacement houses in 2015 (En. Garcia 4/23).

After the Garcia family had to leave their home in Valle el Rey, life changed, and everything was different. In 2009, F. Garcia bought a new, 5.5-hectare farm in San Juan. In 2010, construction of the dam ended, and the lake filled (Picture 1). Of the 83 hectares of their original farm, 28 flooded, and 55 remained (F. Garcia 4/20). All of the plains flooded, including their original house, pasture, and agriculture (Picture 2). That year, F. Garcia bought a small house in Changuinola, and En. Garcia used his money to buy his own 5-hectare farm in Soledad de Risco (En. Garcia 4/22). Ma. Garcia used her money to expand her husband’s house in Valle del Risco (Ma. Garcia 4/25). Si. Garcia used his money to improve what was left of their old farm (Si. Garcia 4/24). Then, the money was gone (En. Garcia 4/22).
In Valle el Rey, the houses that F. Garcia and Sa. Garcia received are nice but have serious problems (Sa. Garcia 4/21; Picture 3). The houses are connected to the electrical grid and have outlets and lightbulb slots, but the electricity is not free like promised. Instead, it is too expensive for most people in the community to afford, including F. Garcia and Sa. Garcia. The houses do have running water, but the system that the water comes from does not have enough water for the community, so the water normally runs out one to two times per day (Sa. Garcia 4/21 & En. Garcia 4/22). The houses often leak when it rains as well (Sa. Garcia 4/21). No one in the community has received any form of documentation for their houses either, meaning that although they live in the houses, they do not own them (Sa. Garcia 4/21 & En. Garcia 4/22). Although the community has a center of health, no one works there, and the road to the community is dangerously steep (En. Garcia 4/20). Additionally, since the lake filled, mosquitoes have become a consistent annoyance (Sa. Garcia 4/21 & En. Garcia 4/22). However, the greatest problem that the new house poses is that it is now difficult to reach the old farm (F. Garcia 4/20, Sa. Garcia 4/21, En. Garcia 4/23, Si. Garcia 4/24, & Ev. Garcia 4/27). To reach the old farm, members of the Garcia family must follow a steep, dangerous, muddy path down the mountain. Then, they must cross the lake. For this, En. Garcia uses a canoe which takes 20 to 25 minutes (En. Garcia 4/21). On the other hand, Si. Garcia takes a motor boat across, but this costs money (Si. Garcia 4/24). When they return from the old farm, they must climb the same path up, often with heavy bags of produce on their back. This has also made fishing less feasible because access to the water is so difficult. Further, the many species of fish from before have disappeared, and now there are only tilapia left (En. Garcia 4/21).

![Picture 3: Photo of replacement houses in Valle el Rey.](image)

The old farm today has little in common with the farm before the dam. Of the 55 hectares still above water, very little is usable because of both the mountainous terrain and the shade of the trees (Picture 4). Although the dam still allows them to use the farm, it has implemented new rules as part of the concession. For example, the Garcia family cannot use any of the farm within 50 meters of the lake, and they are not allowed to cut any trees within the concession (which the entire farm falls within) (En. Garcia 4/21). However, they have recently started to break these rules because there is not enough food (En. Garcia 4/21 & Si. Garcia 4/24). 1.5 years ago, they
made a new pasture in the mountain for their animals (Picture 5). Before the new pasture, they had to pay another family to keep their animals, but that was too expensive. However, the new pasture is dangerous because of the terrain, and last year one of their cows fell to its death. They now have 2 cows, no horses, 6 pigs, and about 20 chickens on this farm (En. Garcia 4/21). Further, there is little agriculturally that can be done with this land, aside from growing wood trees which they are not allowed to cut or sell. Thus, one year ago, En. Garcia, Si. Garcia, and Sa. Garcia’s children started to use the land within 50 meters of the lake to grow cacao and plantains to eat (En. Garcia 4/21 & Si. Garcia 4/24). They plan to expand their farming in these areas because they still do not have enough food (En. Garcia 4/21). However, the family worries about future generations being able to use the farm at all because they no longer own it (F. Garcia 4/20).

Picture 4: Photo of the old farm from Valle el Rey.

Picture 5: Photo of the new pasture on the old farm.
When the farm in San Juan was purchased, it had been an abandoned farm for about 3 to 4 years (Picture 6). The land was “rastrojo,” essentially full of small trees with some large laurel trees around the edges. Now, that “rastrojo” has been replaced with mostly plantains with small amounts of banana, yucca, yams, and maize (En. Garcia 4/27). However, many of the laurel trees remain because the farm exists within Palo Seco Forest Reserve. Because of this protected area, the Garcia family must request permission for every tree they cut down. This permission process requires about 3 to 4 months. The shade from these trees does not cause major problems for the farm; however, they are cutting them when they have permission still for more farmland (En. Garcia 4/26). The crops on this farm are grown to be both eaten and sold. However, transportation to and from the farm is expensive, so it is difficult for the family in Changuinola to get food from the farm (En. Garcia 4/27). F. Garcia bought and much of the family lives in the small house in Changuinola because there is not a good school close to San Juan (F. Garcia 4/20).

![Picture 6: Photo of the San Juan farm.](image)

Similarly, when En. Garcia purchased his farm in Soledad de Risco, it was an abandoned farm full of “rastrojo” (Picture 7). However, unlike the relatively flat farm in San Juan, his farm is mountainous with large forested areas. Of his 5 hectares, only about 1 hectare can be used for agriculture because of the shade from the larger trees. Like the farm in San Juan, this farm is within Palo Seco Forest Reserve, so the 3 to 4-month permission process is required for each tree cut. In the area that he can use, En. Garcia mostly grows cacao and bananas along with some yampee, yams, taro, and yucca. These crops are only grown to eat, except in the rare case when there is enough extra to sell. En. Garcia is cutting trees as he gets permission and plans to continue to expand to the agricultural area of his farm because there is not enough food (En. Garcia 4/19). Although he normally lives on the farm in Soledad de Risco, his wife and children normally live in Nance Risco because there is no school near his farm.
Nance Risco is the capital of the corregimiento and the only community with a colegio within it. The dam provides electricity to the street lights and houses that can afford it, but many houses still have no electricity, including En. Garcia’s family (En. Garcia 4/18). After the dam was built, most houses were upgraded from traditional thatched roofs to aluminum roofs. For example, En. Garcia’s family’s house in Nance Risco, which is owned by his wife’s father, was upgraded with the money he earned as a worker for the dam. However, these jobs were short-lived, and then the money was gone. The new, paved road that AES built to the dam has improved transportation to the community, but the old road that AES also promised to fix remains unpaved (En. Garcia 4/19). Like Valle el Rey, there is a center of health, but it has no workers. Before the dam, much of the area of Nance Risco was farms, but Nance Risco has since grown as families have moved in from the flooded communities, including En. Garcia’s family. These past farms can be evidenced by the banana and cacao trees still scattered around the edges of the community (En. Garcia 4/23).

Finally, Ma. Garcia and her family in Valle del Risco have no farm. They survive by making and selling clothes, but they have problems with having sufficient food. Before, they lived close to the school in Valle el Rey, and it was only a 5-minute walk to school for her children. However, now in Valle del Risco, her children must walk 30 minutes to school. Because she is so separate from the rest of the family, she especially has difficulties seeing them now. Because they have no farm, she also must walk 3 to 4 hours to buy vegetables. These problems are only worsened by the poor conditions of the road, which AES promised to fix but did not (Ma. Garcia 4/25). In total, all of the family members interviewed agreed that there are no benefits from the dam for them or their family (F. Garcia 4/20, Sa. Garcia 4/21, A. Garcia
Map 7: Map of Garcia family farm locations before and after the construction of the Chan 75 dam. The left map represents the farm before the dam. The right represents (from top to bottom) the San Juan farm, the Soledad de Risco farm, and the old farm.

Other Families

Community members 1, 2, and 3 were from Valle el Rey before it was flooded by the dam. Community member 1 was another one of the founders of Valle el Rey. He organized the school in Charco la Pava. His family had lived on their 54-hectare farm in the valley since 1962. Before the dam, life was “tranquila,” and they lived by the Ngobe culture. They had many animals including cows, pigs, turkeys, horses, and chickens, and there were many fish. They could bathe and wash in the river. They sold cacao and coffee, and they could walk, take boats, or ride horses for transportation. Then the company came, and they were promised a better life, a “palacio” in the new Valle el Rey, another house in Changuinola, an education for their children, and $5,000 for the trees on their land that would be flooded. After negotiations, they actually received a small house in Changuinola and a small amount of money. Now, 13 hectares of their farm are underwater: the plains that they farmed on before. The 41 hectares left are mountainous, and they cannot legally cut the trees there because it is within the concession nor do they have the rights to their farm anymore. They now live in a wooden house they built themselves in Valle el Rey, and their children live in Changuinola. They still have no electricity. Walking to what remains of their farm is very difficult because the community is high on the mountain. They no longer have the space to keep animals, and only tilapia remain in the lake. There is not enough water in the community now either. Even though there is a road to the community, there is no transportation, so they cannot sell cacao or coffee anymore (Community member 1 4/21).

Community member 2 was a woman that lived independently in Valle el Rey before the dam. Before the dam, she had a store, a farm, a boat, and animals, and there were many fish in the river. She also described life as “tranquila” and believes that her life is worse now in every way. Although she was living independently, AES never spoke to her, and she received no compensation from them. Now, her entire farm and her old store are underwater. Her boat cannot
pass the dam, so she has no transportation. She also has no place to keep animals. She has to live with the family of Community member 1 because she has no house. She has 4 sons, and she worries that she has no way to better their lives and has nothing to leave for them (Community member 2 4/21).

Community member 3 was a son of another one of the founders of Valle el Rey. Before the dam, his family had a large farm, cows, pigs, and free space, and there were plenty of fish. When the company came he was only 15. Although some of his family members received compensation from the dam, he was too young, so he received nothing. The dam promised his mother $25 per person, but they did not complete this promise. Now, a little land of his family farm is left above the water, but the land is mountainous. It is also impossible to keep cows or pigs there. The rest of his family still lives in the new community of Valle el Rey, and they share what is left of the farm to survive. He lives in a wooden house that his family built in the community, but he still has no electricity. The community suffers problems with insufficient water now and the lack of workers in the center of health. There is also no transportation now, and the quality of the road is poor. Although he was too young to receive compensation from AES, he now has a wife and children to take care of, but he has nothing (Community member 3 4/21).

Community member 4 was from Nance Risco and had a farm close to the dam but not within the concession. However, AES needed to build the road to the dam through his farm. At first, they promised him $70,000 and 4 houses for families living on the farm. Although they built the road through his farm, he has received nothing from AES, and they have not contacted him since. The area that the company took previously had cacao, wood trees, medicinal plants, and vegetables. He lost these without compensation as well. The road also divided his farm which has caused him problems with cultivation. Further, his farm touches the Changuinola River downriver from the dam. The river is now much smaller, and the fish have disappeared. The river is also no longer deep enough to cross by boat. The road has not improved his transportation to his farm either, and he still has no electricity at his house in Nance Risco (Community member 4 4/23).

Community member 5 was from Changuinola Arriba before it was flooded by the dam. He moved there in 1980 and had a 12-hectare farm there. On that farm, he grew cacao, bananas, oranges, taro, and yams. In 2005, the company came and promised him $300,000, a new farm, and a better house in compensation for his farm flooding. However, now his farm is entirely underwater, and he has received nothing from the dam. Now he has to live with his family in Soledad de Risco, and he has nowhere to farm or work. He has problems getting sufficient food, and these problems are made worse by there being fewer fish and animals after the dam. He concluded that now, “solo tengo mi gatito,” or all he has is his kitten (Community member 5 4/19).

Community member 6 was from Guayabal before it was flooded by the dam. Before the dam, his life was “tranquila.” He had a farm by the river. He used the river for water, and there were many fish. He could also easily walk or ride his horse for transportation. Then, a representative from AES came in a helicopter and promised him a better life. They promised him a new house in Guayabal, money for his land, a boat, a university education for his son, and free
electricity. They also promised a road, a school, and a center of health in Guayabal. After negotiations, he only received $5,000 for the 5 hectares of his farm that are underwater and nothing else. The community of Guayabal received no replacement houses, no electricity, no road, no school, and no center of health (Picture 8). The land left from his farm is mountainous and poor for agriculture. Further, transportation to that land is very difficult and expensive because Guayabal is across the lake and far from any road. Now, he has to live with his family in Valle el Rey because he lost his house. He complained that everything now costs money, and the money he received quickly disappeared on food and clothes. Because food costs money and he has no land to work, he has problems with getting sufficient food (Community member 6 4/25). All 6 community members interviewed agreed that there had been no benefits from the dam for them or their family (Community member 1 4/21, Community member 2 4/21, Community member 3 4/21, Community member 4 4/23, Community member 5 4/19, & Community member 6 4/25).

Picture 8: Photo of the community of Guayabal. There are no replacement houses in this community nor is there a school or center of health.

Discussion

Land Use Changes

In terms of land use change, the NDVI and forest loss analyses reveal that vegetation has generally decreased around the reservoir while forest has decreased across Nance del Risco since the construction of the Chan 75 dam. For NDVI, the decrease in vegetation is immediately apparent for the area of the lake formed by the dam. This is reasonable because, as the interviews reveal, much of the land flooded was a mixture of agriculture and pasture. This is supported by the fact that the average NDVI value for the lake area before the dam was lower than those of the other areas since agriculture and pasture generally have lower NDVI values than forest. Similarly, the greater average NDVI values within 1 and 2 kilometers of the lake area support the assertion in interviews that the mountains around the lake were conserved forests before the dam. The average NDVI for the areas within 1 and 2 kilometers of the lake after the dam are lower
than before the dam, and the impact of that vegetation change generally decreases with increasing distance from the flooded area. However, these differences are slight, and the vegetation for the area beyond 2 kilometers has actually increased slightly. These indicate differing changes in vegetation in Nance del Risco since the construction of the Chan 75 dam. However, it is difficult to ascertain from NDVI how much of this loss was forest versus agriculture and whether or not the timing of this change corresponded with the construction of the dam. Additionally, although NDVI obtained from Landsat-7 ETM+ and Landsat-8 OLI are highly linearly correlated, values can differ by up to 0.05 on average, and Landsat-8 OLI generally estimates greater NDVI values than Landsat-7 ETM+ (Li et al. 2014). This effect may have influenced this calculation’s ability to detect all decreases in vegetation.

That said, the forest loss analysis can shed some light on these questions. This analysis reveals that, across all scales in Nance del Risco, there was generally greater forest loss from 2008 to 2012, with spikes in 2008, 2011, and 2012. Based on the interviews, construction of Chan 75 began in 2007 and ended in 2010, with the lake filling in 2010. Thus, it is likely that these spikes are a direct result of these events. The spike in 2008 could be reflective of the clearing of farms by AES that began in 2007 with construction. The spike in 2011 could reflect the final clearing of farms and flooding of the reservoir. The spike in 2012, however, occurs after these events have passed, perhaps reflecting the clearing of new farms by displaced families. Additionally, the larger areas of interest show forest loss beyond the lake following a similar pattern. This could also be indicative of deforestation caused by the relocation of these communities. The Garcia family, for example, were forced to move in 2008 and expanded into new farms in 2009 and 2010. Also, the fact that the lake area only shows 19.1% forest loss since the construction of the dam despite obviously being flooded could be indicative of how much of the area was agricultural and pastoral, which both NDVI analysis and interviews support. Finally, since 2014, forest loss appears to have returned to its original rate, indicating that the impacts of the dam on land change may have largely already occurred. It is important to consider, however, that satellite imagery has been shown to be unable distinguish between forest and agroforestry in other indigenous communities in Panama (Runk et al. 2010). Thus, these numbers are likely underestimates of land use change, and it is possible that agroforestry expansion is occurring despite not being evidenced by the forest loss analysis. At the very least, this is the case for the Garcia family.

The Garcia family had an 83-hectare farm before the dam. They used the 28 hectares of plans for agriculture and pastures, but the remaining 55 hectares were conserved because they were mountainous. However, because the dam flooded the 28 hectares of their old farm that they used for food, they were forced to expand their land use. In 2009, they bought the 5.5-hectare farm in San Juan. In doing so, they cleared 3-4 years of secondary succession, and now only the laurel trees remain. Additionally, that secondary succession has largely been replaced by a monoculture of plantains. In 2010, the lake filled, flooding what remained of the land in the valley. That same year, En. Garcia bought his own 5-hectare farm. Again, he cleared 3-4 years of secondary succession. Thus, at least for the Garcia family, deforestation was at first displaced outside of the immediate area of the reservoir. However, the shade of the large trees and the regulations of Palo Seco Forest Reserve has slowed the conversion of succession and forest to agriculture. Within the last 2 years, this agricultural expansion has continued for the Garcia family as they have started using the old farm again for pasture and agriculture. Now, the Garcia
family plans to further expand their agriculture on all three of their farms in the future. On the other hand, none of the other 6 families had obtained more land since the construction of the dam; all had only lost land. That said, community members 1 and 3 mentioned that they were now working the mountainous areas of their old farms which they did not work before.

Livelihood Changes

Recognizing that land use change has, at least in part, taken the form of agricultural expansion, the natural next question is why. Based on the interviews, the answer is relatively simple: food. Many of the interviews with both the Garcia family and other families mentioned that there was less food after the dam and that they struggled with that. Across the interviews, the loss of land, the loss of animals, and the loss of fish were cited as important reasons for that loss of food. Although the other families did not have the opportunity to buy new lands to expand their land use, they too cite lack of food as a major issue after the dam. Further, this research does not even address changes in food quality and nutrition alongside the decreasing quantity of food. These issues have only been exacerbated by strict land use rules within Palo Seco Forest Reserve and the concession. On the one hand, this is obviously a result of these families losing parts or all of their original farms to the construction of the dam. However, the second half of the problem lies directly with AES.

As part of the concession, it was AES’s legal and financial duty to provide compensation to those affected both directly and indirectly by the construction of the Chan 75 dam. Although AES promised that compensation (with these promises taking many forms), they failed to deliver it adequately. Some families were completely ignored and received no compensation at all, like community members 2 and 5. Others received compensation that was obviously inadequate, like community member 6 who only received $5,000. Finally, even those that were relatively successful in negotiations received inadequate compensation. This is in part because AES focused on providing new infrastructure and not livelihoods. Further, the new Valle el Rey does not have sufficient water, and these families have legal rights to neither their new houses nor their old farms.

For those that received money, all agreed that it was quickly gone. For the Garcia family, that money was spent on houses and farms. For others, they could only afford food and clothing. Now, these families have little to no money and no effective way to earn more. However, now goods and services also cost money and bartering has become less and less feasible. Although the dam has the potential to provide electricity to these families, that electricity costs money. Of the families interviewed, none currently living in Nance del Risco have electricity despite living within walking distance of a 223 MW dam.

Transportation has also become ironically more difficult for these families despite having access to a road. Where before they were able to easily walk, ride horses, or take boats between destinations, that is often no longer an option. The dam blocks boats from going downriver, and the lake is too large to easily canoe around. Accessing farms now requires steep and dangerous hikes through the mountains on muddy trails. These trails are also impossible for horses to navigate, making horses effectively useless. Although it is possible to take motor boats and cars
after the construction of the dam, these options cost money and thus are often just as impossible as they were before.

Transportation issues are especially pertinent for the Garcia family. Although the Garcia family was relatively successful in negotiations and received more compensation than any other interviewed family, that compensation has itself created problems for the family. Although the houses and money they received have given them advantages over other families, they have also driven the family apart. Where before the Garcia family lived together on one farm, they are now split between Valle el Rey, Nance del Risco, Soledad de Risco, Valle del Risco, San Juan, Changuinola, and Valle de Anton. This has made it both time-consuming and expensive to see their family. Additionally, while other families are forced to continue working what is left of their original farms or have no farms, the Garcia family is now split between three different farms. These farms together still do not have the area or quality for agricultural production of their original farm before the dam. Again, transportation between these farms requires both time and money. Much of the family blames these difficulties of transportation and additional work for the worsening health of F. Garcia.

Another common concern among all families was that, despite all the problems they face now, the worst problems are for the future generations. Again, families have no legal rights to their new houses or their old farms. That means that there is no guarantee that their children or their children’s children will be able to continue to use these. Further, AES has not provided for the future. As the Garcia family and community member 3 reveal, nonadults were not considered by AES during negotiations for compensation. Of F. Garcia’s nine children, only four received any form of compensation. Many of these uncompensated youth now have families of their own to support. Further, since negotiations, 15 grandchildren and 2 greatgrandchildren have been born in the Garcia family. These children were certainly not considered when AES was providing compensation to families. Thus, as these families continue to grow, they must continue to do more with less. With these impacts in mind, it is no surprise that all interviewees, both in the Garcia family and in the other 6 families, agreed that there have been no benefits for them or their family from the Chan 75 dam. Given the number of families impacted, this is likely to create instability in Nance del Risco and Bocas del Toro at large over time.

Comparison with Brazil’s Tucurui Dam

Although in some ways Chan 75’s circumstances are unique, many of the land use and livelihood changes described here are not. In Latin America, the oppression of indigenous communities is a historical pattern for dam construction (Finley-Brook and Thomas 2010). The problems created by Chan 75 are especially reminiscent of those created by Brazil’s Tucurui dam. Opened in 1984, the Tucurui dam flooded 178,300 hectares of forest. However, forest loss was not limited to the flooding alone. Deforestation was also caused by the people relocated from the submergence area. Others were also drawn by the new infrastructure, market, and employment opportunities created by the dam, resulting in further forest loss (Fearnside 2001).

Similarly, Chan 75 has resulted in both vegetation and forest loss from the creation of its reservoir. However, as the analyses here show, vegetation and forest loss have also occurred outside of the actual lake area, both within 1 to 2 kilometers of the lake and within the entire
corregimiento. As in the case of the Tucurui dam, it is likely that this additional deforestation is caused by both the development of infrastructure around the dam and the displacement of people from the submerged area. The Garcia family, again, acts as one such case in which a family displaced by the dam has led to increased deforestation to survive.

The Tucurui dam also created large-scale social issues. An estimated 32,871 people were dislocated by the construction of the dam. Areas flooded by the dam included parts of three indigenous reserves. ELETRONORTE, the company that built the Tucurui dam, was in charge of compensating affected families. However, in most cases they only provided compensation in the forms of cash payments. While this relieved the company of its legal responsibility, the money quickly evaporated from these people with little to no experience dealing with finances. Within months, most families had nothing left of their compensation, and the displaced population were reduced to extreme poverty and essentially left to fend for themselves. Further, by 1993, only 103 of the 1,500 resettled families had received land titles (Fearnside 1999).

Likewise, 1,000 people were relocated for Chan 75, and those people were mostly Ngobe. The four communities flooded were indigenous and were theoretically annex areas. In this case, AES was in charge of compensating the affected families. Similarly, AES focused on providing compensation in the form of cash payments that quickly vanished according to the interviews here. Years after the completion of Chan 75, the interviewed families had nothing left of the monetary compensation and only the Garcia family, who was able to buy farms with the land, had anything left to show for it. The families interviewed often cited lack of sufficient money and food as problems caused by the dam, reflecting similar extreme poverty to that caused by the Tucurui dam. Finally, according to the interviews here, no families resettled for the construction of Chan 75 have received land titles.

In some ways, it appears history has repeated itself with the construction of Chan 75. Despite the Tucurui dam having been completed more than 20 years before the construction of Chan 75, the same issues of indigenous land rights, deforestation, and unfair compensation are now present. However, in April 2016, the Inter-American Commission on Human Rights (IACHR) had its first hearing on the problems with resettlement caused by Chan 75 as part of Case 12.717 (IACHR 2016). Still, as Panama, Central America, and much of the world continue to push for more and more hydroelectric dams, perhaps it is time to reconsider the benefits and costs of dams and the impacts they have on nearby communities.

Conclusion

Based on Law 10, Nance del Risco should be an annex area, and the Ngobe that live there should have complete control over their land and resources. Instead, Palo Seco Forest Reserve prevents the Ngobe from having any legal land rights. Because of this, the Panamanian government was able to grant a dam concession to AES against the will of the people that live there. Although, Chan 75 provides electricity and money to Bocas del Toro and Panama as a whole, it provides little to nothing to the people of Nance del Risco. Instead, families in these communities, like the Garcia family and the 6 other interviewed families, now lack sufficient transportation, money, and food. AES has thus failed to fairly negotiate, relocate, and compensate community inhabitants that were directly or indirectly affected by the project.
turn, the Garcia family and others have expanded their agriculture to survive, and both forest and vegetation loss have occurred in Nance del Risco and beyond. Without land rights or sufficient resources, these people worry about their families and future generations. However, they must also worry about future dams as the Panamanian government continues to push new hydroelectric projects. Chan II, for example, is currently scheduled to enter operation in 2020 (Secretaria Nacional de Energia 2016). Now, all that is left for the Garcia family and the people of Nance del Risco are their memories of when life was “tranquila.”


Instituto Nacional de Estadística y Censo (2010). Estimaciones y proyecciones de la población indígena, por provincial y comarca, según sexo y edad años 2010-20.


Appendix I

Interview Guide

Español

Me llamo Patrick McKenzie, y soy estudiante. Estoy estudiando los impactos de la represa Chan 75 en la gente de las comunidades cercanas. ¿Puedo preguntarle sobre sus experiencias con la presa? ¿Puedo escribir sus respuestas para mi proyecto?

¿Cómo era su vida antes de la represa?
¿Cómo es su vida después de la represa?
¿Qué le prometió la empresa de la represa?
¿Qué recibió de la empresa de la represa?
¿Cómo han cambiado sus fincas desde la construcción de la represa?
¿Qué beneficios ha dado la construcción de la represa?
¿Qué problemas ha causado la construcción de la represa?

English

My name is Patrick McKenzie, and I am a student. I am studying the impacts of the Chan 75 dam on the people of the nearby communities. Can I ask you about your experiences with the dam? Can I write your responses for my project?

How was your life before the dam?
How is your life after the dam?
What did the dam company promise you?
What did you receive from the dam company?
How have your farms changed since the construction of the dam?
What benefits has the construction of the dam given?
What problems has the construction of the dam caused?