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PURSUIT

Using GIS to Assist in Social Impact Assessments at Military Installations

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Social Impact Assessments, evolving from NEPA Environmental Impact Assessments, can be used to address societal impacts resulting from large-scale human activities. GIS is a new tool that can be used to assess the spatial distribution of social impacts. This study used GIS and a Dust Impact Index model to identify the populations at risk to dust exposure from a military installation in Hawaii (Pohakuloa Training Area). This analysis is needed due to an Army Stryker brigade transformation that requires more vehicle training, which is resulting in an increase of dust generation. Factors used to determine the Dust Impact Index were wind speed and direction, elevation, and distance from the military installation. The results identified a population to the southwest of the military installation at the highest risk of dust exposure. This project demonstrates the application of geospatial technology as a means to evaluate issues pertaining to environmental anthropology.

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1. Introduction

1.1 Environmental Anthropology as a Foundation for Social Impact Assessments

The post-modern theoretical approach of Environmental Anthropology arose as a response to Ecological Anthropology, or the study of a human population's cultural adaptations and relationships with its biophysical environment, of the 1960s. The major criticism of Ecological Anthropology lies in its seemingly static boundary between a single, isolated culture and the natural environment that surrounds it.[1] The theory of cultural relativism characteristically situates a population within a singular ecosystem and disregards the potential of change and the influence of outside stimuli. On the other hand, Environmental (or New Ecological) Anthropology recognizes that the study of any culture is best done at the intersection of political policies, developmental regulations, media influences, environmental pressures, globalization, and human rights. Environmentalism— a political and social movement with ties to Environmental Anthropology— requires a discursive and holistic understanding of people, their environment, and the governing institution in charge of regulating both.[2]

Anthropologist Peter Brosius remarks on the study of Environmental Anthropology as follows: "Anthropology has a critical role to play not only in contributing to our understanding of the human impact on the physical and biotic environment, but also in showing how that environment is constructed, represented, claimed, and contested" (1999). In an age of increased globalization, external organizations and outsiders are playing a much larger role in local and regional cultural ecosystems. This mixing among social and political levels, however, results in what anthropologist Conrad Kottak calls "a clash of cultures" (1999). In a rapidly developing world, political, environmental, and economic expansion projects often fail to consider the ethnoecology— or society's perceptions of its own environment— of the population under influence (Kottak 1999). To combat this disruption of life (e.g.. physical health and well-being) and livelihood (e.g. socioeconomic and political stability) in the name of progress, applied anthropologists are contemplating ways to proceed with land development in a manner that is sustainable for both the environment and the people living in it.

1.2 Development of The Social Impact Assessment

A corollary of Environmental Anthropology, the Social Impact Assessment (SIA) emerged as a method to evaluate the social impact of development. The SIA developed alongside the Environmental Impact Assessment (EIA), which was mandated by the National Environmental Policy Act (NEPA) in 1969/1970 for all developmental projects funded by the US federal government (Council 1970). While it was created as a way of documenting encroachment on the environment during development, it remained within the confines of the biophysical environment, cataloging impacts such as land degradation, wildlife and habitat loss, and air and water pollution. As the environment is its primary concern, the EIA offers only a very superficial analysis of the socioeconomic impacts. To combat this deficiency, the SIA was introduced to assess the social impacts of planned infrastructure or development and to adopt strategies for the management of those impacts in a manner that was sustainable for both humans and the environment.[3] The guidelines for writing an SIA within the context of the US-mandated NEPA begin with gaining an extensive understanding of the local and regional settings to be affected. The study should be focused primarily on key elements of the human environment and the cultural variables that will be scrutinized. After collecting the requisite data and determining its significance, as well as describing and analyzing any possible environmental justice issues, the final step is to evaluate, monitor, and mitigate the action or policy under examination. The focus of the social impact study depends on the situation at hand and could include such impacts as economic, demographic, gender perception, political, or health (Interorganizational 2003).[4]

A more rigorous form of the EIA, the Environmental Impact Statement (EIS) is evolving to incorporate societal impact (Council 1970). For example, the Guam and CNMI Military Relocation

EIS written in July 2010 in preparation for a relocation of Marine Corps personnel from Okinawa to a military base in Guam and an expansion in facilities included a stand-alone Socioeconomic Impact Assessment Study (SIAS) to identify issues within population change, economic activity, public services, and sociocultural issues (Joint 2010). The overarching prediction of the SIAS was that the community surrounding the military base in Guam would experience a swift and significant increase in population and economic activity. This would lead to a "Boomtown Effect", which the SIAS defines as "a growth and decline scenario where a community experiences a period of extraordinary growth and expects a rapid decline as the project is phased out" (Joint 2010). This is a familiar theory in demographic and economic evaluations of development projects and is expected under these circumstances.

The Social Impact Assessment is at the frontier of combining quantitative and qualitative data to assess how environmental, economic, and governmental changes affect the societal health of local communities. This relatively novel field of research provides the ideal setting for interdisciplinary studies. One such interdisciplinary approach to the SIA is the combination of anthropological theory and geospatial analysis. In order to quantify the level of human and community risk involved in development, the spatial distributions of populations and impacts of the project must be observed and understood.

2. Case Study

2.1 Introduction

A project done in conjunction with the Department of Geography at the University of Tennessee, Knoxville, presents the opportunity to combine Geographic Information Systems (GIS) mapping with anthropological assessment. The purpose of the study is to identify population areas which face the highest risk of being impacted by dust generated by training vehicles at a military base on the Big Island of Hawaii. After the identification of these at-risk areas, further research may be conducted on the potential effects for the societal health and well-being of the local population. Local Hawaiians have exhibited concern about this dust for its direct influence on air pollution and lung health, as well as its potential to carry depleted uranium particles and other particulate matter from the nearby military base. [5] A model, based on the factors of distance, topography (elevation), and wind direction and velocity, was developed to identify the population areas with the highest relative risk of encountering dust from the military base. Using this model, a thematic map was created via GIS to illustrate the heavily populated census blocks near the military base that are at a higher risk of being exposed to dust.

2.2 Military Training Vehicles at Pohakuloa Training Area

The US Army is undergoing a transformation of their military vehicle brigades. This includes a transition to faster 8-wheeled Infantry Carrier Vehicles called Strykers. Much of the new training involved with these vehicles has taken place at the Pohakuloa Training Area (PTA) in Hawaii (Feickert 2006). Following the implementation of the National Environmental Policy Act in 1970, whenever the Army changes their operational mode, it must develop an EIS to evaluate and quantify the expected cultural and environmental impact.

An EIS entitled "The Permanent Home Stationing of the 2/25th Stryker Brigade Combat Team" was developed for this transformation effort. The EIS raised concerns about dust and air quality with military vehicles training at PTA. In an attempt to quantify this concern, an independent study (with no military association) was conducted (Potteti 2009). [6] The new military vehicles were tracked with GPS during military maneuvers to determine vehicle movement patterns, such as location and speed, which were useful for estimating dust generation through use of EPA guidelines. Dust generation from military vehicle maneuvers was deemed a serious issue for both human and environmental concerns (Potteti 2009). Additionally, although several reports have found little to no adverse health effects caused by depleted uranium, other reports suggest that there may be some effect.[7]

2.3 Methods and Results

In order to identify the populations at risk of this dust hazard, a model was developed as a means to assess social impacts through the application of Geographic Information Systems (GIS). This model – based on wind, elevation, and distance – was used to develop a dust-impact index. Unlike the dust propagation models of previous Department of Defense, Center for Disease Control, and Environmental Protection Agency studies[8] that determine how much dust is produced, this simplified model describes the potential impact of dust on population areas through an assessment of elevation, wind speed and direction, and distance (the same factors used in the earlier dust propagation models). Although complete description of dust propagation is beyond the scope of this project, this simplified model provides a valuable glimpse at potential high-risk areas. The impact index shown below was developed as an alternative method to determine where the dust may be settling and which populations may thereby be at risk:

$$\text{Dust-Impact Index} = 100 * \frac{\left(\frac{W}{W_{\max}}\right) + \left(\frac{E_{PTA} - E}{E_{PTA}}\right) + \left(\frac{D_{\max} - D}{D_{\max}}\right)^2}{3} \quad \textbf{(1)}$$

In this equation, W represents wind speed (normalized to W_max, the maximum wind index value) and direction, E represents elevation (with EPTA being the elevation at PTA), and D represents distance in two dimensions from the training area to the center of a population census block (with Dmax being the maximum distance to a population center from PTA). The model is dimensionless, meaning that it is relative to location and wind speed. The scale runs from 0 to 100 with three factors weighted to quantify the Dust-Impact Index, or the potential impact to recognized populations. Distance is squared and therefore weighted more heavily than the other two factors because of deposition and spatial distribution. As the dust reaches further distances, the concentration of dust will become lower as the dust disperses. A limitation of the model is the inability to account for geographic formations beyond a positive or negative slope, since only the elevation change between the initial and final points is calculated.

Once the Dust-Impact Index algorithm was applied, the top 10% of the population with the highest relative risk of dust exposure (usually those that they were downwind, down slope, or close in distance) was identified as the final resulting area in need of further investigation of possible detectable harm, as shown in Figure 1.

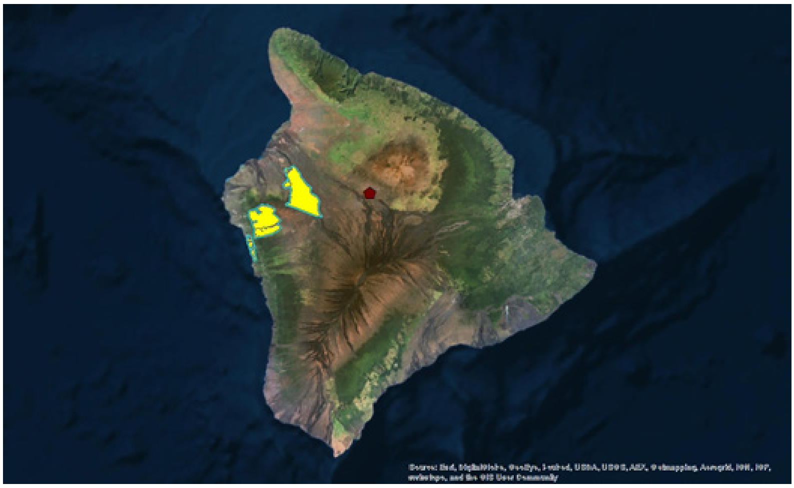

Fig.1: GIS map identifying heavily populated census blocks with the highest relative risk of dust exposure (yellow) in relation to PTA (red)

2.3.1 Data Sources

The demographic data was taken from the 2010 US Census Bureau within a 60-mile radius of the military base under evaluation.[9] The elevation contour line data at 100-ft intervals was found on Hawaii's government planning website.[10] Hawaii wind rose data was provided by the National Water and Climate Center under USDA National Resources Conservation Service.[11]

3. Future Steps: Validating the Approach

Next steps include calibrating and validating the proposed model. This may be done through experimentation in the form of dust sampling, investigative surveys, and statistical analysis, which may become a future development within this project.

To further evaluate the social impact of potential dust exposure in these at-risk population areas, next steps include employing applied anthropological methods of interviewing populations living in these areas and monitoring any changes in health. It may also be beneficial to investigate the demographics and socioeconomics of the populations in the area in order to truly understand the population sector as well as the overall health of the community. If dust is found to be a problem, a long-term solution may be to implement modifications to vehicle training procedures at the base in order to facilitate dust control. These changes may include an improvement of the training exercises, treating roads to keep dust expulsion to a minimum, or an enhancement of vehicles themselves. It is also important to observe any future population changes and track areas that may be experiencing population growth in order to understand how the variable of population change may influence the results. Such changes may be in the form of fluctuations in population size (changes in birth and death rate) or migration in and out of the area.

4. Conclusion

Pohakuloa Training Area is one of many incidents in which a federal improvement – in this case, the development of new military training vehicles and procedures – required the development of an EIS. At this base, environmental concerns were identified, but there was little to no evaluation of possible influences to the local populations. Using the factors of distance, elevation, wind speed and wind direction to create a Dust Impact Index and identify potentially-affected populations is one way of assessing possible anthropological influences. The simplified model developed demonstrates an easily-implemented, yet valuable, method for quickly determining at-risk populations. As demonstrated by this research, GIS is a tool that can be used to not only spatially and geographically identify a potential societal risk from development, but also to quantify the degree of social impact in devising strategies to mitigate future damage. This project adds to the ongoing pursuit of applying technical formulae and knowledge to solve social problems.

5. End Notes

1. Conrad P. Kottak (1999) offers a more in-depth critique of ecological anthropology in his article in American Anthropologist.

2. J. Peter Brosius (1999) explains anthropology's relationship with the environmentalism movement in his article in Current Anthropology.

3. C. J. Barrow's book Social Impact Assessment: An Introduction offers a comprehensive history and overview of the theoretical approaches, methods, and techniques used to construct an SIA.

4. A more thorough description of the principles and guidelines related to SIA can be found in the International Association for Impact Assessment's quarterly journal, Impact Assessment and Project Appraisal.

5. Although this paper has not attempted to verify all of the claims of these sources, the sources do show that the use of radioactive isotopes— particularly, depleted uranium— is of great concern to the local population.

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7. These studies found depleted uranium to cause little to no effect on health:

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