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Problem Statement:

Exponential Human Development, while beneficial to overall GDP per capita and to the socio-economic status of certain groups, has created significant problems of environmental degradation in Vietnam calling for necessary sustainable development methods in order to promote all facets of the SDGs. Potential solutions to allow Vietnam to continue to exponentially grow must be found and introduced immediately. It is no surprise that the immense strides the nation has made over the past decade in lifting over half the population above the poverty line have come with a cost. Today, the extent of urbanization, industrialization, and farming have created dead rivers, immense losses in biodiversity and land erosion. According to thematic coverage from the government-funded Mekong Delta Geospatial Information Systems, forest coverage has reduced by more than half since the 1990s with over 300,000 hectares of forest being lost between 2010 and 2015. The land of these areas has been lost to urban & agricultural expansion and illegal logging. In addition, according to the World Health Organization, over 60,000 deaths are attributed to air pollution annually with many more hospitalized due to respiratory illnesses. Even if methods of sustainable development are implemented to address the prevalent issues of biodiversity loss, air pollution, and overall environmental degradation, there lay many problems that we must tackle. Other issues such as rising inequality and the lingering effects of Agent Orange still mar human development from excelling; disproportionate poverty rates continue to grow for ethnic minority groups and the lasting effects of Agent Orange can still be found in breastmilk of women living near exposed areas today. On another note, GIS technology still has not reached the forefront of the nation with many sources and scientists attributing inefficient environmental and economic policies with the lack of proper coordination and experience among datasets. Moves to domesticate GIS technology and improve transparency have been proposed in many through the use of Web GIS, however. Corruption among the local and federal levels of government also may potentially hinder progress in the struggle to find sustainable development methods.

Annotation One:

Chaudhery, K. (2016, May 23). Vietnam: Re-inventing itself. Retrieved February 12, 2020, from https://www.geospatialworld.net/article/vietnam-re-inventing-itself/

How can the improvement of GIS technology aid Vietnam in the social and economic aspects of human development? Marked as one of south-east Asia's fastest-growing nations, Vietnam is blessed with an abundance of natural resources which it invests heavily towards nation-building. Urban centers such as Hanoi or Ho Chi Min City have been subject to rapid expansion and the diversity of the nations rooting in agriculture, aquaculture, and rich ecosystems have called for the use of geospatial technology in order to get a better overview of Vietnam's diverse portfolio. This diversity in topographical data, demographic and even climate-changing patterns has led to the immense development of GIS technology from industries and academia alike. The role of GIS technology is taking a more integral stance within the nation with its potential in addressing an array of problems including that of food security and rural development and ineffective coordination between local and international NGOs. While the government's Ministry of Natural Resources and Environment has already provided a great deal of data through provincial and topographic mappings, the struggle for greater transparency in data availability has produced grey markets that provide various kinds of maps of higher detail. The role of this technology can aid the nation in a multitude of ways whether it be through protecting coastal areas from the imminent dangers of climate change or coastal storm surges. Regarding agriculture, the role of GIS applications is essential to understanding and predicting the future wellbeing of the country; with rice exports accounting for 16% of world rice trades, improved models of crop yields are core to pre-anticipating many economic decisions. In urban planning, the demand for transportation infrastructure, industrial growth, and inroads development has driven the importance of GIS among organizations such as the Vietnam Institute of Architecture, and Urban Development Agency.

Although the plausible applications of GIS technology in Vietnam are encouraging, there remain many problems associated with such opportunities, one being the minimal expertise on the technology in Vietnam. Perhaps the collaboration among both national and international organizations can continue to propel domestic GIS use to further enhance people's legitimate choices and freedoms. The use of GIS to develop inroads can bring aid and education to rural communities, a facet of goal 4 of the SDGs, allowing for greater participation in a social and economic sense thus combatting unfreedoms that Amartya Sen defined in his work "Development as Freedom". By simply ensuring greater transparency among different sectors and the people, preemptive measures and further policies can be taken to plan disaster relief, enhancing the notion of protective freedoms. Furthermore, this transparency can combat corruption by hold governments accountable for their policies in helping lift those marginalized out of poverty and inequality, creating more social and political freedoms for such groups as

defined by SDG goal 10. It cannot be forgotten that greater investments in GIS technology are imperative to driving such actions, however. Although the methods in which the data will be collected are not specified, data sets combined from basic topographic maps can be combined with other sources such as the SPOT satellite imaging and Indian Remote Sensing to create contour and climate mapping.

Annotation Two:

Trung, L. V., & Tam, D. M. (2018). Web GIS Solution for Monitoring the Forest-Cover in the Mekong Delta, Vietnam. *Journal of Geographic Information System*, *10*(05), 491–502. doi: 10.4236/jgis.2018.105026

The analysis, sorting and sharing of data provided by Geospatial Information Systems create the cross-opportunity for free and open access to information from law enforcement agencies and users. However many previous projects do not reflect this potential, for example, even government-funded projects like the Mekong Delta Geospatial Information Systems (MGIS), funded by the Ministry of Science and Technology, which strives to support leadership in planning and executing sustainable development methods, have failed. While some provinces have made efforts to modernize and model the current environment and future development goals, the lack of coordination of these provinces has marred efficiency through duplications of data, lackluster communication, and various other issues. Therefore an interactive database management system must be set up in order to ensure an efficient and diverse dataset. A method to combat this issue is through the use of Web GIS applications which can share data among multiple agencies and provide updated information on land coverage which this paper will explore.

Mekong Delta was chosen as the site of study as it is extremely vulnerable to climate change; a 100 increase in sea-levels may flood more than a third of its rivers which will indefinitely impact the surrounding city of Can Tho and other provinces. A thematic map of the region has been created through 7 basic layers composed of a Mathematical basis, Boundary, Elevation, Transportation, Hydrology, Urban areas, and Vegetation. .Net core and ASP.NET Core framework were used to develop the side servers. Open source platforms such as PostgreSQL and GeoServer were used to develop the open access MGIS information system which contains various data sources from satellites to monitor changes in natural resources, and in the environment. A thematic data group of the MGIS detailing the extent of forest coverage has illustrated a significant decrease in coverage rate from 10.4% in 1990 to 4.1% in 2015. According to a spatial distribution of forestry, the largest land loss took place in An Giang where 11,713 ha of was lost over the course of 2 and a half decades. In the vast journey to further the legitimate opportunities of people in social and economic regards, we must find ways in which we can further increase the efficient use of GIS in all nations to allow for the essential

collaboration of people which Sen's highlights. In some regard, however, a check needs to be placed on the economic freedoms of people; while logging presents vast opportunities to increase monetary assets, it cannot go entirely unregulated. Rather than freely "enlarging" the choices for everyone, we must strive to find smarter ways to resolve the same issues. This collaboration is essential among not only the people but also the higher organizations of civilization is to drafting the best policies for further development. By creating a more clear picture of forestry degradation through the use of this Web GIS, potential future efforts on sustainable urban development can take place. In addition, the ability of GIS technology to evaluate the changes in forestry, which is important data in modeling climate change and predicting population models, has created valuable data for SDGs 13 to be closer to coming to reality. This article further calling for a better and more transparent GIS system in Vietnam which can provide free access to all users that center on a basic data set. In many aspects, transparency in information can do much to not only increase efficient communication in policymaking but also amend relations between the government and its people, fostering mutual trust. This will allow for improvements in communications among the provinces and cities of the country, allowing for a better understanding of policymaking in the future, ultimately striving for collaboration and the outlining of greater choices for humans in all regards.

Annotation Three:

Kim, S. E., Harish, S. P., Kennedy, R., Jin, X., & Urpelainen, J. (2019). Environmental Degradation and Public Opinion: The Case of Air Pollution in Vietnam. The Journal of Environment & Development, 107049651988825. doi: 10.1177/1070496519888252

With over 90% of air pollution-related deaths coming from developing nations according to the World Health Organization, this issue is no little matter. While there are many alternatives to addressing air pollution such as potential reforms and the switch to clean energy, governments have little incentive to without the support of the public. This public awareness fluctuates considerably when it comes to these issues, however, making it hard to enact certain policies and hold authorities accountable for their promises. Vietnam plans to continue investing in and growing goal consumption capabilities by an astounding 8% annually from its current 44 million ton consumption. Ranking as one of the countries with the worst air pollution levels, Vietnam plans to allow renewable energy to generate a more significant portion of its electricity, this is masked by their plan to build over 20 more coal power plants by the end of this year. Through a study, scientists found that education level correlates to oppositions to coal power plants; individuals with at least a high school diploma are 6% more likely to oppose such plants and take more measures, such as mask-wearing, to combat its products. Furthermore, air pollution intensity also relates to satisfaction levels with government policies. The degree of pollution in local areas also plays a significant role in the residents' perception of air pollution; over 50% of

people sampled in a study relate their awareness to air pollution to sensory indicators like the smell, sight or taste. This awareness does not insight opposition to cheap energy however, with a majority of developing countries having weaker preferences for clean energy to trade-off for cheaper and better economic alternatives. Education is more likely to propel significant environmental policy change for several reasons; not only are they able to acquire and process information regarding pollution better, but they are also more capable of inciting greater environmental consciousness among the community. To estimate NO2 levels and the amount of pollution emanating from coal power plants, scientists used a combination of the HYSPLIT model which tracks particle movements and spatial degree grids to count the number of particles that passed through the given grids. Through the use of a linear regression model, coal plants were found to correlate to NO2 emissions quite strongly with a result of r=0.76. A mere 1 standard deviation increase in NO2 and coal-related pollution has created a 10% and 11% increase in negative perception of the issue. By studying how air pollution affects Vietnam and methods to ensure change within the country, the researchers of this article are ultimately providing methods for its citizens to have the opportunity to live long and prosperous lives while also accomplishing SDGs 4 and 13. The authors are essentially saying that education is the route to ensure change in the world as it helps facilitate governmental policy changes. While the country has faced considerable economic growth within the past decades, this change has not guaranteed the modernization of its education system which still lags behind many other Southeast countries. With tertiary education demand tripling within the last twenty years, and an education system unable to complement this blooming populous, further resources need to be pooled in to address this issue. Through a well-rounded education, paths for social, economic and political mobility becomes possible thus granting greater freedoms and room for development according to Amartya Sen. The harms of vast economic participation cannot be forgotten, however, as put by Sen, various dilemmas rise from something that we all might see as beneficial. For example, economic participation may deter tradition and heritage, a foundational rooting of a country such as Vietnam.

Annotation Four:

Nhu, D. D., Kido, T., Naganuma, R., Sawano, N., Tawara, K., Nishijo, M., … Thom, L. T. H. (2009, November). A GIS study of dioxin contamination in a Vietnamese region sprayed with herbicide. Retrieved February 21, 2020, from
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2767499/

This study was conducted in order to find the correlation between dioxin levels in the soil and in breast milk in the Quang Tri province. In order to further the waning efforts in the Vietnam War, the US military used close to 20 million gallons of herbicides, namely Agent Orange and White, in order to defoliate large areas of forests and croplands however even after 40 years, the adverse

effect this toxin had on humans is still very apparent. In this study, Geospatial Information Systems (GIS) were employed in order to further improve the extent to which dioxins affected people. After investigating a spray site in Aluoi Valley the transfer of tetrachlorodibenzo-p-dioxin (TCDD) was apparent in the food chain, transferring from the soil to ducks and finally to human tissue. Data from 16 soil samples and 1 sediment sample was used to estimate the spatial distribution of dioxins using the Kriging interpolation method, a method originally used to estimate the distribution of mineral deposits. The breast milk from the 151 sample size of lactating females between the ages of 20 to 40 was analyzed and using an extension of ArcGIS, a surface contour of dioxin was created by combining the breast milk analysis, location of the participants and with soil/sediment samples. The mean concentration of dioxin levels in previously sprayed areas was significantly higher than in the unsprayed areas, illustrating a 1.9 pg-TEQ/gI as compared to a .38 concentration respectively. Furthermore, the concentration of dioxin in breast milk in the sprayed areas was significantly higher than in the non-sprayed areas according to a 99.9% confidence interval study, this was also accompanied by higher birth reproductive failures and disease rates among the mothers. While the results illustrated little to no correlation between dioxin levels and concentrations in breast milk, dioxin levels in the soil and breast milk were significantly higher in sprayed areas than in unsprayed areas. Combating the prevalence of Agent Orange and White in the communities of Vietnam is essential in enlarging the basic definition of human development by Amartya Sens. Ultimately development is "enlarging people's choices, capabilities, and freedoms" and enabling one's own ability and the capability of the future generations to live a long and healthy life is no different. With millions of Vietnamese citizens already exposed along with hundreds of thousands of children being born with defects related to dioxin, it is essential that further cleanup efforts are implemented in soil areas with high dioxin concentrations in order to promote the 3rd goal of 17 of the SDGs: good health and wellbeing. The Kriging interpolation method was used alongside the Geostatistical Analyst program to enable the mapping of such areas in the Quang Tri province.

Annotation Five:

Ngo, T. B., Nguyen, T. A., Vu, N. Q., Chu, T. T. H., & Cao, M. Q. (2012). Management and monitoring of air and water pollution by using GIS technology. Retrieved February 22, 2020, from
https://www.researchgate.net/publication/237010127_Management_and_monitoring_of_air_and_water_pollution_by_using_GIS_technology

The need to monitor and manage air and water pollution through the use of GIS technology is necessary in order to combat the large amounts of waste discharged at any given time around the globe. This issue is no different for Vietnam. Through GIS technology, continuous data on such

issues can be compiled quickly and efficiently in any given region. Greenhouse gasses such as CO_2 and CH_4 contribute heavily to climate change which in turn changes precipitation and human activity patterns, leading to drops in water quality. With around 90% of industrial production factories not having any wastewater treatment centers, Vietnams 800 industrial facilities contribute heavily to environmental damage. A total of 30 mobile/stationary monitoring stations oversee the quality of the air and water and even then monthly monitoring quotas were not accomplished. The limited knowledge of operating such systems also proved to be detrimental to the efficiency of such a system. Thus design, development, and improvement on these monitoring stations are imperative to the environmental management and monitoring process. The new monitoring software is based on WebGIS which transmits, integrates and distributes geographic information through the World Wide Web. Users essentially interact with the web servers to obtain the data from these monitoring services on specific areas, marked by GIS software, in the form of interactive HTML pages. Graphs regarding specific parameters of air and water such as dust or ph levels can be drawn from selected areas of monitoring sites, this way users can recognize when data exceeds certain limitation levels, allowing potential solutions and warnings to be given accordingly. A monitoring system like this can transform the way Vietnam tackles environmental issues; with a cheaper production cost and a central data storage system which transfers information to local stations and the Ministry of Natural Resources and Environment, solutions regarding the treatment of pollution can be enacted quickly and more efficiently. This article focuses on potential ways in which transparency and efficiency can be heightened; rather than having to individually extract data from each monitoring station before the implementation of such technology, this new GIS-based monitoring system can provide for continuous management of huge data which it uploads to the internet allowing for greater user access and transparency. It greatly decreases the former costs of importing foreign monitoring technology and enables co-management between authorities and citizens, highlighting the important notion of cooperation between all weaves of the populous and ultimately enlarging all aspects of Sen's definition of development. The potential consequences of such technology can help push for cleaner water and better sanitation by holding unregulated plants more accountable for discharge while also creating more safe and sustainable cities through greater climate action, all goals of SDG 6, 11 and 13.

Other Sources:

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- Education in Vietnam - Current Trends and Qualifications. (2019, April 16). Retrieved February 23, 2020, from https://wenr.wes.org/2017/11/education-in-vietnam
- Vietnam Poverty Rate 1992-2020. (n.d.). Retrieved February 23, 2020, from https://www.macrotrends.net/countries/VNM/vietnam/poverty-rate