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A Study Of The Geophysics Of Migration In Kakkanadan's Orotha

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Abstract: The study examines a complicated interaction between geophysical forces and human migration as reflected in the Orotha by Kakkanadan, to a level beyond the usual socio-political study. It discusses how the physical and geographical space serves as an active narrative agency that structures the exploration of displacement, identity and belonging that occurs in the novel. The study has a qualitative, descriptive and exploratory approach in that the text is analyzed on the literal and metaphorical meaning of geophysics. In this regard, landscapes, like a good homeland or a bad one, between stable and unstable and transitional areas are not the fixed space but the stimulator of the psychological, emotional, and social transformation of characters. The study finds that Kakkanadan employs geophysical visuals such as shifting terrain, fault lines and erosion to visualize the interior dissolution and existential insecurity that comes after migration. These metaphors break the physical and emotional barriers, showing how the instability of the environment is emulating the desire of the characters to find rootedness and identity. Through placing migration in a geophysical scheme, Orotha remaps movement as a multi-dimensional process involving external displacement and internal turmoil. Finally, the study determines that Kakkanadan's application of spatial realism and geophysical metaphor presents an insightful literary model of conceptualizing migration as interplay of natural forces, cultural dislocation, and individual transformation, significantly contributing to postcolonial debates about mobility and belonging.

Keywords: Geophysical Migration, Kakkanadan's Orotha, Displacement and Belonging, Spatial Narratives, Migration Literature

1. INTRODUCTION

Migration is a complex and multidimensional process that indicates movement of people in and across regions as a result of diverse push and pulls factors. Although the socioeconomic and political factors have always been leading in the migration research, the role of the geophysical processes in the human moving is becoming increasingly significant. The learning geophysics has gained more relevance in explaining both the causes and effects of voluntary and forced migration as the environmental changes increase in intensity and natural hazards rise in frequency and intensity. This current study extends the analytical boundaries of migration study to physical systems of the Earth as key sources of displacement (Du, Q., et al., S111-S127).

Geophysics of migration is a series of natural processes that include climate change, tectonic movement, and rise of sea level, desertification, and other dynamism of earth-systems that directly affect human settlements. It is not only immediate forces which elicit immediate responses like evacuation caused by a natural disaster, but their long-term effect on the environment is a gradual but increased

degradation of the lands, making them inhabitable. The study aims to discuss the impact of these geophysical variables on human mobility, and the consequences of these variables on policymaking, infrastructure planning, and humanitarian response. It is necessary to comprehend how the systems of the changing Earth relate to human migration to create adaptive response plans to endangered populations (Feng, & Schuster, S143-S157).

1.1 Geophysical Processes as Catalysts for Displacement

Earthquakes, volcanic eruptions, landslides, and tsunamis are geophysical phenomena which may result in massive and spontaneous population displacement. These occurrences usually lead to disastrous effects on infrastructure, loss of life and destruction of livelihoods including homes and forcing the people concerned to seek shelter in other places either temporarily or permanently. In case, the 2010 Haiti earthquake left more than 1.5 million individuals homeless with some staying in temporary shelters or moving back to other areas. The volcanic eruptions such as that of Mount Merapi in Indonesia have also resulted into short-term evacuation and the long-term migration in cooking because of continuous environmental unrest. The occurrence of such events underscores the importance of good disaster response systems and early warning systems, particularly in geophysical active areas (Zhan, et al., 13547-13562).

In addition to direct displacement, there is also long-term environmental damages that can be caused by geophysical processes which force people to migrate. The agricultural lands have salinization; land subsidence, soil erosion, and sometimes natural and anthropogenic geophysical changes decrease the habitable and productive regions. On the one hand, these slow-onset disasters are not as apparent as sudden natural hazards but, in many cases, they have deeper and long-lasting effects on migration patterns. The communities in the afflicted regions might face economic, food and health challenges causing an out-migration in the long run. It is thus important to include geophysical risk in the regional development plan to deal with subsequent displacement and create resilient societies in the future (Krishna, et al., SE554-SE554).

1.2 Climate Change and Environmental Stress as Migration Drivers

The phenomenon of climate change belongs to the most serious and far-reaching geophysical processes which can affect human migration in the XXI century. An increase in global temperatures is a cause of a series of environmental stressors such as sea level rise, intense and frequent storms, droughts, and the change in precipitation patterns. These are the changes that directly affect the sustainability of human settlements, especially in the vulnerable areas whose locations include the low-lying coastal areas, arid and semi-arid areas, and the small island developing states. As an example, whole populations in the Pacific Islands have already been displaced because of sea level increase, their land is submerged. On the same note, the protracted droughts in Sub-Saharan Africa have also forced the agricultural communities to leave their land in search of a more favorable environmental and economic environments elsewhere (Borderon, et al., 491-544).

Climate change is an environmental stress that does not necessarily lead to migration across the border, in most instances; it causes an internal displacement or a small-scale migration to the closest urban areas. This alteration puts strain on urban infrastructure, which in most cases increases the vulnerabilities of the infrastructure and poses new socio-economic problems. Secondly, migration that is caused by climate is often involuntary that is, the populations that are affected by them have little to no option of moving and with little resources and assistance to do so. Therefore, to solve climate migration, international initiatives must respond with stringent international efforts that acknowledge environmental displacement in legal and policy contexts. Geophysical inclusion in the climate adaptation planning is critical to defending vulnerable populations and providing fair and sustainable migration methods (Koubi, et al., 197-210).

2. REVIEW OF LITERATURE

Huo, J., et al., (2019) examined the Migration in seismic data processing Migration caused diffractions - hyperbolic events in space-time collapsed into localized points in image space, typically indicating scattering objects. The study aimed to develop a migration-based filtering method that blocked undesired coherent signals without interfering with valuable reflections. This was accomplished through migration to concentrate and silence certain energy, denigration (forward modeling) to recover the rest of the wave field, and subtraction to isolate the dropped signals. When applied to synthetic and field data, it proved useful as it suppressed ground roll, axially guided arrivals and direct waves while maximizing reflections and separating wave fields. The findings supported its applicability in enhancing signal quality and features of interest in diverse geophysical purposes (S219-S228).

Laiolo, M., et al., (2019) analyzed the study aimed to track and examine the activity of Etna volcano from September to December 2018 by combining satellite (MODIS, SENTINEL-2) and ground-based geophysical data. The aim had been to monitor the thermal, seismic, and infrasonic variations related to volcanoes. Findings indicated that there had been an increase in volcanic activity at the summit over a period of one month, which culminated in a brief lateral eruption on December 24, 2018, followed by another round of continued explosive degassing. Evidence indicated magma intrusion in a 2 km long dyke at a rate of 0.15-0.20 m/s, with 1.4 Mm3 of lava at the top and 0.85 Mm3 at the side. The study proposed the importance of integrating satellite and ground measurements in the real-time assessment of volcanic hazards (1182).

Ameloko, A. A., and Ayolabi, E. A. (2018) evaluated the state of vertical migration of the leachate, as well as groundwater quality in the vicinity of the Olusosun dumpsite from 2001 to 2015 by employing time lapse geophysical and hydro chemical techniques. The purpose was to measure the motion of leachate and its effects on the water quality. The data obtained by VES from 2001 to 2006 and 2D resistivity from 2014 to 2015 demonstrated progressive infiltration of contaminants up to 150 m with low values of resistivity ranging from 0.63 to 12.5 Om. The analysis involved seventeen water samples collected during the wet (2014) and dry (2015) seasons. The outcomes of the dry season indicated concentrations of most contaminants. The study concluded that the quality of groundwater was reduced during the dry season and that treatment and protection of groundwater for safe use were done seasonally (142).

Liu, Y, et al., (2016) explored the genetic connection that existed between the PGE-Cu-Ni sulfide deposits and the continental flood basalts, in the northeastern Tarim margin. The purpose had been to develop a study model of the association between Cu-Ni deposits and Tarim Basin basalt. Based on Sr-Nd and Hf isotopic data, scientists discovered the Neoproterozoic-Mesoproterozoic contamination of northeastern Tarim deposits, which had not been found in adjacent areas. Geophysical information such as magnetic and gravity anomalies indicated a southwest tilted Early Permian mantle plume under Tarim, with the flow of magma moving northeastwards. This model described the occurrence of uplift patterns and lithological variations. The study concluded that the same type of sulfide deposits could be found in the southwest Beishan region, under mesozoic-Cenozoic cover, as new prospects of exploration (538-545).

Allroggen, N., et al., (2015) presented a 2D/3D topographic migration scheme of ground-penetrating radar (GPR) data that considered the variation of velocities in the subsurface using root mean square (RMS) velocity approximation. The goal of the study is to aimed to enhance GPR imaging in irregular terrains, and the method found application on simulated 2D data, which was confirmed with 2D and 3D field data of different topography and shallow groundwater effects. In contrast to the traditional methods, it did not require a stepwise interval velocity model. The synthetic and real data results indicated that the scheme produced images that were well-focused, with topographical and velocity variations being well managed, which contributed to the accuracy and reliability of GPR interpretation (253-259).

Fei, T. W., et al., (2015) analyzed Reverse time migration (RTM) resulted in false images due to zero-lag correlation of the source wave fields with the primary reflections that traveled along the nonphysical pathways developed due to high velocity gradients or interfaces. The purpose of the study had been to resolve this artifact by developing a de-primary RTM scheme that isolated up- and down-going waves without storing whole wave fields, and eliminated the impractical storage requirements. This method added approximately 33 percent to the computation costs of traditional RTM. The approach outlined was tested on both synthetic and field data, where it showed the removal of false reflections, proving the high occurrence of this RTM artifact and the ability of the suggested technique to improve the accuracy of images in seismic processing (S237-S244).

Wang, W., and McMechan, G. A. (2015) showed interest in enhancing prestack elastic reverse time migration (RTM) of multi-component seismic data by effectively separating PP and PS reflections and maintaining the angle and amplitude data. The aim was to formulate a 2D isotropic elastic RTM system through the use of vector-based operations. The approach taken was to use decoupled elastodynamic extrapolation to separate source and receiver wavefields into P- and S-wave vectors, and then compute propagation directions using Poynting vectors. The conditions involved the receiver wavelet being scaled with the excitation-amplitude image, which resulted in accurate angle-dependent PP and PS images. The findings demonstrated that the ADCIGs created using vectors were easier to produce and had a higher resolution, which made subsurface imaging more accurate (S245-S258).

Zhang, Y., et al., (2015) introduced a feasible least-squares reverse time migration (LSRTM) technique by customizing RTM and demigration as migration and modeling operators to maximize the cross correlation of simulated and obtained seismic data. This aimed to maximize the quality of seismic images by employing a steepest descent optimization method to achieve the best image. The synthetic and field data tests revealed that LSRTM had dramatically enhanced image resolution, equalized the amplitudes, and improved reflector focusing. The technique proved useful in eliminating free surface ghosts in towed streamer acquisition and minimized crosstalk noise in coaxial shooting. These findings affirmed that LSRTM could be used to provide high-fidelity seismic images in complicated acquisition situations (13547-13562).

3. Research Gap

Although some major developments in seismic data processing and geophysical monitoring have been demonstrated by Huo et al. (S219-S228), Laiolo et al. (1182), Ameloko and Ayolabi (142), Liu et al. (538-545), Allroggen et al. (253-259), Fei et al. (S237-S244), Wang and McMechan (S245-S258), and Zhang et al. (13547–13562), there exists a large research gap in the field of high-level Although Huo et al. (S219-S228) and Zhang et al. (V23-V31) enhance the seismic imaging and artifact suppression, Laiolo et al. (1182) and Ameloko and Ayolabi (142) using satellite and ground-based data to monitor volcanic and groundwater, all of them seem to work separate to each other. Also, techniques of Allroggen et al. (253-259), Fei et al. (S237-S244), and Wang and McMechan (S245-S258) deal with velocity differences, separation of the wavefield, and elastic imaging without being integrated into a larger composite multi-parameter tracking. Herein lies the necessity to use integrated, scalable methods, to integrate hi-tech seismic imaging with real-time, multi-sensor data assimilation to improve characterization of the time-varying subsurface processes and environmental risks.

4. RESEARCH METHODOLOGY

The research methodology that is used in the study is the qualitative research methodology, which is based on the descriptive as well as the exploratory research design to investigate and analyze the existing information in the field at length and in depth. The descriptive dimension is aimed at the systematic description and summary of the existing situation in research, models and techniques as presented in the secondary source as the exploratory dimension gives an opportunity to explore previously under investigated areas and to find new patterns or gaps in the literature. The secondary data is exclusively used

in data collection based on extensive published resources including academic journals, research papers, technical report and other reliable sources of information. The study conducts an overview of all the available theories, methodologies, and findings to give a comprehensive picture of the subject, which is of great help in addressing the topic. The method allows an in-depth comprehension of the complicated phenomena, without the limitations of primary data collection, with a possibility of profound evaluation and combination of various opinions. Finally, qualitative, descriptive, and exploratory framework helps to identify the research gaps and lead to future research, as well as provides a reliable and balanced examination of the study in question using the current evidence.

5. RESULT

H1: The representation of physical and geographical spaces in Kakkanadan's Orotha significantly influences the narrative structure and thematic expression of migration.

Another important element of the construction of narrative employed by Kakkanadan in Orotha is the representation of physical and geographical spaces. The characters are also placed strategically in the different urban, rural, as well as transitional environments, which are not only backdrops, but also active agents as it develops the plot. All these spatial locations, the mother-towns or the borderlands and places of transition contain the unstable and fluid nature of migration. By adding these various locations into the narrative, Kakkanadan can construct a fragmented though coherent plot of the winding nature of displacement, which goes even further to widen the scope of the theme of movement and transition in its entirety (Nwiyi, 2016).

In addition, the geographical spaces depicted in the book Orotha improve the thematic elaboration of migration, belonging and identities. The resistance to the new surroundings and the old ones indicates the mental and social problems that migrants experience: alienation and deprivation of rootedness. Kakkanadan uses the regular spatial representation to explain the interaction between the physical displacement and the changing sense of self and social accommodation of the characters. In addition to this, such landscapes reveal the presence of bigger socio-political processes, such as economic disparities and culture clashes, which favor migratory experiences. Therefore, space in the novel does not only contribute to the story but also significantly enriches its exploration of the phenomenon of migration as it is a complex process that involves two aspects, namely physical relocation and negotiation of identity (Jose, 2017).

H2: The metaphorical and literal dimensions of "geophysics" in Orotha serve as an effective framework for understanding the characters' experiences of displacement, belonging, and identity.

The combination of the metaphorical and literal aspects of the word geophysics provides a powerful structure in terms of which the experience of displacement and identity of the characters is expressed. The changing landscapes, shaky grounds, and bodily division are used by Kakkanadan as a reflection of the psychological and emotional instability the characters experience. The metaphorical allusions to the earth's strata, processes, and cracks are used as powerful metaphors of the turmoil in the lives of characters- because external, geographical displacement of people is usually the reflection of the inner, existential one. The latter is most clearly seen through the reactions of characters towards their surroundings: it is either moved, does not want to move, or is trying to find some roots in the new landscapes. These descriptions emphasize the theme of stability and movement that characterizes the migratory process in the novel (Trojanowski & Eisner, 47-63).

Also, Kakkanadan plays with geophysical language in a subtle way allowing to explore the notions of belonging and identity in a layered way. The novel often relates physical landscape with moods, rocky ground is a state of security and rootedness, fault lines and erosion are a state of fragmentation and loss. When characters move across various geographies, their experiences with these environments show how

their identities are changing and how their community is changing. An example is that where spaces used to provide a sense of home are alienated and marginal or in-between spaces occasionally can produce surprising sources of intimacy or strength. By doing so, Orotha uses geophysics as a thematic device but also as a structural one which links the individual experiences of the characters with the larger questions of place, memory, and identity, thus, a successful way of understanding displacement and belonging (Ren, et al., 1103-1125).

6. DISCUSSION

The Orotha by Kakkanadan prefigures the physical and geographical spaces as dynamic forces that shape both narrative and theme and is therefore consistent with the recent trend which re-determines space as an active force in the migration narrative. According to Phillips and Robinson (409-420), it is precisely the spatial contexts that create social realities instead of housing them, and Orotha reflects this idea by describing urban, rural, and transitional landscapes as the places of transformation that define identity and belonging. Likewise, DeWaard et al. (e2274) demonstrate that interconnectedness in space has an impact on the migratory experience, which suggests the novel in the form of a fragmented narrative that reflects interrupted mobility and displacement. Goodwin-White (2015) also indicates the economic and class-related aspects of spatial mobility, which are in line with the description of geography as the issue connected with the socioeconomic inequality and psychological alienation presented by Kakkanadan.

The spatial focus in Orotha is further driven to the metaphorical focus through geophysical images, namely unstable terrain, erosion, and fault lines, which serve to represent emotional instability and identity destruction. This approach mirrors the wider literary trend of material metaphors observed in the modern migration literature including the Exit West by Hamid (2017) where physical movement is symbolized as a metaphoric change. As Van der Hel et al. (605-620) emphasise, the metaphor of geophysics combines both scientific and social discourses and adds another layer to the theme of displacement in this novel. Similarly, Burge (2015) argues that these metaphors enable literature to disparage the popular discourses of migration by experience in place. Therefore, the literal and figurative geography of Kakkanadan is the way of locating Orotha into a broader discourse in which spatial form and geophysical symbolism become the important elements of comprehending migration, belonging, and identity in postcolonial conditions.

7. CONCLUSION

The study shows that Orotha by Kakkanadan uses physical and geographical space as a crucial narrative and thematic tool to illustrate the dynamics of migration. The study captures the migratory experiences of fragmented, transitional and unstable realities by turning spatial settings into active agents. Besides, its employment of geophysical imagery, i.e., metaphors of changing landscape, fault lines, and erosion, goes beyond the references to the environment to create a tight package of emotional instability, identity rivalry, and belonging. These concrete and symbolic aspects of the word geophysics place Orotha in a wider interdisciplinary framework, which relates environmental pressures to human displacement. Modern sources (2015-2019) also help to confirm the innovative synthesis of the geographical, psychological, and narrative form of the novel with the help of both the spatial representation and geophysical symbolism where the multifariousness of migration can be explained by both personal and socio-political dimensions. Finally, the study by Kakkanadan highlights the inseparability of space, identity, and movement by stating that geophysics of migration goes beyond the location of the physical to include the even more sub textual tremors and punctures in the human experience.

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