Gugulothu Nagesh, 2024, 12:3
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology

An Open Access Journal

Consequences Due to Transmutation of Agriculture Land to Aquaculture Land Using Gee

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Abstract- The transmutation of agriculture land to aquaculture land has become a critical environmental and economic concern. This project employs Geographic Information System(GIS) technology, specifically Google Earth Engine(GEE), to assess the consequences of the land-use transformation key factors addressed in this research are utilized to analyze and visualize the spatial dynamics of this transition. The findings of this study aim to provide valuable insights for sustainable land-use planning and policy development in the context of the growing aquaculture industry and its implications for agriculture and ecosystem. The research examines the environmental, economic, and social consequences of this land- use transition. Through spatial analysis and data modeling, the study aims to provide insights into the potential benefits and drawbacks of such transmutations, offering valuable information for policymakers, land managers, and stakeholders in the realm of agriculture and aquaculture. The conversion of agricultural land to aquaculture land refers to the transformation of arable land traditionally used for crop cultivation or livestock farming into facilities dedicated to the cultivation of aquatic organisms. This shift involves the creation of ponds, tanks, or other aquatic enclosures for the purpose of raising fish, shellfish, or aquatic plants. This abstract will explore the reasons for such conversions, their environmental and economic implications, and the challenges associated with this transition.

Keywords- Agriculture, Aquaculture, Land-use transformation, Google Earth Engine (GEE), Environmental consequences, Economic implications, Social factors, Spatial analysis.

I. INTRODUCTION

Over the past decade, there has been a significant shift in land use patterns in the Kolamuru village, situated near Bhimavaram Town, as agricultural lands have been extensively converted to aquaculture. This transition has not only impacted the economic landscape for farmers but has also brought about noteworthy changes in the environment. The motivation behind this transformation lies in the increased income potential offered by aquaculture compared to traditional agriculture. In this study, we focus on the environmental consequences of this shift, aiming to comprehensively understand and document the alterations in key factors such as water quality, pesticide usage, and overall profitability.

Engaging directly with local farmers has been instrumental in obtaining crucial insights into the project's key factors. Through interactions, we have gathered information on the environmental conditions, water quality parameters, the extent of pesticide usage, profits realized by farmers, and the challenges posed by pests. This on-the-ground knowledge, combined with advanced technologies, forms the backbone of our research.

Utilizing satellite imagery, particularly data from Google Earth Engine and QGIS, we have conducted a comprehensive land use and land cover analysis of the study area. These remote sensing tools enable us to visualize and quantify the changes in the landscape over time, providing valuable information for further investigation.

By merging the perspectives gained from farmers with the objective data derived from satellite images, our project seeks to present a nuanced understanding of the environmental repercussions of the widespread conversion of agriculture to aquaculture lands in Kolamuru village.

As we delve into the intricate details of this transformation, our research aims not only to contribute to the academic understanding of land-use dynamics but also to provide practical insights that may inform sustainable practices for farmers, policymakers, and environmentalists alike .The subsequent sections of this paper will delve into the specific findings and analyses, shedding light on the multifaceted impacts of this significant land-use change.

II. STUDY AREA

Kolamuru is Located in Undi Mandal of West Godavari in Andhra Pradesh, India. This Area is taken as the Study area For the Research .It’s Located 6Km down from the Sub-District Headquarters of Bhimavaram.

Bhimavaram is the nearest city to kolamuru for all major profitable conditioning, Kolamuru village, its history intricately woven with the rich earth of agriculture. Though the precise date of this union remains lost to time, the village has likely danced with harvests for centuries, the fertile land nourishing generations past. While details on specific crops and land use paint a hazy picture, the undeniable influence of agriculture on Kolamuru's identity resonates deeply. However, like the gentle ripple of a changing tide, a shift murmurs within the village. Aquaculture, the art of cultivating aquatic life, has dipped its toes into the waters of Kolamuru, evidenced by at least one established farm.

The extent of this potential transformation, however, remains veiled. Did economic whispers entice villagers, promising a bountiful harvest from the waters compared to the traditional yields of the land? Perhaps the availability of water swayed their hands, whispering promises of life beyond the dusty fields. Or the guiding hand of government policies, promoting the embrace of aquaculture, nudged the village towards a new horizon.

Unearthing the reasons behind this potential shift necessitates a deeper dive. The archives of the local government hold the key, their records whispering tales of land use, the changing tapestry of crops, and the nascent ripples of aquaculture. Academic research and news articles, like scattered whispers carried on the wind, might offer broader context and specific details about Kolamuru's journey. But the most potent voices likely reside within the village itself. Engaging with local farmers, fishermen, and agricultural extension officers promises a treasure trove of firsthand perspectives, enriching our understanding of this potential metamorphosis.

Figure 1: Get Tag pic from local study

By embarking on this exploration, we embark on a journey alongside Kolamuru. We witness the village navigating a potential turning point, understanding the whispers that might have swayed its path. This journey unveils the motivations behind the shift, its impact on the lives of the villagers, and perhaps, even offers a glimpse into the future of Kolamuru's agricultural landscape. It is a story not just of changing practices, but of a community grappling with tradition, opportunity, and the ever-evolving dance between land and water.

Figure 2: Soil Qualities from Agricultural

III. DATA COLLECTION

Google Earth Engine (GEE) is a potent tool for remote sensing and geospatial analysis that may be used to evaluate the complex process of turning agricultural land into aquaculture land. This transition entails turning formerly arable land into regions that are mostly utilized for the aquaculture of fish and crustaceans. The environmental, economic, and social dimensions of this transformation must all be included in the data collection process in order to fully comprehend its effects.

The evaluation of the conversion's effects on the environment is one important factor. Changes in vegetation patterns, water bodies, and general landscape dynamics can be identified by the use of GEE for land cover analysis. Changes in the productivity of land and the health of plants can be detected over time by tracking metrics such as the Normalized

Difference Vegetation Index (NDVI). Furthermore, modifications to the size and form of water bodies can be evaluated to determine the effects on regional hydrology.

Moreover, changes in soil qualities could result from the conversion of agricultural land to aquaculture. Analysis of the soil's composition, moisture content, and other pertinent variables is made possible by GEE. Comprehending these alterations is pivotal in evaluating the enduring viability of aquaculture methodologies and their possible influence on the soil's capacity to bolster forthcoming agricultural pursuits, should they arise.

In-depth research is also necessary for social repercussions. GEE can help with infrastructure and human settlement mapping, making it easier to analyze the potential effects on local populations of turning agricultural land into aquaculture. Examining possible modifications to land tenure, community relocation, and the sociocultural composition of the impacted areas are critical. Through the integration of remote sensing data and demographics, researchers can obtain a full picture of the social dynamics linked to the change in land use.

Furthermore, great consideration must be given to the environmental effects of aquaculture, including habitat degradation and water pollution. GEE can support the monitoring of water quality metrics, the identification of possible sources of contamination linked to aquaculture activities, and the detection of changes in the health of water bodies. Developing sustainable aquaculture methods that reduce detrimental effects on ecosystems requires analyzing the temporal and spatial patterns of these environmental changes.

It is necessary to take into account indirect effects on biodiversity in addition to direct ones. Hotspots for biodiversity and changes in habitat distribution can be evaluated using GEE. Developing conservation methods that lessen possible harm to ecosystems and animals requires an understanding of how the conversion of agricultural land into aquaculture land affects the local flora and fauna.

In conclusion, a thorough examination of the environmental, economic, and social aspects of the effects of converting agricultural land into aquaculture land is made possible by the use of GEE for data collecting. With the help of this method, policymakers and researchers may make well-informed decisions about sustainable land use practices that balance the advantages of aquaculture with the protection of ecosystems and the welfare of nearby communities.

IV. METHODOLOGY

A thorough, multi-step process is used in the methodology for evaluating the effects of converting agricultural land into aquaculture land using Google Earth Engine (GEE). First, obtain high-resolution satellite imagery data that spans the research region across several time intervals so that changes in land use may be examined over time. Make use of GEE's ability to retrieve and preprocess these satellite images, guaranteeing a consistent level of format and data quality.

Next, use GEE's supervised or unsupervised classification algorithms to draw boundaries between the land cover classes for agriculture and aquaculture. While unsupervised classification finds patterns in the data without previous training, supervised classification uses ground truth data to train the algorithm. Verify the categorization results' correctness using field surveys or already-existing ground truth data, and reclassify as needed.

Determine the transmutation's ecological effects by evaluating important variables like habitat loss, biodiversity, and water quality. Use the GEE tools that are available for remote sensing-based water quality assessment, and add field data to confirm and improve the accuracy of the findings.

Analyze changes in food production, revenue creation, and employment prospects to further assess socioeconomic effects. To identify possible hotspots of risk or places benefiting from the transition to aquaculture, overlay socioeconomic data with changes in land cover.

Lastly, use GEE to create statistical summaries and spatially explicit maps that effectively communicate the findings. This thorough approach makes use of GEE for a comprehensive evaluation of the effects of turning agricultural land into aquaculture land, offering insightful information for sustainable land management and policy choices.

The transformation of agriculture land to aquaculture land in Kolamuru entails a comprehensive methodology employing the advanced capabilities of Google Earth Engine (GEE). In this particular study area, the initial step involves a meticulous land cover change detection process utilizing GEE's satellite imagery analysis. By harnessing the power of high- resolution satellite data, we can precisely identify and quantify the areas within Kolamuru undergoing this significant transition. This data-driven approach allows for a nuanced understanding of the spatial dynamics of land transformation, enabling a thorough assessment of the extent of change over time.

Following the land cover change detection, GEE's machine learning algorithms become instrumental in land use classification, distinguishing between the distinct features of agriculture and aquaculture regions in Kolamuru. The algorithms are trained on historical and current satellite imagery, providing a robust framework for accurately categorizing the evolving landscape. This classification process not only facilitates the identification of converted areas but also contributes to building a comprehensive land use map specific to Kolamuru, laying the foundation for a nuanced analysis of the consequences of such transmutation.

The assessment then extends to the health of vegetation in both agriculture and aquaculture lands within Kolamuru. Spectral indices, such as the Normalized Difference Vegetation Index (NDVI), are employed through GEE to quantify and compare the vegetation cover in these distinct land types. This step is crucial for understanding the ecological impact of the conversion process, providing insights into potential changes in biodiversity, ecosystem dynamics, and overall environmental health in Kolamuru.

Simultaneously, GEE's capabilities in analyzing water quality parameters are harnessed to assess the impact on aquatic environments resulting from the shift to aquaculture. Factors such as turbidity, chlorophyll-a concentration, and water temperature are crucial indicators of the health and sustainability of aquaculture practices. By integrating this water quality analysis with the land cover and land use data specific to Kolamuru, a comprehensive picture emerges, allowing for an in-depth exploration of the consequences of the transmutation on local ecosystems and water bodies.

Spatial analysis within GEE becomes a pivotal component of the methodology, enabling the quantification of the spatial extent of land conversion and its ripple effects on neighboring ecosystems within Kolamuru. The identification of potential hotspots or areas of concern allows for targeted interventions and management strategies to mitigate any adverse consequences arising from the transmutation.

The economic and community assessments are tailored to the socio-economic context of Kolamuru, integrating GEE outputs with local data to evaluate the impact on livelihoods, income distribution, and community well-being. This nuanced approach ensures that the consequences are not only assessed in terms of environmental impact but also in the context of the human communities directly affected by the land use transformation.

To ensure the long-term sustainability of aquaculture practices and monitor changes over time, a GEE-based monitoring system is established. This continuous monitoring allows for the identification of trends, patterns, and potential areas of concern, supporting adaptive management strategies specific to Kolamuru. The visualization tools within GEE are employed to effectively communicate the findings of the study, providing stakeholders in Kolamuru with clear insights into the consequences of the transmutation of agriculture land to aquaculture land. These visualizations, whether in the form of maps, time-series imagery, or interactive dashboards, serve as powerful communication tools to convey the complexity of the changes occurring in the study area.

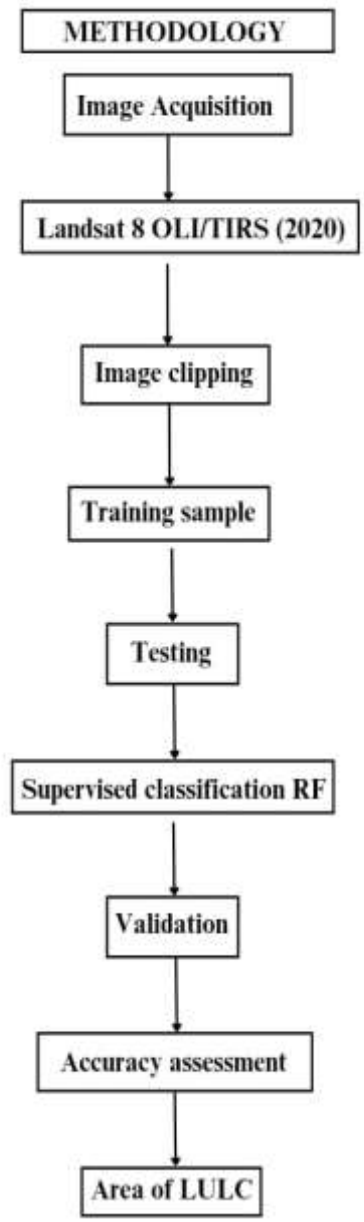

Figure 3: Methodology for Actuation

V. RESULTS

1. LULC Analysis

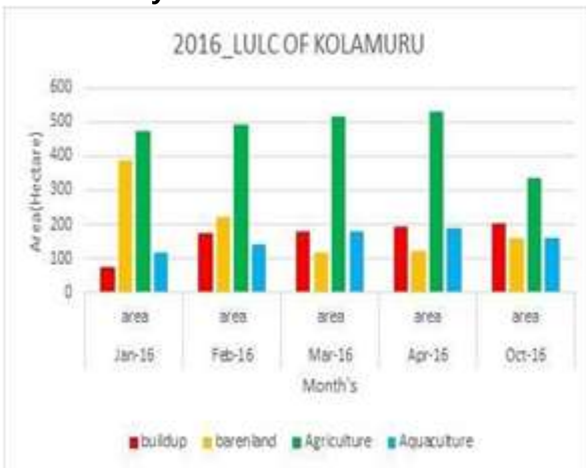

Figure 4: LULC of Kolamuru 2016

This Graph displays monthly observations of land area in hectares in Kolamuru Area for 2016, using colour coding to distinguish between urban development (red), barren land (yellow), agricultural land (green), and aquaculture areas (light blue), aiding in understanding land usage patterns and trends.

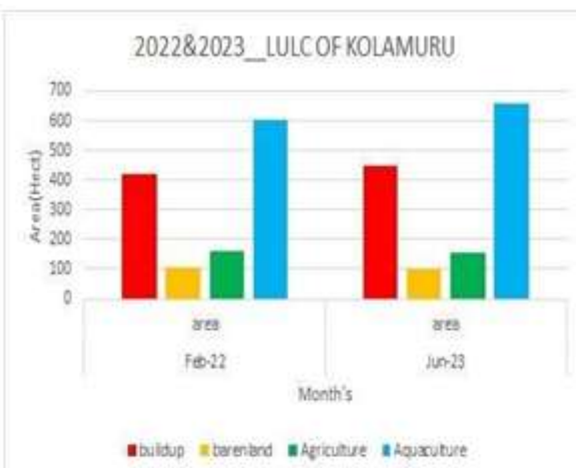

Figure 5: LULC of Kolamuru 2022 & 2023

This Graph illustrates monthly land area observations in hectares for the year 2023 in Kolamuru Area, utilizing a color-coded system to distinguish urban development (red), barren land (yellow), agricultural land (green), and aquaculture areas (light blue), providing insights into land usage patterns and highlighting the increasing trend in aquaculture activities.

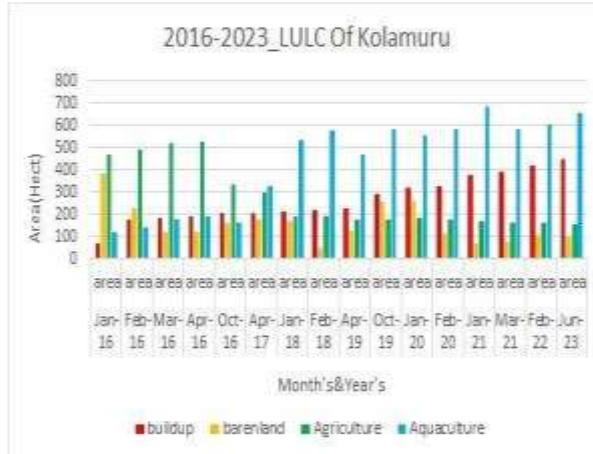

Figure 6: LULC of Kolamuru 2016-2023

This Graph showcases monthly land area data on the X-axis and hectares on the Y-axis, using colour coding to represent buildup areas (red), barren land (yellow), agricultural land (green), and aquaculture zones (light blue). A comparison between 2016 and 2023 indicates significant growth in aquaculture areas, suggesting economic opportunities but also highlighting concerns about environmental impact and disaster susceptibility. Implementing monitoring and regulatory measures is crucial to balance economic development with environmental sustainability and disaster resilience.

2. Temperature Analysis

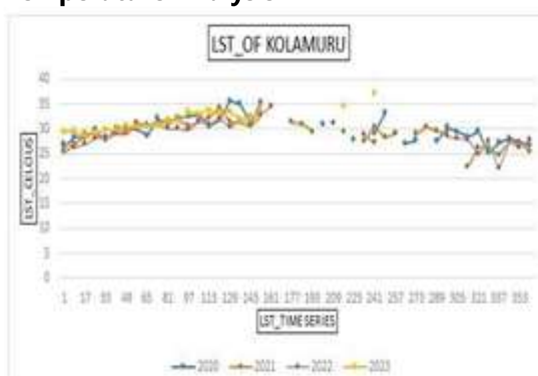

Figure 7: LULC of Kolamuru 2020-2023

This Graph displays temperature data in degrees Celsius on the Y-axis against days on the X- axis, comparing 2020 and 2023 data and highlighting significant changes, particularly in aquaculture land expansion. This expansion signals economic opportunities but also raises concerns about environmental impacts, including temperature rise. Rising temperatures can exacerbate natural calamities and affect ecosystems and human health. Addressing these challenges requires holistic approaches integrating sustainable land management, climate resilient infrastructure, and proactive disaster risk reduction measures to promote environmental sustainability and resilience.

Air Quality Analysis
NO2

1. NO2:

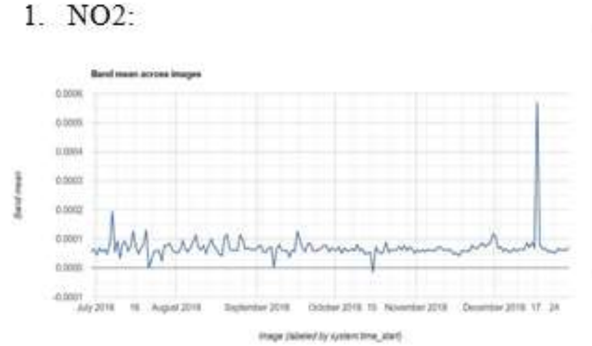

Figure 8: NO2 Analysis(2018)

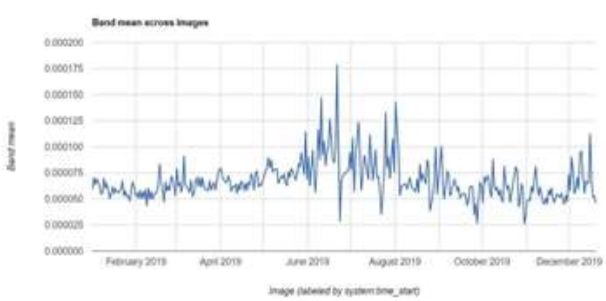

Figure 9: NO2 Analysis(2019)

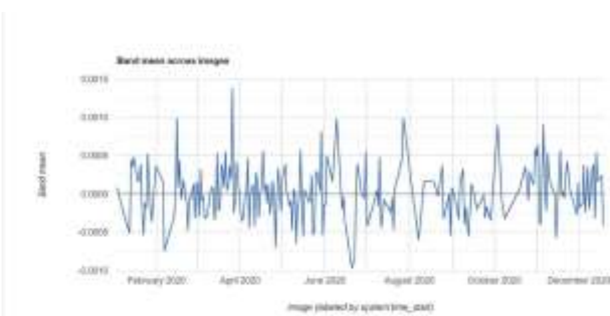

Figure 10: NO2 Analysis(2020)

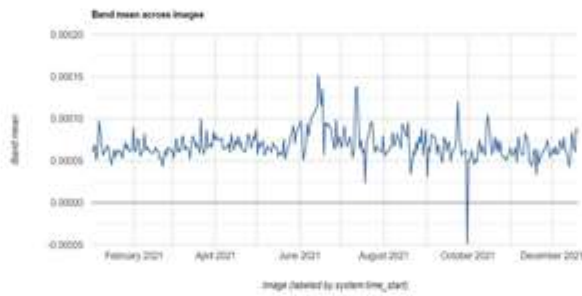

Figure 11: NO2 NO2 Analysis(2021)

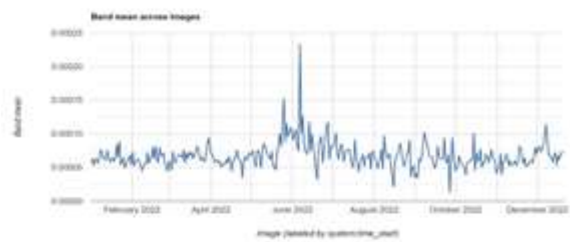

Figure 12: NO2 Analysis(2022)

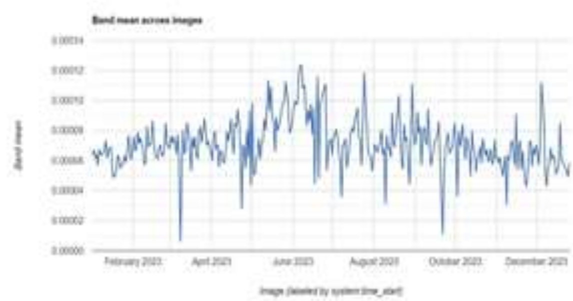

Figure 13: NO2 Analysis(2023)

No2 Analysis Graphs depict percentages on the Y-axis against months on the X- axis, revealing significant changes between 2018 and 2023, particularly in aquaculture land area expansion. This growth raises concerns about environmental impacts, including increased nitrogen dioxide (NO2) levels in the air. Aquaculture activities may contribute to elevated NO2 emissions through various pathways, posing risks to human health and ecosystems. Addressing these challenges requires comprehensive strategies promoting sustainable practices and collaboration among stakeholders to mitigate environmental impacts and safeguard public health. Achieving a balance between economic development and environmental protection is crucial for ensuring a healthier and more resilient future for communities in the Kolamuru area and beyond.

SO2

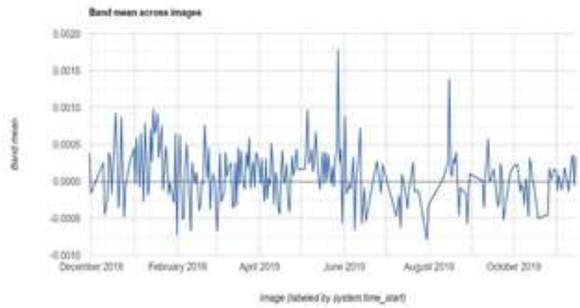

Figure 14: SO2 Analysis (2019)

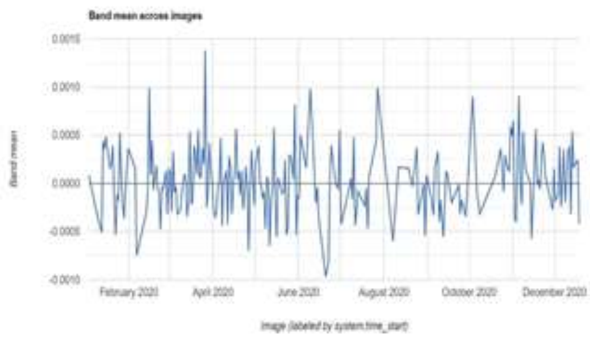

Figure 15: SO2 Analysis(2020)

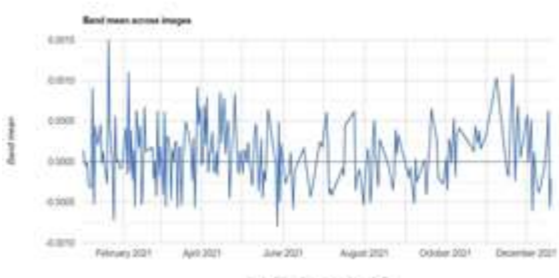

Figure 16: SO2 Analysis(2021)

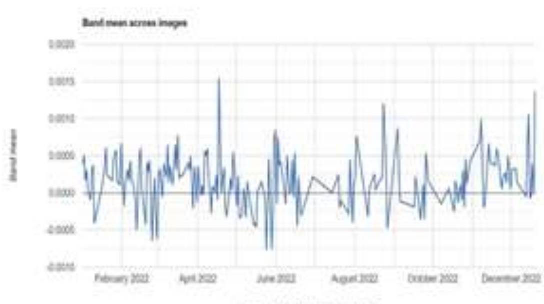

Figure 17: SO2 Analysis(2022)

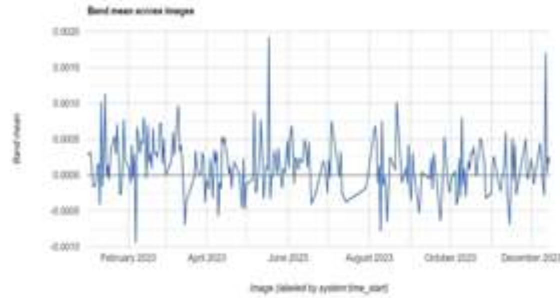

Figure 18: SO2 Analysis(2023)

So2 Analysis Graphs display monthly percentage changes between 2018 and 2023, highlighting increased aquaculture area and potential concerns about susceptibility to natural calamities. The rise in aquaculture activities correlates with elevated sulfur dioxide (SO2) levels in the air within the Kolamuru area, indicating environmental implications and risks to public health and ecosystem integrity. Addressing these challenges requires comprehensive management strategies, including regulatory measures and sustainable land use practices, to mitigate SO2 emissions and promote environmental sustainability and public well-being.

VI. CONCLUSION & DISCUSSION

What has emerged in our discussions and writing is a synthesis of the polarity expressed above. The capture fishery is important because it establishes a market and a network to get the fish to consumers. However, capture fishermen may have difficulty transferring to culture operations, unless very strong economic pressures induce the change. Agriculture, on the other hand, tends to promote producer characteristics (e.g., animal husbandry) which may be instrumental to aqua cultural growth.

The market for fish, however, must exist and yield a price sufficient to cover both out-of-pocket and opportunity costs. It is not possible, and probably neither necessary nor desirable, to suggest that either view is the “right one”. Rather each attempt to predict aqua cultural development could benefit by considering both perspectives.

Discussions surrounding the conversion of agricultural land to aquaculture land involve a range of considerations, including environmental, economic, and social factors.

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