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Implementation Of Agrabah Carbon+ As A Local Emissions Accounting and Offset Platform: Basis for Policy Enhancement

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Abstract- ***This study addresses the systemic exclusion of smallholder farmers and micro, small, and medium enterprises (MSMEs) from carbon markets due to high entry costs, technical complexity, and centralized verification systems. It proposes Agrabah Carbon+, a localized emissions accounting and offset platform integrating a Local Government Unit (LGU)-anchored Net-Zero Policy Framework, a simplified Measurement, Reporting, and Verification (MRV) protocol, and a community-based accreditation mechanism. Using a design science research approach with a mixed-methods framework, a 45-day pilot involving 20 smallholder seaweed farms was conducted. Platform-generated datasets captured biomass production and operational fuel use to estimate net carbon removal. Results demonstrate that localized MRV can reliably convert farm-level data into verifiable net carbon removal units. Under a standardized scenario, 10,000 kilograms of dried Kappaphycus alvarezii generated approximately 11.01 metric tons of carbon dioxide equivalent (CO_2e) in net removals. Expert validation further confirmed high feasibility across policy, technical, and governance dimensions. The study concludes that decentralized carbon accounting systems provide a more inclusive, scalable, and operationally feasible alternative to conventional voluntary carbon markets while supporting community-based climate mitigation and local economic development.***

Index Terms - Blue carbon, carbon accounting, local governance, MRV, net-zero policy

I. INTRODUCTION

The global climate response has entered a critical implementation phase where emissions reductions alone are insufficient, necessitating large-scale carbon dioxide removal (CDR). Despite the expansion of voluntary carbon markets, their structural design continues to exclude grassroots actors due to costly verification processes, technical complexity, and centralized accreditation systems.

In the Philippine context, this exclusion persists despite the country's strong potential in seaweed farming. Kappaphycus alvarezii has been identified as a high-efficiency carbon sink due to rapid biomass accumulation. However, the absence of a localized carbon accounting framework prevents the monetization of this environmental service, resulting in carbon value leakage where benefits bypass local producers.

This study introduces Agrabah Carbon+, a localized emissions accounting and offset platform anchored in Local Government Unit (LGU) governance. The system integrates policy mechanisms, digital MRV protocols, and community-based accreditation to create an inclusive carbon market model. The research contributes to bridging global carbon finance mechanisms with localized implementation while promoting economic inclusion and climate resilience.

II. IDENTIFY, RESEARCH AND COLLECT IDEA

This study is based on a systematic review of literature from peer-reviewed journals, international climate reports, and national policy frameworks related to carbon markets, blue carbon ecosystems, and decentralized governance. The research process involved analyzing existing MRV methodologies, identifying participation barriers among smallholders, and evaluating alternative governance structures.

Findings from literature indicate that centralized MRV systems impose high transaction costs, limiting accessibility for small-scale actors. Studies on macroalgae confirm that Kappaphycus alvarezii exhibits high carbon sequestration potential,

particularly in tropical conditions with continuous cultivation cycles. However, existing methodologies remain impractical for community-level implementation.

The study is anchored in Institutional Theory and Market Design Theory, which emphasize the importance of localized governance and simplified systems in improving participation, reducing transaction costs, and ensuring market efficiency. These theoretical insights guided the development of a localized carbon accounting and accreditation framework.

III. WRITE DOWN YOUR STUDIES AND FINDINGS

This research adopts a Design Science Research methodology aimed at developing and evaluating Agrabah Carbon+ as a functional system. A mixed-methods approach was employed, combining qualitative stakeholder insights with quantitative carbon accounting analysis.

The study conducted a 45-day pilot involving 20 smallholder seaweed farms. Data collection focused on biomass production and fuel consumption, recorded through structured monitoring and validated at accredited buying hubs. These hubs served as the primary point of data verification, ensuring consistency and transparency.

A localized MRV protocol was developed to convert biomass into net carbon removal units using the following model:

$$\text{Net } CO_2e = [(\text{Dry Biomass} \times 0.30 \times 3.67) - (\text{Fuel} \times 2.30)] \div 1000$$

This model applies a conservative carbon content factor, a stoichiometric conversion ratio, and a fuel emission factor to ensure scientific validity while maintaining computational simplicity.

The study scope is limited to Kappaphycus alvarezii, focusing on direct operational emissions (Scope 1) and voluntary carbon market transactions. Indirect emissions and other blue carbon ecosystems are excluded to maintain methodological feasibility.

Governance is operationalized through a proposed quasi-judicial municipal carbon board responsible for accreditation, certification, and dispute resolution, ensuring transparency and institutional legitimacy.

IV. RESULTS OR FINDINGS

The localized MRV protocol successfully translated farm-level data into verifiable carbon removal units. Under a standardized scenario, 10,000 kilograms of dried seaweed generated approximately 11.01 metric tons of CO_2e in net removals, with minimal deductions from fuel-related emissions.

Table 1 presents a summary of the MRV computation:

Table 1. Summary of Carbon Conversion Output

Parameter	Value
Dry Biomass	10,000 kg
Carbon Content Factor	0.30
CO_2 Conversion Factor	3.67
Fuel Emissions Deduction	Minimal
Net CO_2e Output	11.01 tCO_2e

Policy analysis indicates strong feasibility for LGU adoption, supported by existing legal mandates. Expert validation confirms that the framework is viable across governance, technical, and operational dimensions.

Operational testing demonstrates that the platform is user-friendly and scalable. Farmers were able to record data effectively, and transaction-level verification improved data integrity while minimizing risks of double counting.

V. CONCLUSION

This study demonstrates that decentralized, policy-backed carbon accounting systems provide a viable and inclusive alternative to conventional voluntary carbon markets. Agrabah Carbon+ enables smallholder participation by reducing technical and financial barriers through localized MRV and governance structures.

The system delivers a triple-win outcome by integrating climate mitigation, economic development, and community resilience. It represents one of the first localized, LGU-led carbon accounting frameworks for seaweed-based carbon sequestration, offering a scalable model for developing economies.

Future research may explore integration with national carbon registries, expansion to other blue carbon ecosystems, and long-term market adoption dynamics.

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