

Digital Traceability on Agriculture Industry towards Net Zero GHG Emissions in Developing Countries: Case of Southeast Asia

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Abstract

The latest 6th IPCC Report has been highlighted the role of digital technologies to mitigate climate change. This policy brief outlines the role of digital technology to ensure deforestation free supply chain in agriculture industry towards net zero greenhouse gasses (GHG) emissions. It was shown that the digital traceability could be effective tool to monitor, reporting and verification (MRV) of the GHG emissions from land use change in the case of agriculture products. In the future, the cost of digital technology could be reduced thanks to massive utilization and granularity.

Background

The latest 6th IPCC Assessment Report mentioned that in 2019, approximately 34% [20 GtCO₂-eq] of total net anthropogenic GHG emissions came from the energy supply sector, 24% [14 GtCO₂-eq] from industry, 22% [13 GtCO₂-eq] from agriculture, forestry, and other land use (AFOLU), 15% [8.7 GtCO₂-eq] from transport and 6% [3.3 GtCO₂-eq] from buildings. Average annual GHG emissions growth between 2010 and 2019 slowed compared to the previous decade in energy supply [from 2.3% to 1.0%] and industry [from 3.4% to 1.4%] but remained roughly constant at about 2% per year in the transport sector.

Emissions growth in AFOLU, comprising emissions from agriculture (mainly CH₄ and N₂O) and forestry and other land use (mainly CO₂) is more uncertain than in other sectors due to the high share and uncertainty of CO₂ from Land Use, Land Use Change and Forestry (LULUCF) emissions. About half of total net AFOLU emissions are from CO₂ LULUCF, predominantly from deforestation (IPCC, 2022). This IPCC Report also highlighted the role of digital technologies to mitigate climate change and to achieve several SDGs. For

example, sensors, Internet of Things (IoT), robotics, and artificial intelligence can improve energy management in all sectors, increase energy efficiency, and promote the adoption of many low-emission technologies, including decentralized renewable energy, while creating economic opportunities.

Combinations of systemic changes including, teleworking, digitalization, dematerialization, supply chain management, and smart and shared mobility may reduce greenhouse gas emissions by more efficient supply chain and reduce the idle time for the logistic. However, some of these climate change mitigation gains can be reduced or counterbalanced by growth in demand for goods and services due to the use of digital devices. Digitalization can involve trade-offs across several SDGs, e.g., increasing electronic waste, negative impacts on labor markets, and exacerbating the existing digital divide. Digital technology supports decarbonization only if appropriately governed (IPCC, 2022).

The aim of this policy brief is to elaborate the digital tools application in agriculture sector. Agriculture sector is still dominant in particular in developing

countries context. The digital traceability technology could be useful to develop deforestation free supply chain (DFSC) across agriculture commodities i.e.: palm oil, cacao, coffee, etc.

Deforestation Free Supply Chain (DFSC)

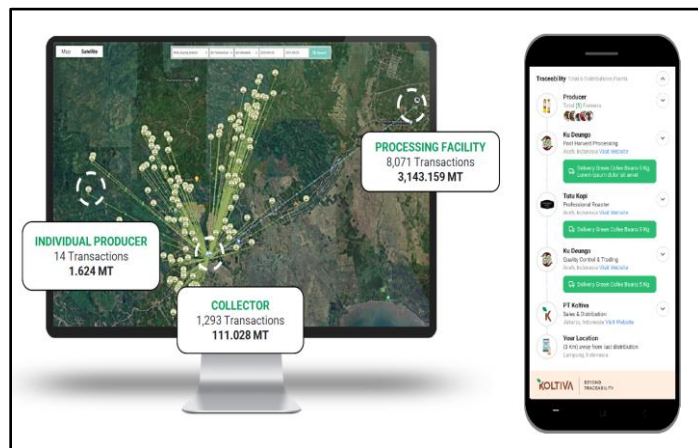
The rapid spread of mobile phones creates potential for sustainably raising agricultural productivity for the 2 billion people living in smallholder farming households. Meta analysis study suggest that providing agricultural information via digital technologies increased yields by 4% and the odds of adopting recommended inputs by 22%. This benefits likely exceed the cost of information transmission by an order of magnitude (Fabregas, et al. 2019). During the period 2016- 2020, Japan government launched “Society 5.0’ concept where the society should be able to use digital technology fluently and supports the transition from industry 4.0 to industry 5.0 (Harayama, 2022).

Deforestation is largely driven by expanding forestry and agriculture. However, despite agricultural expansion being increasingly driven by foreign demand, the links between deforestation and foreign demand for agricultural commodities have only been partially mapped. Carbon emissions from deforestation is associated with the expansion of agriculture and forest plantations and trace embodied emissions through global supply chains to consumers.

Study from Pendril found that in the period 2010–2014, expansion of agriculture and tree plantations into forests across the tropics was associated with net emissions of approximately 2.6 Gt CO₂ per year. Cattle and oilseed products account for over half of these emissions. Europe and China are major importers, and for many developed countries, deforestation emissions

embodied in imports rival or exceed emissions from domestic agriculture. Depending on the trade model used, 29–39% of deforestation-related emissions were driven by international trade. This is substantially higher than the share of fossil carbon emissions embodied in trade, indicating that efforts to reduce greenhouse gas emissions from land-use change need to consider the role of international demand in driving deforestation. Additionally, the study found that deforestation emissions are like, or larger than, other emissions in the carbon footprint of key forest-risk commodities (Pendril et al., 2019). A more systematic and coordinated approach based on transparent and reliable data and methodologies is needed to induce global low greenhouse gasses (GHG) market development.

Figure 1. Real time measurement on digital traceability. Data source: Koltiva, 2022.



The recent private sector commitments aim to eliminate deforestation from a company’s operations or supply chain, but they fall short on several fronts. Company pledges vary in the degree to which they include time-bound interventions with clear definitions and criteria to achieve verifiable outcomes. Zero-deforestation policies by companies may be insufficient

to achieve broader impact on their own due to leakage, lack of transparency and traceability, selective adoption, and smallholder marginalization. Public-private policy mixes are needed to increase the effectiveness of supply-chain initiatives that aim to reduce deforestation. There are several supply-chain initiatives had been made but not address the impact of digitalization on traceability (Lambin et al., 2018). DFSC is one of the prerequisites to achieve net zero Greenhouse gasses (GHG) emissions for land-based industries as prescribed by science-based targets initiative (SBTi, 2023).

Recent technological development already helped to advance the radical transparency and accountability necessary to achieve a deforestation free supply chain, although there is still room for improvement in technology as well as its application at scale. Hence, this study assessed the impact of the applications of drones and sensors to monitor the supply chain to enhance traceability, from smallholder farmers origin. This technology provider is using real data to map and monitor the commodity agriculture supply chain for deforestation free products. This digital tool at affordable price would be the game changer for the transparency supply chain of commodity agriculture (Koltiva, 2022). To date, already 9,500 business entities with 862,000 smallholder farmers has been using this digital tool in 32 countries covering 39 crops commodities (Koltiva,2023).

The case study will be focused on the digital supply chain from seed to table as depicted in **Figure 1**. Accessing data on an “only-when-needed basis” allows decision-makers to share information, collaborate transparently and cement trust with consumers. For example, product recalls or quality, counterfeit or

conformity issues will trigger access to specific information and comply with safe, sustainable, and environmentally transparent operations. Being able to simplify the accessibility of this information is vital for environmental, social and governance (ESG) compliance and will also help build consumer loyalty for brands with sustainability appeal.

Using transparent supply chain data such as blockchain for example could bring value added to the product as the proof of non-deforestation. Palm oil alone has market value more than 150 billion US\$/year, while coffee and cocoa have market value around 466 billion USD/year and 45 billion US\$ (Coffee, Cocoa, 2022). The barrier for the digital technology penetration to the market is the relatively high cost. To scaling up the digital technology it was relies on the learning experience which massive utilization could help to reduce the cost of technology (Jupesta, 2012).

More granular technologies will be lower the cost in absolute terms and more likely to be scaled to replicate. Shortly, smaller and modular technologies will have more advantage to lower the cost (Wilson et al., 2020). Furthermore, the risk of digitalization also exists such as the reliability on the open access online database which acknowledged by ChatAI online platform which was developed by OpenAI (Times, 2023).

Policy recommendation

There are three important things to be consider regarding the digital traceability in the agriculture sectors:

- The digital traceability should be scale up to track deforestation free supply chain for agriculture commodities. This is to show the transparency supply chain to support net zero GHG emissions

across supply chain. Policy makers should create enabling environment to support this DFSC towards net zero GHG emissions.

- While digital tool will be game changer, to ensure the affordable price, it should be relying on massive scaling and granularity of the technology. The granularity such as smaller size of digital tools could be realized from the digital tools developers along their supply chains.
- The risk of digitalization does exist in term of reliability data on open access data platform. While open access data is global public good, it still not governed well. Hence, all government and private institutions should be work together to cooperate for the data which meet principles of findability, accessibility, interoperability, and reusability (FAIR).

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