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Sustainability indicators from resource flow trends in the Philippines

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ABSTRACT

The topics of resource efficiency, pollution reduction and waste minimization have become important global policy goals and have gained prominence in developing countries in the context of the new Sustainable Development Goals. These pose challenges to the policy community in the formulation of plausible and ambitious targets for resource use, greenhouse gas emissions and waste. To bridge this gap, we utilize the material flow indicators derived from standard MFA methodology to show trends in material use, waste and emissions in the Philippines. We find that direct material inputs in the Philippines grew at 2.4% yearly, from 293 million tonnes in 1980 to 661 million tonnes in 2014. Domestic processed output, or materials released to environment has tripled from 96 million tonnes in 1980 to 260 million tonnes in 2014, with 89% as emission to air. The environmental Kuznets curve shows that the growing economy entails greater pressure to the environment. Net additions to stock grew slower than waste and emissions which is testament of a lack of infrastructure investment in the Philippines. Such a comprehensive material flow account responds to the information requirements of a modern environmental policy stance that looks at economy and environment simultaneously and has not previously been available. These findings call for policies to increase resource efficiency and improvement on recycling system, strict implementation of policies related to solid wastes management, mitigating air emission, and wastewater. The new dataset also shows slow progress in achieving SDG targets 8.4, 12.2 and 12.5.

1. Introduction

The flow of material and energy create disturbances in the environment as wastes are generated out of extraction, processing, consumption, and final disposal of products. As the material flows vary on the size and level of economic growth, it is regarded as an indirect indicator of pressure to the environment (Eurostat, 2001; Matthews et al., 2000). Because of its relevance and applicability, material flow analysis (MFA) has grown and expanded its scope outside the academia and research institutes. MFA provides indicators towards the assessment of intensity, efficiency and productivity of resource use of the society. These indicators served as tool to develop and evaluate policies on management of natural resources. The established material flow accounts of Japan led to formulation of indicators and targets towards a sound material-cycle society (Ministry of the Environment, Government of Japan, 2011). Likewise, intensive studies were conducted on leading economies in Asia and Pacific such as China, Australia and Japan (Schandl and West, 2012) and comparison of socio-economic metabolism of Asian countries with different levels of economic development namely; Japan, China, and South Korea. It highlighted that resource efficiency and productivity of the nation is influenced by industrialization and position in the global market (Dong et al., 2017). Recently, MFA studies in the developing country has expanded, especially in Southeast Asia such as in Lao (Vilaysouk et al., 2017). MFA has also gained respect on its application on waste management and recycling systems. While national statistics compile sufficient data to account the material inflow, wastes statistics or outflow remains to be insufficient, and requires standardization for better compare nations (Moriguchi and Hashimoto, 2016). Few studies have been done covering the accounts of outflows to the environment. Highly notable first efforts to account and compare direct processed output among nations was done for Austria, Germany, Japan, Netherlands and United States (Matthews et al., 2000). Succeeding studies were conducted in European countries such as Czech Republic (Scasny et al., 2003) and Italy (Barbiero et al., 2003). Recently, literatures are available for upper middle-income countries such as China (Dai and Wang, 2017); as well as the capital cities such as Cape Town in South Africa (Hoekman and Von Blottnitz, 2016).

Studies including the accounts of output to environment have been deemed necessary to come up with the total assessment of resource management as well as evaluation of related polices. In the view of the foregoing, we aim to fill this gap through expanding the knowledge

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base using the case of the Philippines. The material flow of the Philippines, which has largely been focused on the input side, will be expanded to material outflows following the influential model of the World Resources Institute 'Weight of Nations' report (Matthews et al., 2000) and the recent methodological specifications of Eurostat (2013, 2016). The knowledge base for the material consequences of economic growth in Asian economies (Schandl and West, 2010) in general and the Philippines economy in particular (Martinico-Perez et al., 2017; Martinico-Perez et al., 2018; Chiu et al., 2017;) and in comparison to other developing countries in Asia (Maung et al., 2015) has been growing in recent years. These studies focused on material flows and implemented the international guidelines for material flow accounts laid out by the European Statistical Office. They used international and domestic datasets to establish the accounts and indicators. Similarly, research into energy use and energy efficiency (Pacudan and de Guzman, 2002; Silang et al., 2014; Kennedy et al., 2015; Cabalu et al., 2015; Quilty et al., 2014) and greenhouse gas emissions has also grown (World Bank, 2016; Janssens-Maenhout et al., 2017; DOE, 2012; UNDP and GOP, 2011). Most analysis shows a policy focus on renewable energy, the share of which will increase in the Philippines' energy mix for power generation, however, fossil fuels, oil in particular, will remain the leading energy sources in the near future (Brahim, 2014).

Similarly, the evidence base for natural resource use and resource productivity in the emerging economy such as Philippines has grown and this has coincided with increasing interest in the policy community in a better understanding of natural resource accounts and indicators for materials and waste, energy and emissions, and water use. Interest in national material flow accounts has been reinforced by the newly adopted Sustainable Development Goals (SDGs) which aim to achieve economic growth, human wellbeing and environmental integrity simultaneously. Achieving all SDG objectives will require a massive effort to decouple economic growth from environmental pressure and impacts. Specifically, SDG target 8.4 aims to improve resource efficiency of production and consumption. In a similar vein, SDG target 12.2 focuses on the sustainable use of natural resource. SDG target 12.5 for waste reduction is also relevant in this context and it is obvious that a smaller material throughput will also contribute to reduced waste and emissions.

Awareness among the national policy elites in the Philippines is high and has resulted in a number of cross-cutting environmental policies that support efforts towards green growth, sustainable consumption and production and energy efficiency. Sustainable development is a primary focus for the development of the agriculture and fisheries sector laid out in the Agriculture and Fisheries Modernization Act of 1997. Similarly, the Clean Air Act of 1999 requires compliance by industries and companies to reverse air pollution through both regulatory and market-based instruments; the Ecological Solid Waste Management Act of 2000 calls for proper transfer, transport, processing, and disposal of solid wastes; the Philippine Clean Water Act of 2004 aims for protection of all water bodies from land-based sources of pollution to be achieved through comprehensive water quality management. More recently, policies to further cleaner production and energy efficiency have been put forward in the Biofuels Act of 2006 and the Renewable Energy Act of 2008. The Climate Change Act was also enacted in 2009 to coordinate, monitor and evaluate programs to curb the impacts of climate change in the country. The Philippines has commendable environmental policy and legal frameworks in place providing a foundation to switch from the current unsustainable patterns of consumption and production to sustainable development of the Philippines economy and society. Policy implementation, however, remains a challenge with environmental and socio-economic indicators for the Philippines suggest a considerable gap between the rhetoric of the lawmakers and actual sustainability outcomes (Sta. Romana, 2017).

The aim of transitioning to a sustainable lifestyle and resource consumption in the Philippines has social complexity (Retamal and Schandl, 2017). While material use and waste levels are still low in the Philippines, it will increase in future to build infrastructure and to fuel a growing economy. A focus on resource efficiency and greenhouse gas abatement will be an economically attractive option to drive innovation and development outcomes. A national strategy and objectives for the Philippines can be modeled after the successful high-level policy initiative of Japan for a Sound Material Cycle Society (Takiguchi and Takemoto, 2008). The Japanese policy uses three indicators for material efficiency, recycling and waste reduction which can be adapted for the Philippines economy.

The main objective of this research is to develop a first full material flow balance of an emerging economy in Southeast Asia. Utilizing the case of the Philippines, its demonstrate the feasibility of this approach for a developing nation where data is often less reliable or missing. We estimate the output flow in terms of environmental gateways and aim to assess the effectiveness of existing environmental policies. We also present the input and output indicators to analyze the trends of material intensity and waste flows. We further elucidate the resource extraction of the Philippines by presenting the disaggregated data of the provinces. Such data is also important for further analysis of the environmental pressure of extraction and consumption in each of the Philippine regions and provinces; this is not part of this research but contributes to an improved database.

This study highlights the adapting and localizing methods of material flow accounting in the context of developing nations in Southeast Asia. It contributes to the better interpretation of the usefulness of indicators for the policy process and follow the recent report by the International Research Panel, which identified domestic extraction of materials as an indicator of extractive pressure, and the physical trade balance as proxy for trade dependence (UNEP, 2015). Both aspects relate environmental concerns to economic considerations and create a new potential coalition between environmental and economic policy or at least identify new partnerships for environmental policy makers with government agencies that look after the economy.

2. Methods and data

We present a comprehensive material flow accounts for the Philippines based on the framework of Economy-Wide Material Flow Accounts and Analysis laid out in the methodological guide of the European Statistical Office (Eurostat). A first methodological guide was released in 2001, wherein it provided an accounting framework that can be expanded to different spatial units such as regions, nations, provinces and cities. Revisions and updates were released in 2009 and 2013, thereby providing additional estimation factors for developing material flow accounts. MFA measures all material transactions between the economy and the environment (and with other economies) in mass units (tonnes). The methods for the input side of the material flow accounts for the Philippines have been described in detail based on Eurostat (2009, 2013). We also utilized the latest Eurostat guidelines for outputs of 2016 to account for domestic processed output and balancing items. We focus the discussion of methods on accounting for outflows and balancing items. The indicators presented in this study are discussed and shown in Table 1. Following Eurostat (2009) we group the material flow indicators into extensive and intensive indicators. Additional detail and dataset are available in the Supporting Information.

2.1. Resource input account

We utilize four material categories, namely biomass, metal ores, non-metallic minerals and fossil energy materials/carriers. We put priority on accounting for extracted materials from domestic environment that crossed boundaries, processed for consumption in the socio-economic system. Materials associated with the extraction of raw materials such as mining excavation, overburden from mining, gas flare from oil and gas extraction, and unused straw harvests in agriculture