



Review

Air quality management in the Pacific Islands: A review of past performance and implications for future directions

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ABSTRACT

Air quality is the leading global environmental risk factor for disease. This article focuses on the evidence for the need to develop effective air quality policies for the Pacific Islands region. Factors that have influenced the success and failures of previous and existing environmental policies are considered to help understand necessary future actions. Factors instrumental in resulting in policy failures include nations focusing on economic growth and poorly managing the externalities (i.e. waste and fossil fuel emissions); inappropriate application of aid; a lack of planning; insufficient resources; misunderstanding of risks and conflicts in systems of governance. Successful programs have included capacity building activities in collaboration with traditional land-users; empowering of existing leaders, regional co-operation and local acceptance of financial responsibility. Forward strategizing for more effective leadership in air quality management will require a more co-ordinated approach to address enforcement of environmental policy from multiple angles: including raising awareness, provision of viable alternatives, local financial responsibility and the co-operation of different authorities to facilitate enforcement.

1. Introduction

Globally, exposure to environmental pollution kills three times as many people each year than AIDS, tuberculosis and malaria combined; almost 15 times as many as war and all forms of violence (Landrigan et al., 2017). Air pollution is the leading global environmental risk factor for disease and premature death (World Health Organization, 2014). Risk from PM_{2.5} (particles less than 2.5 μm) includes all-cause mortality (Kloog et al., 2013; Shi et al., 2016), particularly cardiovascular mortality (Hoek et al., 2013) with no evidence of a threshold below which effects are not observed (Pope and Dockery, 2006; Brook et al., 2010). Other associations include diabetes (Potera, 2014; Rao et al., 2015); deep vein thrombosis and pulmonary embolism (Kloog et al., 2015), dementia, Alzheimer's and Parkinson's disease (Kioumourtoglou et al., 2016). In Suva alone, the annual mortality risk from PM_{2.5} exceeds the national road toll for Fiji (Isley et al. (2018a)). The main sources of PM_{2.5} in Suva, Fiji's capital, are smoke from fossil fuel burning in industry, power generation, shipping and vehicles (Isley et al., 2016, 2017b, 2018a, 2018b) as well as smoke from burning wastes in residential areas (Isley et al., 2017a; Isley et al., 2018b).

The Fiji Department of Environment are aware of these air pollution sources (Department of Environment Fiji, 2007; Fiji Department of

Environment, 2013). Essentially, the same sources of air pollution (diesel combustion and waste burning) are common across all of the Pacific Island countries (PICs) and many other developing countries (Thaman et al., 2003; Periathamby et al., 2009; Gleye, 2010; Matak, 2011; Owens et al., 2011; Dornan and Jotzo, 2012; Keruring van Elektrotechnische Materialen te Arnhem, 2012; Pacific Energy Summit, 2013; Wiedinmyer et al., 2014; Escoffier et al., 2016; Taibi et al., 2016; Isley et al., 2018a). The Pacific Island nations suffer from an absence of, or incomplete options for residential waste disposal, leading to individuals incinerating domestic waste. This causes localised air quality issues (Matak, 2011; Woodruf, 2014a). Consequently, effective waste management forms an integral aspect of air quality policy (Department of Environment Fiji, 2007; Fiji Department of Environment, 2013) and is examined in this article as part of the matrix for lowering health risks from particulate pollution in Pacific Island cities.

For Suva, Fiji, scientific air quality studies are available to describe the current particle air quality and pollutant sources (Isley et al., 2016, 2017a, 2017b, 2018a). Similar information is largely absent across the PICs, with the exception of Noumea and New Caledonia (Gleye, 2013; Escoffier et al., 2016). For the city area in Suva, Fiji, diesel emissions from industry, electricity generation and small shipping craft contribute approximately 21% of the fine atmospheric particle (PM_{2.5}) load; with

Abbreviations: OECD, Organisation for Economic Co-operation and Development; PIC, Pacific Island Country; SPREP, Secretariat of the Pacific Regional Environment Programme

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17% from vehicle emissions, 7.5% from open burning and 7% from large ships and other industries. In the residential areas of Suva, the open burning contribution is more than double that in the city, largely due to waste burning and cooking practices (Isley et al., 2018b). In Noumea, industrial activity, traffic and domestic burning practices are notable sources of particle air pollutants, although quantitative data on their specific contribution is not available (Escoffier et al., 2016).

The article evaluates current air quality management in the Pacific Islands in the context of existing environmental management practices and known health risk. The aim is to determine the best practices for developing forward strategies for air quality management.

2. Existing policy

Much environmental policy exists across the PICs. This includes legislation (Fiji Environmental Law Association, 2017a; Secretariat of the Pacific Environment Programme, 2017). Participation of PIC's in 37 different international environmental treaties and regional frameworks and policies is listed in Secretariat of the Pacific Regional Environment Programme (2016). Air pollution is encompassed within this broader legislation, however, for Fiji, the Environment Management (EIA process) Regulations (Government of Fiji, 2007b) include a section on air emission licenses. The national ambient air quality standards are included within Environment Management (waste disposal and recycling) Regulations (Government of Fiji, 2007a); which include penalties for open burning of domestic waste, tyres, oil and other materials. Despite existing legislation, implementation and enforcement are seldom effective, both in Fiji (Fiji Environmental Law Association, 2017b) and elsewhere across the region (Papua New Guinea (Mowbray and Duguman, 2009), Micronesia (Government of the Federated States of Micronesia, 2007) and other Pacific Islands (Nunn, 2009).

For example, with respect to waste burning, Micronesia's law clearly states that the open burning of wastes is not allowed (United States Government 1980; Harding, 1992). Yet, "the burning of yard waste, which may include plastics, rubber and many other inorganic items, is a common practice" (Government of the Federated States of Micronesia, 2007). Waste burning continues in Micronesia despite advances in waste policy (Woodruff, 2014b). Fiji's open fires by-laws (Government of Fiji, 2007c) include a \$10,000 (FJD) penalty for burning household garbage without a permit. This penalty is severe, being half of the average annual wage in Fiji (Fiji Bureau of Statistics, 2015); yet there is no evidence of enforcement. Instead, surveys show that waste burning is widespread in Fiji with over 50% of people in Suva (capital) burning household waste and green waste (McDowall, 2005; Department of Environment Fiji, 2007; Isley et al., 2016). Imagery of waste-burning in Suva Fiji (Supplementary Section A), show that items burned are similar to those described for Micronesia. Likewise, for Kiribati, the Cook Islands and the Marshall Islands, enforcement of bylaws and policy around waste disposal is minimal and are ineffective at preventing burning of waste (Marshall Islands, 1984; Kiribati, 1999; Dusevic, 2001; Secretariat of the Pacific Environment Programme, 2013; Aitken, 2014).

Even where legislation is uplifted to remedy pollution caused by poorly maintained vehicles, past history has shown that it is difficult to implement. United States Government (1980) regulations prohibit use of vehicles in Micronesia that have become 'mechanically deficient so as to cause the emission of visible air contaminants' and list penalties. Smoky vehicles remain a problem despite these legal controls (Government of the Federated States of Micronesia, 2007; UNEP, 2015). Similar to Fiji's burning laws, this may be because the controls are "unenforceably severe" p.22 (Harding, 1992). The Fiji Department of Environment, (2013) listed vehicle emissions as the most common source of air pollution complaints. Since then, the number of registered vehicles has risen steadily, from 89,190 in 2013 (Fiji Bureau of Statistics, 2018); to 110,763 in 2016 (Vula, 2017). The most recently available data for the composition of Fiji's vehicle fleet is from 2013

(Fiji Bureau of Statistics, 2018), with 22% of vehicles being buses, carriers and goods vehicles. Whilst the Fiji Bureau of Statistics (2018) does not list data for the age of vehicles in Fiji's fleet, vehicle emissions from old and poorly maintained vehicles also remain an unresolved problem (Campbell, 2004; Rogo, 2011; Land Transport Authority Fiji, 2016). Fiji's Land Transit Authority Fiji (2015) notes that "while it is true that all motor vehicles smoke, it is the degree of it which is the problem" in Fiji (imagery in Supplementary Section B). Fiji's Land Transport Authority is currently taking action to reduce emissions, detailed in Section 4.3.

3. Barriers to implementing policy successfully

3.1. Economic barriers

Governments in PICs trend to focus on economic growth, with spending on environmental protection being a low priority (Nunn, 2009; Lata and Nunn, 2012; OECD, 2012). Growing expectations for development compete with management of impacts on a fragile environment (Storey and Hunter, 2010). This is driven by communities who are more focussed on short-term economic benefits (Lata and Nunn, 2012).

For those on low incomes, long term health risk or environmental goals seem less relevant than daily needs (Nunn, 2009). In the Federated States of Micronesia, 17% of the population lived below the \$1.90 per day income poverty line in 2013 (39% in Papua New Guinea (World Bank, 2017)). For many in informal settlements (squatters), day-to-day survival is the primary concern (Jones, 2013). A similar situation exists in Port Moresby (Papua New Guinea), where more than 375,000 live in informal settlements (50% of population (Jones, 2013)) and to varying degrees in Suva where 20% of the population are squatters (Phillips and Keen, 2016). Nadi (Fiji), Honiara (Solomon Islands), Port Vila (Vanuatu) and Apia, Samoa also have significant squatter populations (Jones, 2013). Issues such as climate change or long-term health impacts are a future problem, for which the timing and severity of the impact is uncertain. Understandably, these are often not given substantial consideration for those facing immediate daily challenges of poor housing, inadequate waste disposal, unemployment, nutrition-related health problems and under-resourced health services (Mortreux and Barnett, 2009).

Low income households are less likely to consider air pollution consequences when disposing of rubbish or choosing cooking fuel. Informal settlements lack solid waste collection services, because they do not pay land rates (Lal et al., 2007). In some instances, communities will pay for their own waste collection (Lal et al., 2007). Suva Council (Fiji) has installed bins at the edge of informal settlements to allow waste disposal (Phillips and Keen, 2016). Unfortunately, the frequency of waste collection is not always adequate (imagery Supplementary Section C). Burying wastes or burning them are often the only practical and hygienic options (Mataki, 2011). Therefore, policies prohibiting waste burning are unlikely to be effective, unless alternative options are available. Likewise, when choosing fuels for cooking, the poorest households are likely to choose high-emission fuels that can be freely collected, such as firewood and even plastics (Government of the Federated States of Micronesia, 2007), because cleaner fuels are priced beyond their reach (OECD, 2012).

This short-term perspective is also demonstrated in the transport sector, where motorists lack economic incentive to consider adverse environmental and health impacts, which are not borne by themselves, but by the general public (OECD, 2012). Transport is a vital component of Fiji's economy, contributing 16% to GDP (Fiji Bureau of Statistics, 2014). As diesel is considered to be Fiji's 'working fuel', it is taxed less in comparison to petrol (Rogo, 2011). This growth-oriented policy generates increased diesel emissions, competing with environmental policies that advocate emission reduction (Rogo, 2011). Further, lower taxes on diesel fuels are common across many countries, leading to an

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