

RESEARCH ARTICLE

GPI Island Style: Localizing the Genuine Progress Indicator to Hawaii

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Applying the Genuine Progress Indicator (GPI) to an island setting offers insight into whether and how standardization of subnational GPI models can adequately capture important local conditions and inform local policy. We argue in favor of localization and against scaling down national data and transferring valuation studies to Hawaii because of the state's unique setting. To localize GPI to our context, we suggest (a) omitting some indicators that are not applicable to Hawaii; (b) expanding and discretizing the list of indicators to other important economic, environmental, and social changes; and (c) amending existing indicators to better reflect their contribution to Hawaii's welfare. This would involve (a) improving local data on economic, social, and environmental changes; (b) building new indicators through a participatory process; and (c) conducting local valuation studies that accurately reflect the social value of the changes.

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Gross domestic product (GDP), which is the dollar value of all final goods and services produced within an economy for a specified period, was originally developed solely as an indicator of economic activity but is now often associated with social welfare. Critics have raised considerable awareness of GDP's inability to capture the nuances of social welfare and well-being (Cobb and Cobb, 1994; Cobb, Halstead, and Rowe, 1995; Costanza et al., 2009; Daly, 2005; Lawn, 2003; Stiglitz, Sen, and Fitoussi, 2010; Talberth, Cobb, and Slattery, 2007; van den Bergh, 2009).

In response, alternative measures to GDP (and similarly gross state product or GSP at the state level) are gaining traction. One promising alternative, the Genuine Progress

Indicator (GPI), has been estimated at both national and subnational levels (Kubiszewski et al., 2013). These local applications of the standard GPI framework contribute to a growing data set of comparable GPIs, but the question remains as to whether this comes at the expense of place-based contextualization that may be more useful for local management.

In this article, we examine the use of GPI within the unique island setting of the state of Hawaii. After providing an introduction to GPI in general, we highlight what is unique about Hawaii and its island setting, drawing on the experience of applying the GPI framework to Hawaii in 2012–13. Based on our findings, we identify features that should be incorporated into the framework, and we discuss how the GPI method might be altered to fit Hawaii. As the movement to improve the GPI framework continues (i.e., GPI 2.0), this article seeks to further the conversation as to whether and how the standardization of subnational GPI models can adequately capture important local conditions.

GDP and Beyond

GDP measures all goods and services that are produced by an economy within its borders during a year. While increases in GDP are generally associated with the so-called healthy growth of an economy, GDP fails to account for many other factors impacting welfare (Clarke and Lawn, 2008), such as unpaid labor, pollution externalities, ecosystem degradation, defensive expenditures, capital depreciation, and income inequality.

Despite the inability of GDP to capture social welfare, the measure continues to play a critical role in today's policy

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making. As awareness of GDP's limitations has grown within the last few decades, so has the literature on the development and classification of alternative measures to adjust, replace, or supplement GDP (Schepelmann, Goossens, and Makipaa, 2010). One particular category of alternative indicators uses accounting adjustments to GDP to correct for deficiencies. Starting in the early 1970s, Nordhaus and Tobin (1971) developed the Measure of Economic Welfare (MEW). Daly and Cobb (1989) followed with the Index for Sustainable Economic Welfare (ISEW). In 1995, Redefining Progress further modified the ISEW into what is now known as the GPI (Cobb, Halstead, and Rowe, 1995; Talberth, Cobb, and Slattery, 2007).

The GPI model recognizes that GDP is limited in the ability to measure the economic, environmental, and social factors of economic welfare. Although GDP and GPI use the same economic starting point, GPI subtracts incidental costs and adds unrecognized benefits to society that are not traditionally captured in GDP. When the result of the GPI calculation is compared with GDP, in some cases the two measures diverge at some point in time (Kubiszewski et al., 2013); a widening gap between the two illustrates that continued economic growth does not represent gains in social progress or well-being.

The GPI Framework

Welfare is related to the net benefits of economic growth; a growing economy will have sustained, positive welfare effects only if the benefits outweigh the costs (Clarke and Lawn, 2008). GPI is grounded in Fisher's income and capital theory (Fisher, 1906; Lawn, 2003), which considers long-term benefits of capital accumulation. As shown in the

following equation, GPI has a number of components that capture the costs and benefits of past and present economic activity (Bagstad and Ceroni, 2007; equation adapted from Hanley et al., 1999):

$$GPI = PCE(adj) + G + W - D - S - E - N$$

where PCE(adj) is the personal consumption adjusted for income inequality, G is the growth in capital, W is nonmonetary contributions to welfare (e.g., unpaid labor like housework), D is defensive expenditures (e.g., protection against crime), S is change in social capital (e.g., cost of commuting), E is environmental degradation (e.g., pollution), and N is depletion of natural capital (e.g., loss of forests).

Based on those variables, and after almost two decades of evolution, the current standard GPI model consists of a set of 26 indicators representing economic, environmental, and social factors (see Table 1) carefully chosen to avoid double counting of impacts. The indicators denote monetizable adjustments to the welfare derived from personal consumption and reflect priority areas for which trade-offs are expected among the economic, environmental, and social goals (Lawn, 2014).

GPI's calculation relies on existing, publicly available data to track changes in each indicator. For cases in which data are not readily available at a local level, the model uses proxy data from national sources or extrapolates data from existing trends. The model then translates all changes into dollar terms for the sake of commensurability by using the best available estimates from peer-reviewed and nationally accepted valuation studies.

Table 1. Genuine Progress Indicator's 26 indicators (State of Maryland, 2010)

Economic	Environmental	Social
Personal consumption expenditure (PCE)	Cost of inland water pollution	Value of housework
Income inequality	Cost of air pollution	Cost of family changes
Adjusted personal consumption	Cost of noise pollution	Cost of crime
Services of consumer durables	Cost of net wetlands change	Cost of personal pollution abatement
Cost of consumer durables	Cost of net farmland change	Value of volunteer work
Cost of underemployment	Cost of net forest change	Cost of lost leisure time
Net capital investment	Cost of climate change	Value of higher education
	Cost of nonrenewable energy resource depletion	Services of streets and highways
	Cost of ozone depletion	Cost of commuting
		Cost of motor vehicle accidents

In the end, the model provides a coarse estimate that is powerful enough to illustrate general trends and magnitudes of change across time (McGuire, Posner, and Haake, 2012). As the resulting GPI is in dollar terms, its structural similarity to GDP can uniquely inform policy makers and raise public awareness (Schepelmann, Goossens, and Makipaa, 2010). This framework becomes even more valuable for practitioners when used to inventory and account for existing data to provide a central data repository with regular updating and reporting schemes, to facilitate collaboration among data owners (e.g., state agencies), and to envision future data collection efforts. GPI provides a platform for an interactive tool to educate and engage the public (McGuire, Posner, and Haake, 2012). GPI can be used by state legislatures for public policy and budget analysis (Erickson et al., 2013) or by state agencies for project ranking related to land use (McGuire, Posner, and Haake, 2012).

Critics of GPI cite the lack of theoretical grounding, subjectivity of included indicators, and methodological flaws (Brennan, 2008; Dietz and Neumayer, 2006; Neumayer, 1999, 2000). While some work addressed these (Lawn, 2003, 2005, 2013), weaknesses remained, especially when down-scaling to the subnational level. In particular, data and valuation studies at the local scale can be hard to come by, any effort to localize the GPI is subject to the analysts' value judgments, and cross-subsidies across subnational regions confound assessments of sustainable economic growth (Bagstad and Ceroni, 2007; Clarke and Lawn, 2008).

Nevertheless, the utility of the framework is evident in a growing number of applications at the national, subnational, and local scales. National studies have been done in the United States (US) (Anielski and Rowe, 1999; Talberth, Cobb, and Slattery, 2007), Australia (Lawn and Clark, 2008), and China (Wen et al., 2003), among others. Subnational studies were conducted both abroad (Anielski et al., 2001; Lawn and Clarke, 2008) and in the US for multiple states, including Maryland (McGuire, Posner, and Haake, 2012; Posner and Costanza, 2011; State of Maryland, 2010), Vermont (Bagstad and Ceroni, 2007; Costanza et al., 2004; Erickson et al., 2013), Utah (Berik and Gaddis, 2011), Ohio (Bagstad and Shammin, 2012), Hawaii (State of Hawaii Environmental Council, 2013, 2014), and Colorado (Stiffler, 2014), with others forthcoming. Other studies calculated the GPI for local governments—that is, cities and counties (Bagstad and Shammin, 2012; Costanza et al., 2004; Posner and Costanza, 2011).

The flurry of activity at the state level has spurred greater momentum among researchers and practitioners, resulting in the formation of a GPI Technical Working Group in

June 2013. The group explores theoretical and empirical issues related to GPI, with the ultimate goal of establishing an improved and more refined framework—a GPI 2.0 (Bagstad, Berik, and Brown Gaddis, 2014).

GPI Island Style

GPI island style grew out of a desire to introduce a supplementary, more holistic decision-making framework to Hawaii and reinforce efforts to make data more accessible to the general public. The State of Hawaii Environmental Council Annual Reports for both 2012 and 2013 showcased the GPI technical reports (State of Hawaii Environmental Council, 2013, 2014).

Using the Maryland GPI (State of Maryland, 2010) as a foundation, we collected relevant, publicly accessible data from federal, state, and local agencies, academia, and other sources. For each of the 26 indicators, we described associated trends within the state, evaluated its use in previous GPI studies, and calculated findings over the period for which data were available. In addition, we identified data gaps and corresponding research needs, and made recommendations for integration of GPI into other state initiatives. Results from the further synthesis of our findings, above and beyond what was included in the technical reports, are reported in the next section of this article.

Figure 1 shows the results for the calculations of GPI in Hawaii in 2013. Hawaii's economy is growing, driven by the major economic sectors of tourism, the military, and real estate. Measured by GPI, Hawaii has made genuine progress since 1969 (the earliest year for which we have most data). Both its GSP and GPI show upward trends, although GPI is below GDP, reflecting costs of the state's growth and showing that GDP overestimates the state's true progress (State of Hawaii, 2014).

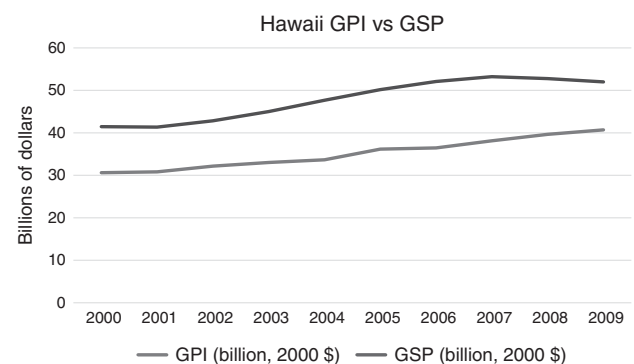


Figure 1. Hawaii's Genuine Progress Indicator (GPI) and gross state product (GSP) (2000–9) (State of Hawaii, 2014).

2.0 GPI Island Style: Findings and Discussion

Here we explore how the island setting in particular challenges the GPI framework, and, conversely, how GPI can be useful in highlighting hidden costs and benefits of economic development. Furthermore, we evaluate whether a standardized model using downscaled national data and transferred values is useful for Hawaii.

Some limitations are common to all subnational applications of the GPI model but are more acute for Hawaii. All GPI studies face missing or incomplete data at the state or local level, leading instead to the use of national data scaled down according to the population size of the state. This erases any local nuance in the variables important for quality of life, which is arguably the point of subnational studies (Bagstad and Ceroni, 2007), although this limitation is becoming less acute as states improve their publicly available data. Another issue is the general lack of valuation studies connecting local changes to quality of life; the standard GPI applies the same value (i.e., the value of clean water) regardless of setting. Proxy data or valuation studies from elsewhere are not so easily transferable to Hawaii. For example, valuation studies of wetlands done on the US mainland do not reflect the crucial role of Hawaiian wetlands for endangered species habitat and groundwater recharge. Table 2 summarizes some of the key features relevant to the GPI that differentiate Hawaii from the mainland US. These may necessitate more localization and adaptation of the GPI to make it useful for Hawaii.

Table 3 summarizes the 26 indicators that we propose for GPI island style. Beyond the assumption that local data will be applied whenever possible, the table highlights those indicators that are particularly relevant for Hawaii (grey), are inapplicable at this point in time (black), require additional alteration (diagonal), or are recommended expansions (vertical).

Economic Indicators

We begin with an evaluation of economic indicators because the starting point for the calculation of both GDP and GPI is personal consumption expenditure (PCE). Currently, PCE at the subnational level is not calculated directly either by the US Bureau of Economic Analysis or the state. Instead, GPI uses national data to find the ratio of PCE to personal income on a per-capita basis, and adjusts to the state level by multiplying that ratio by the average per-capita income and population of the state. Unfortunately, the reliance on national data for these calculations misses factors that are critical to the Hawaii context—namely, the impact of Hawaii's high cost of living on the disposable income of residents.

Hawaii's location in the middle of the Pacific Ocean provides for a beautiful, lush tropical setting, but at a price; consumer goods and services transported to the islands are considerably more expensive than elsewhere in the US. The composite index of the cost of living for Honolulu is 165% the national average. The cost of groceries, utilities,

Table 2. Summary of Hawaii's unique environmental, social, and economic features relevant to the Genuine Progress Indicator

Economic

- Undiversified, export-based economy (tourism, military, and agriculture)
- Inequality, especially between nonindigenous and indigenous groups, urban and rural, and across islands
- Vulnerability (isolation, dependence on external inputs, and undiversified economy)

Social

- Social and family networks (social capital) important for quality of life
- Multigenerational housing and homelessness growing because of high cost of living
- Human capital growing, but leaving (brain drain)
- Social norms and strong values (*aloha, ohana*, etc.)

Environmental

- Scarce resources (water, land, and coral reefs) underpin economy, food security, culture
 - Hot spot of biodiversity, endemism, endangered species
 - Invasive species threaten native species, water supply, and natural beauty
 - Climate change impacts threaten coastal areas, native species, and water supply
 - Fossil fuel dependence entrenched despite high renewables potential
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Table 3. Indicators in the Genuine Progress Indicator island style, designated as particularly useful for Hawaii (*gray*), inapplicable at this time (*black*), requiring additional alteration (*diagonal lines*), remaining the same (*white*), or recommended expansions (*vertical lines*)

Economic	Environmental	Social
Personal consumption expenditure (PCE)	Cost of inland and coastal water pollution	Value of housework
Income inequality	Cost of air pollution	Cost of family changes
Adjusted personal consumption	Cost of noise pollution	Cost of crime
Costs and services of consumer durables	Cost of wetlands change	Value of volunteer work
Costs of underemployment	Cost of net farmland change	Cost of lost leisure time
Net capital investment	Cost of forest change	Value of higher education
	Cost of climate change	Cost of commuting
	Cost of nonrenewable energy resource depletion	Cost of motor vehicle accidents
	Cost of submerged coastal systems change	Services of streets and highways
	Cost of other natural resource depletion (fish, groundwater)	
	Cost of ozone depletion	
	Personal pollution abatement	

transportation, and health care are consistently above the national average, and housing costs in particular are well above the mean (249% of the national average) (US Census Bureau, 2011), yet wages in Hawaii still remain close to or below the national average. In May 2013, for example, the annual mean wage was \$45,420 in Hawaii, slightly below the national annual mean of \$46,440 (US Bureau of Labor Statistics, 2013). Revised personal income statistics reflecting the differences in the cost of living across states and will be available in 2014 (US Bureau of Economic Analysis, 2014). In the meantime, other GPI studies opted to purchase state-level consumption data through ESRI (Bagstad and Shammin, 2012; Berik and Gaddis, 2011). A revision to use more locally relevant measures for PCE will help address the insufficiency of this indicator.

Yet the high cost of living in paradise leads to other social costs that are not identified within the current GPI framework. The cost of housing in Hawaii is significantly higher than the national average and is prohibitively expensive for many residents. In order to afford the fair market rent on a two-bedroom apartment without spending

more than 30% of income on housing, a household must earn \$66,853 annually, well above the state average. Moreover, rental prices have risen 94% since the year 2000 (National Low Income Housing Coalition, 2013). The lack of affordable housing exacerbates the continuous and growing problem of homelessness throughout the state. Hawaii has many *working homeless*, people who hold jobs but are overwhelmed by housing costs. Survey data from shelter and outreach programs in the state estimate that 11%–27% of the homeless using the services hold part- or full-time jobs (Center on the Family, 2013).

Another interesting phenomenon also touches upon the lack of affordable housing. Hawaii has the highest occurrence of multigenerational households in the nation, at 11% compared to a national average of 5.6% (Lofquist, 2012). Many households with grandparents tending children are Native Hawaiian (Office of Hawaiian Affairs, 2013). On one hand, that these large households form out of economic necessity can be construed as a social cost; on the other hand, combined households are a social benefit that augments the already strong sense of family or *ohana* in

Hawaii. Although both cultural and economic factors are certainly at play, the more relevant question is how GPI can reflect this cost of economic growth.

GPI incorporates the *Gini coefficient*, an index that reflects income inequality within a population. Values for the Gini coefficient can range from 0 (perfect equality) to 1 (perfect inequality). The Gini coefficient for the state of Hawaii continues to rise (signaling a rising inequality) but most recently hovers around 0.43, below the national average of 0.47–0.48. Although GPI's adjustment for income disparity is an important element for going beyond GDP, the case of Hawaii illustrates weaknesses to this approach because of population sizes on the islands. The Gini coefficient has a downward bias in small populations (Bee, 2010), understating true levels of inequality. This is particularly concerning in Hawaii, whose total population of approximately 1.4 million is ranked 40th in population size (US Census Bureau, 2014). Furthermore, about 70% of the state population is concentrated on Oahu, with considerably smaller populations across the other island (State of Hawaii Department of Business, Economic Development & Tourism, 2012a). The Gini coefficient cannot capture inequality in smaller populations or their subgroups.

While GPI's focus on economic inequality is laudable, it misses social impacts associated with poverty, particularly across ethnic subgroups, thereby missing distinctive features of Hawaii's population. The share of Hawaii's total population living below the poverty line is only 10.8%, favorable to the national average of 14.9% (US Census Bureau, 2014). However, poverty rates within the Native Hawaiian community, who make up more than 20% of the state population, are an estimated 14.7% (Office of Hawaiian Affairs, 2011; US Census Bureau, 2014).

Other distinctive features of the island economy, specifically tourism and the military, are not directly evident in the current GPI framework. Tourism and the military constitute the two most important sectors of the economy in Hawaii, and both are unique to the island setting because of its natural beauty and its strategic location in the middle of the Pacific Ocean. The primary source of income for Hawaii is direct visitor expenditures across the service, transportation, and retail trade industries (estimated at over \$14 billion in 2012). The second largest sector after tourism is the defense industry, contributing approximately \$10 billion in 2009 (the last year for which data were available) (State of Hawaii Department of Business, Economic Development & Tourism, 2012b). In 2010, Hawaii ranked first among states in per-capita direct

federal expenditures from the Department of Defense (State of Hawaii Department of Business, Economic Development & Tourism, 2012c).

Both tourism and the military raise challenges for GPI because their costs and benefits are not limited to Hawaii. Tourists pump money into the economy, yet demand massive amounts of scarce natural resources and drive up land prices via demand for accommodations or second homes. Similarly, the military not only injects huge sums of money into the local economy but also develops local infrastructure, providing public goods to Hawaii. At the same time, an increased demand on natural resources and land use leads to negative externalities.

One adjustment to the GPI to better account for externalities from tourism is to use *de facto* population figures. The *de facto population* is the average daily number of people in a certain area at any given point in time; it includes both visitors and residents but excludes residents who are absent. For example, in 2012, the resident population for Hawaii was estimated at 1.39 million while the *de facto* population was estimated at 1.52 million (University of Hawaii Economic Research Organization, 2014a). This is a more accurate representation of the number of people consuming local goods and services such as housing, roads, water and food supplies, police and fire protection, wastewater treatment, public facilities, and, of course, natural capital. Determining how GPI should capture the effects of the military presence in Hawaii is complicated. One step forward would be to track spending on infrastructure instituted by the military, particularly those expenditures that would otherwise not be incurred by the state.

As a final observation within the category of GPI economic indicators, there is no indicator to monitor the resilience of the economy. Hawaii economy's dependence on a handful of sectors, as well as its isolation, make it vulnerable to external shocks. For example, because of the 2007–9 recession, visitor expenditures in the state dropped 22% (University of Hawaii Economic Research Organization, 2014b) and, in 2007–11, job losses in the two industries impacted by tourism (trade, transportation, and utilities; and leisure and hospitality) were 9% and 6%, respectively (State of Hawaii Department of Labor & Industrial Relations, 2012). The GPI assesses the costs and benefits of past and current economic activity by using macro measures that can miss the subtleties of vulnerability and resilience within subsections of the state economy; we feel this issue deserves further attention.

Environmental Indicators

A number of the features highlighted in Table 2 point to the environmental uniqueness of the island setting. Hawaii's tourism-based economy, local culture, and general quality of life are intricately linked to the state of the environment. Despite this, Hawaii's environment is being degraded and its resources depleted. Urban dwellings and resorts replace rural, agricultural, coastal, and forested areas to support a rapidly growing local and tourist population (State of Hawaii Office of Planning, 2014). Land-based pollution caused by development and improper sewage disposal threatens coastal environments (Jokiel et al., 2004). Transboundary exchanges of water support growth in water-scarce areas while ever-increasing demand leads to withdrawals that exceed natural infiltration rates (Konikow, 2013). Invasive ungulates spread disease, cause erosion, trample native plants, and enable nonnative plants to outcompete natives (Stock et al., 2011). Many reef and pelagic fish are depleted at a rate above their sustainable yield, causing worries about crashes and impacts on reefs (Williams, Walsh et al., 2008). Projected impacts from climate change, such as sea-level rise and altered precipitation patterns, may alter ecosystems and hydrologic regimes (Ponette-González et al., 2014).

The basic approach of GPI's environmental indicators is to capture a biophysical change (whether it be loss of an acre of wetlands or increase of a ton of carbon dioxide), multiply the change by a corresponding price for the unit lost or gained, and result in a monetary value. Amending and/or expanding the GPI indicators related to natural capital depletion and environmental degradation to better fit the island setting will also more fully account for the environmental costs and benefits of economic development in Hawaii.

The GPI framework includes several indicators to track loss of natural capital (i.e., wetlands, farmland, and forests) due to land use change. New indicators should be added to reflect those habitats, such as coral reefs and beaches, that are critically important to Hawaii for recreation, tourism, food, shoreline protection, and aesthetics. Moreover, these indicators should be further discretized to reflect changes in habitat quality. For example, an indicator tracking a change in forest area should further discern between native versus nonnative forest changes because society will value forests hosting endemic, endangered species differently than those riddled by invasive species.

Hawaii's GPI should expand its coverage of the depletion of natural resources to address the costs of unsustainable use

of groundwater, fisheries, and soil. Over 99% of Hawaii's drinking water and 50% of all freshwater derives from groundwater; in some areas of urban Honolulu, wells have been abandoned because of saltwater intrusion from over-pumping (Gingerich and Oki, 2000). Declining fish catches from nearshore reefs hint at overexploitation (Friedlander et al., 2008) and may threaten local food security and cultural practices (Vaughan and Vitousek, 2013). Current rates of soil loss impact agricultural yields, native species, aesthetic views, coral reefs, carbon stocks, and even human health (from airborne dust) (Hobbs and Huenneke, 1992; Jackson et al., 2002; Pimentel et al., 1995; Weber, Lott, and Fabricius, 2006). Statewide data may be scarce for these indicators, stressing the need for expanded research, but local studies may serve as proxies in the meantime.

Local pollution is an externality of economic development overlooked by GDP, but GPI studies commonly capture it through costs of water and air pollution, as well as defensive expenditures for the disposal of wastewater and solid waste. The current GPI indicator for water pollution is incomplete for Hawaii because it traces local water pollution based only on degraded streams. Certainly, given Hawaii's reliance on coastal water and groundwater resources, its GPI should be expanded to include costs of water quality beyond just stream data.

The GPI method to calculate air pollution is impractical for Hawaii because the method uses local exceedances of ambient air quality standards to estimate the costs of damages incurred. First, most exceedances in Hawaii are due to *vog* (volcanic air pollution) from naturally occurring Kilauea Volcano emissions and are not relevant because GPI counts only costs or benefits from anthropogenic impacts. Second, Hawaii's well-known trade winds transport the emissions and their potential impacts outside state boundaries. A few hot spots of anthropogenic air pollution (e.g., burning of sugarcane on Maui) demand heightened monitoring, but little justification exists for increased monitoring within the state. If future monitoring either identifies impacts locally, particularly as urbanization increases, or provides evidence of remote damages (or both), then GPI for Hawaii should revisit the inclusion of an air pollution indicator in consultation with state agencies and others. This should be informed by larger discussions on how the GPI model addresses externalities (i.e., impacts of production or consumption that are borne by external actors), a point that is also directly relevant to the following discussion of global climate change.

In terms of global pollution, GPI accounts for costs of climate change by quantifying Hawaii's carbon emissions

and using the social cost of carbon (summarized by Tol, 2005) to monetize damages. The results are significant given that Hawaii is the most fossil-fuel dependent state in the nation, relying on petroleum for more than four-fifths of its energy (US Department of Energy, 2014). For Hawaii, a more fundamental issue is whether the GPI should deduct damages *caused* or damages *suffered*. The former approach, as currently embedded in the climate change indicator, assumes that Hawaii's consumption of fossil fuels results in greenhouse gases, which in turn cause damages somewhere on Earth, and those damages are deducted from Hawaii's GPI. The latter, alternative approach deducts the damages suffered locally from climate change, no matter who emitted the pollution. The damages-suffered approach more closely matches how the other indicators unrelated to climate are handled (i.e., deducting local damages from a change in a local resource). Moreover, a damages-suffered approach may provide more locally relevant information. Hawaii may experience a complete shift from historical climate within the near future (Mora et al., 2013) and is highly vulnerable to climate change impacts. Hawaii will likely incur local damages far in excess of its relative share of global emissions. While policy makers are creating adaptation plans for the state, the GPI could incentivize action by providing a clear estimate of the damages the state suffered each year. While this does not abrogate Hawaii's responsibility to mitigate emissions and compensate for damages abroad, it is more informative for local policy makers and the public. That said, accounting for actual damages directly attributable to global climate change may be difficult.

Social Indicators

Social changes brought about by economic growth may increase or decrease people's well-being. Therefore, GPI adjusts PCE for things like the costs of crime, defensive expenditures, and commuting. GPI also takes into account nonmarketed values and services, such as unpaid labor. The following paragraphs highlight social indicators relevant to the island setting of Hawaii, as well as some that should be amended.

Several GPI studies, including Hawaii's, include an indicator for the value of higher education, which assumes that the contributions of a better-educated workforce spill over to the larger society, extending benefits beyond the increased income earned by degree holders (State of Maryland, 2010; Talberth, Cobb, and Slattery, 2007). These studies tracked the number of residents with college degrees and above, and then multiplied by an additional

monetary amount per graduate to calculate societal benefits. Other GPI studies omitted higher education because some of its effects are likely already captured in PCE (Bagstad and Shammin, 2012; Berik and Gaddis, 2011). Although we included the indicator in our baseline study, we need more evidence to determine whether it garners further support. Although higher-education attainment based on the number of Hawaii residents with college degrees rose in 2000–10 to 29% or slightly above the national average (US Census Bureau, 2012), half of the Hawaii residents entering four-year degree-granting programs enroll in out-of-state institutions (US Department of Education, 2011). The potential loss in spillover benefits associated with a brain drain (i.e., graduates do not return to Hawaii) is unknown and not currently captured in GPI.

The value of housework is an extremely relevant indicator for the case of Hawaii, especially given the high proportion of multigenerational households throughout the state. Of the households in Hawaii, 11% contain three or more parent-child generations (Lofquist, 2012). The additional housework or child care performed by those at-home family members is not valued in the calculation of GDP, yet is invaluable to providing greater flexibility for wage-earning family members and quality of life for the whole household. The figure for value of housework is calculated by multiplying the Department of Labor's American Time Use Survey estimate of how long full-time workers spend on housework by the average wage rate for housekeepers in the state. Future refinements of this indicator for Hawaii should better recognize the inputs of these additional household members.

Likewise, the cost of commuting is very relevant to the quality of life of many Hawaii residents. The average commute in Hawaii takes 25 minutes one way, comparable to the national average (McKenzie and Rapino, 2011), yet Hawaii is ranked the second-worst city in the nation for traffic congestion, and the trend is increasing (INRIX, 2014). Unlike the long distances for many mainland commuters, commuting in Hawaii involves short distances but on congested roads. GPI captures only the quantity of time spent commuting but not the quality of that commute once frustration and psychic income loss are incorporated.

While some social indicators are key to illustrating quality of life in Hawaii, others are not as relevant. We chose not to include the cost of family changes, given the difficulty of corroborating data for this indicator from previous GPI studies, spotty data for Hawaii, and the general inadequacy of the current calculation method relative to the Hawaii

context. Past GPI studies typically track divorce rates and associated costs, as well as household television viewing rates, assuming more time spent watching television means less time engaging with family. For this indicator to be reconsidered in later versions of GPI for Hawaii, it should capture the strong sense of extended family or *ohana* that exists here.

Conclusions

Living in paradise comes with unique benefits, yet is not without associated drawbacks. Similarly, economic growth provides both advantages and disadvantages. In this article, we used our experiences applying the Genuine Progress Indicator (GPI) to the state of Hawaii to identify benefits and costs related to economic growth, highlighting those that are unique to the island setting.

From our findings, we identified features in Hawaii that warrant more attention, and we discussed how GPI might be altered to better fit the Hawaii context. The GPI community is grappling with the question of whether GPI should be standardized for comparison or context-specific for local decisions. The debate about localization versus standardization is especially relevant to Hawaii because of its uniqueness as an isolated, biodiverse island system with an undiversified, export- and fossil fuel-based economy. For GPI to be most useful for guiding policy in Hawaii, we feel the included economic, social, and environmental changes must mirror those of local concern, which should be elicited through broad consultation to diminish analyst bias. In addition, any adjustments must reflect local priority areas and trade-offs between economic development and environmental, social, or other economic goals. In Hawaii, the GPI initiative is embedded in statewide *green growth* discussions to promote environmentally sustainable economic progress.

The GPI process helped us to uncover benefits and costs not otherwise recognized under state measures like GSP. The high cost of living, for example, can have secondary negative impacts (e.g., homelessness) or indirect benefits (such as family support via multigenerational households). In another example, tourism in Hawaii infuses the local economy with funds, but at the expense of increased pressure on natural habitats.

Moreover, we assumed that despite drawbacks in data availability and quality, GPI offers a readily available, proven, and useful framework that can be used to engage

policy makers and the public in analyzing trade-offs. The process of amending and updating the indicators for GPI island style will be through interactions with the data owners at state and local agencies, as well as in consultation with other states engaging in GPI activities.

As the movement to improve and standardize the GPI framework moves forward (i.e., GPI 2.0), this article sought to further that conversation among the GPI community and practitioners, the GPI Technical Working Group, and citizens curious about how subnational GPI models can capture important local conditions adequately.

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