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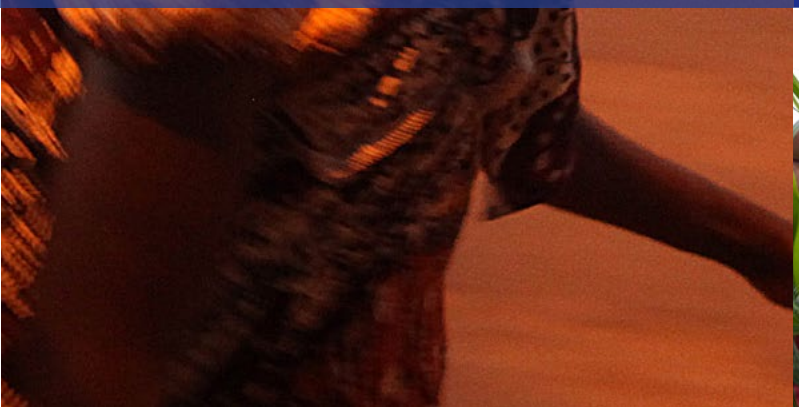
Poverty-Environment Accounting Framework (PEAF):

Application to Inform Public Investments in Environment, Climate Change and Poverty

November 2017



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Contents

1. Purpose and Background

The Poverty Environment Initiative Asia-Pacific of the United Nations Development Program (UNDP) and United Nations (UN) Environment developed a discussion paper on the Poverty-Environment Accounting Framework (PEAF)[1]. PEAF is an application of the accounting principles described in the System of Environmental-Economic Accounting (SEEA) to advance the measurement and analysis of the poverty-environment nexus.

This working paper is developed to further examine how the PEAF can be applied to improve public investments in environment, climate change and poverty. It aims to explore how the PEAF can be used to support pro-poor environmental sustainability outcomes by providing an integrated set of data and information on the inter-linked issues of environment, climate change and poverty to budget analysis, public expenditure reviews and return on investment analysis.

The Poverty Environment Expenditure Framework (PEAF) is a tool to assist the application of the System of Environmental Economic Assessment (SEEA), and offers to capture the state of environment (e.g. ecosystem services) and linkages with changes in poverty. By doing so, the PEAF aims to improve the system of national accounts, and allow for public expenditure reviews (in the future) to better analyse the efficiency and effectiveness of public expenditure contributing to environmental sustainability and poverty reduction in a balanced manner.

The intended audience of this paper is primarily government officers that are involved in budgetary processes and public investment management in the Ministry of Finance, Planning, Environment and other development sector ministries as well as agencies involved in providing national data and accounts such as the National Statistics Office. Other audiences may include development partners, civil society organisations and private sector actors engaged in promoting and delivering more efficient and greater public and private investments in pro-poor environment and climate change priorities at national, regional and international levels.

This working paper is a product of the PEI Asia-Pacific, a joint initiative of the UNDP and UN Environment. The paper was written by Mark Eigenraam[2] (lead author) and Seonmi Choi[3] (contributing author and project lead). We would like to thank colleagues who helped draft and refine the paper with their review and suggestions. These include Alex Forbes, Salman Hussain and Jillian Campbell from UN Environment and Michael Bordt and Sanjesh Naidu from the UN Economic and Social Commission for Asia and the Pacific. This is a working paper which is expected to be further refined with experiences from country-level applications and additional expert feedback.

1 http://www.unpei.org/latest-news/data-crunch-how-do-we-measure-the-complicated-relationship-between-poverty-and-the-environment

2 Director, IDEEA Group, consultant to the PEI, www.ideeagroup.com

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2. Measuring the Poverty-Environment Nexus to achieve the SDGs

The linkages that exist between poverty and the environment are often described as the poverty-environment nexus (PEN)[4]. There is a strong alignment between the objectives of the Sustainable Development Goals (SDG) and the PEN. For instance, about half of the SDGs are directly environmental in focus or address the sustainability of natural resources", and "...over 86 targets concern environmental sustainability, including at least one in each of the 17 SDGs".[5] Many of the SDGs include poverty and consider the interlinkages between society (both the impoverished and not) and natural resources (land, water, forests, agriculture, seas and oceans). When applying an Environmental Economic Accounting approach natural resources are referred to as environmental assets and are the foundation for reporting and accounting for links to social and economic wellbeing.

A key challenge to achieving both SDG and PEN objectives is determining how to measure and report on the return on investment in the environment to generate the greatest returns both now and in the future. Given the inter-connected nature of the environment and social wellbeing, and the plethora of investment choices it is difficult for stakeholders to evaluate alternative investment options.

It is instructive to define sustainable development and PEN as an investment pathway problem in which the choices of the present generation are enlarged without restricting the choices of future generations, which suggests there are a number of challenges[6]:

- Sustainability in the context of the PEN encompasses more than the **physical environment** (land, water, forests) with the challenge being how to measure and report the impacts of **economic and institutional (regulation, laws) choices** on the poverty and environment outcomes.
- The concept of sustainability is a **dynamic inter-generational and inter-temporal notion**. Therefore, investments made today need to incorporate future income and account for future impacts on the asset base in which investments rely upon (both natural and built). The challenge is how to specifically consider the extent and condition of environmental assets as key to understanding the PEN and the impacts of investments made today over different temporal scales.
- Traditional aggregate measures of wealth and poverty such as Gross Domestic Product (GDP) and Multidimensional Poverty Index (MPI) do not reflect local biophysical and social conditions or address the **spatial dependences between the environment and the poor**. The analysis of the links between the environment and social wellbeing has been undertaken at the aggregate level lacking spatial specificity. The challenge is developing an approach that can measure and report on local conditions and spatial dependencies in an integrated and systematic manner.

The abstract concept of sustainable development needs to be operationalised, which raises the challenge on how to develop measurable indicators and targets for coherent and integrated monitoring and reporting that is relevant and scalable (local versus national) to stakeholder needs and that is feasible in terms of local capacity in data collection and analysis.

Expansion of human choices and well-being will need to be within planetary boundaries, which leads to the need to measure and report on **environmental thresholds**. How to operationalize this threshold concept in the context of economic and social development policy and investment decision-making is another challenge in the discussion on poverty-environment nexus.

Poverty-environment nexus and investment choices must tackle the challenge of equity, which requires each public investment choice to yield optimal returns that are equitable with careful consideration of **distributional impacts of each investment**.

4 http://www.unpei.org/about-the-poverty-environment-initiative

5 The United Nations Environment Programme and the 2030 Agenda: Global Action for People and the Planet, 2015

6 S. Jahan, A. Umana (2003), The Environment-poverty Nexus, UNDP Development Policy Journal, Volume 3

To address these challenges, it is necessary to have information to analyse the interactions of public policies and outcomes in the environmental, social and economic fronts that aim to achieve both PEN and SDG objectives. The PEN requires the achievement of several SDGs in concert with one another including:

1) Ending Poverty;

2) End hunger and promote sustainable agriculture;

6) Sustainable management of water;

13) Take urgent action to combat climate change and its impacts;

14) Sustainably use oceans, seas and marine resources;

15) Protect, restore and sustainably use terrestrial ecosystems; and

17.14 Enhance policy coherence for sustainable development

17.18) & 17.19) Increase high quality and timely data that is location specific and complements statistical analysis and reporting of Gross Domestic Product (GDP).

Specifically, the PEN reflects a joint set of goals that requires quantitative analysis and reporting to understand how and where to invest (in financial terms or in social/environmental benefits) to achieve integrated outcomes efficiently and effectively.

Poverty, as with sustainability, is linked to all forms of capital — environmental, economic and social — and their maintenance and reproduction. The measurement challenge is understanding where to target investments to achieve the greatest social, economic and environmental outcomes across the capitals and determining the level of investment required both now and in the future. Governments are faced with the challenge of how to best invest across the capitals to achieve SDGs, poverty and environmental goals without compromising one another and maximising positive feedback links between them. Further, governments need to be able to demonstrate how investments (expenditure) are currently performing so they can argue for future funding to meet ongoing financing challenges.

Over the past decade, many countries have undertaken Public Expenditure Reviews (PER) on environmental (e.g. Public Environment Expenditure Reviews, PEER) and climate change (e.g. Climate Public Expenditure and Institutional Review, CPEIR). In general terms the aim of these reviews is to assess the efficiency and effectiveness of public expenditure. These reviews collect data on government (and in some instances private) expenditures in the environment, climate or biodiversity policies and programs. Many of the past environment and climate public expenditure reviews have focused on a single dimension of the environment (natural resources including quality of air, water and land and biodiversity) or climate change, with an assessment of social and economic wellbeing as an add on, but not the explicit focus. More recently there have been attempts to extend the current approach to expenditure reviews to include poverty outcomes.[7]

This paper will show how the Poverty-Environment Accounting Framework (PEAF) can support an integrated assessment of the links between the environment and climate, biodiversity and poverty with a set of information using an environmental-economic accounting (EEA) approach. The advantage of PEAF is the focus on clearly specifying environmental assets (natural resources) and ecosystem services and measuring and reporting the social and economic benefits they provide. Further, PEAF data collection and collation are spatially specific allowing for spatial distributional analysis of the links between the environment and poverty.

In this paper, we show that current approaches to public expenditure reviews provide a qualitative assessment of the expenditure however the results cannot be used to assess return on investment, report on actual environmental and poverty outcomes achieved and inform future investment needs. Further, existing reviews do not provide an adequate assessment of financing gaps or track the effectiveness of investments in a systematic manner that links explicitly with environmental assets and the benefits they provide across different segments of the population especially those most excluded and impoverished.

7 Thiry, G., Alkire, S., Schleicher, J (2017) Incorporating environmental and natural resources within analyses of multidimensional poverty, Oxford Poverty and Human Development Initiative (OPHI), Department of International Development, University of Oxford

3. Budget Processes and Public Expenditure Reviews

3.1 Why review public expenditures?

A public expenditure review (PER) is generally considered as a tool for evaluating the effectiveness of public finances. In practice, public expenditure reviews can have multiple objectives. The purposes of the expenditure reviews vary depending on country contexts, but it is crucial to clearly set out the primary purpose of any expenditure review. Many countries of the Organisation for Economic Co-operation and Development (OECD) undertake spending reviews to identify savings measures from baseline expenditure and/or reviewing new spending proposals. The expenditure review design needs to be tailored for each policy purpose.

It is important to understand how public expenditure reviews are used as part of the budgetary processes and to design and undertake tailored expenditure reviews on poverty, environment and climate change targeting the specific purpose of the budgeting process. Most public environment and climate change expenditure reviews supported by PEI and other development partners in the Asia-Pacific region were undertaken mainly to establish a baseline of the trend of public spending on these issues across the government with the objective of making the case for greater engagement of the Ministries of Finance and Planning and also for increasing public expenditures on these important cross-cutting policy objectives related to poverty reduction, environmental sustainability and climate change. Public environment and climate change expenditure reviews in the region have been horizontal, cutting across different agencies and sectors. These reviews tend to be very time-consuming and data-intensive and thus should be decided carefully responding to the policy demand and country capacity.

3.2 Are expenditure reviews part of the budgetary process?

The experiences of public environment and climate change expenditure reviews indicate that expenditure reviews are not yet an integral and systematic part of the budget process and especially expenditure reviews with a focus on environment and climate change issues are generally not done regularly. In addition, there is limited evidence that expenditure reviews are directly linked to or inform the government performance-based budgeting or performance assessment process. Expenditure reviews could provide critical information for assessing performance and better expenditure prioritization to implement performance-based budgeting if they produced appropriate data and information for the analysis of the links between expenditure and outcomes. Most countries have annual budgeting processes and thus expenditure reviews could be institutionalized into the annual budgeting process. The frequency and scope of expenditure reviews needs to be carefully reviewed, consensus-built across the government and institutionalized as an integral part of budgetary process of countries. However, there is still a challenge in designing and implementing expenditure reviews that will result in a suitable set of data and information to inform the budgetary process and have credibility with government agencies.

The following section provides an assessment of past PERs to provide an overview of the type of information they produce and the recommendations they make with respect to budgetary processes.

4. Assessment of country-level PERs

This section provides a brief assessment of several PERs for Bhutan, Nepal and Indonesia. The assessments aim to determine if the PERs provide information that could be used to meet the challenges highlighted in the introduction and give a sense of how the reviews are applied in practice. The results of the review are used to provide guidance on how the Poverty-Environment Accounting Framework (PEAF) can guide future data collection and analysis in the Public Expenditure Reviews so those reviews can provide more substantive analysis on the effectiveness and efficiency of public spending on actual changes on the environmental and poverty conditions and its return on investment.

4.1 Bhutan: Public Environmental Expenditure Review (PEER)

The Public Environmental Expenditure Review (PEER) undertaken for Bhutan (2011, 2012, 2013) identified the following objectives:

- Effectiveness – an assessment of the effectiveness of the public expenditure in relation to development priorities. That is an assessment of public expenditures compared to priorities contained in the national development policy (eg. 10th FYP in Bhutan).
- Efficiency – the cost efficiency of the public expenditure in delivering outputs and outcomes, how agencies and institutions perform on the delivery of public services. The key starting point for the efficiency measure was to assess whether the budget allocations were fully utilised. Note this approach to measuring efficiency is different from standard economic approaches to measuring efficiency. This point is further discussed in section 5.1 below.
- Accountability – the aim of accountability is to ensure that the public expenditures were aligned with and met the prescribed functions of the public agencies (institutions).

Based on the objectives of the Bhutan PEER it is clear there is a strong focus on fiscal responsibility (i.e. accountability) ensuring government pursues an appropriate level of government spending and tax to maintain sustainable public finances and appropriate levels of public investment. The reports noted the importance of environmental wealth for poverty reduction and the relevance of assessing environmental expenditures. However, they did not provide any quantitative measures of the changes in poverty linked to environmental expenditures, or measures of the change in environmental wealth or assets.

4.2 Nepal: Climate Public Expenditure and Institutional Review (CPEIR)

A climate expenditure review study was undertaken in Nepal resulting in two reports: the Nepal Climate Public Expenditure and Institutional Review (CPEIR [8]) and The Future for Climate Finance in Nepal[9]. The CPEIR study examined the development effectiveness dimensions of climate finance in Nepal. The analysis was based on the premise that the management of climate finance should build on relevant examples of good practice in other areas of public finance management, recognising the likely need for a variety of instruments to deliver climate change programming. The study focused on the public financing component of climate finance and the role of international support.

Both the CPEIR and Future for Climate Finance study found the following issues based on national development experiences in Nepal, that have relevance for climate finance delivery:

- Budgeting appears to be the weakest link in the policy, strategy, implementation chain. It is not clear whether this is because it does not receive the attention it deserves, or, because it is the most problematic stage to address.
- Meeting the needs of the most vulnerable to climate change will require a strong local finance delivery

8 CPEIR (2011). Nepal Climate Public Expenditure and Institutional Review (CPEIR), Published by Government of Nepal, National Planning Commission with support from UNDP/UNEP/CDDE in Kathmandu, Nepal

9 NPC/UNDP/UNEP/CDDE (2011): The Future for Climate Finance in Nepal, Study Conducted by ODI for Government of Nepal, National Planning Commission with support from UNDP/UNEP/CDDE. Published by NPC/UNDP/UNEP/CDDE in Kathmandu, Nepal

mechanism. This is where there are already identified weaknesses in the national financial management system.

- There is much diversity of structure and processes for the delivery of development finance. It may be expected this will also be the case for climate finance, at least in its initial stages of delivery. A key principle should be to match the finance modality with institutional function and spending objective.
- The limited development of results-based financing frameworks represents a significant challenge for climate change actions where performance-related issues hold such prominence.
- Improving transparency of climate change finance is key to secure greater accountability of the public administration.
- Finally, there appears to be limited engagement with, and recognition of, the important role to be played by the private sector in tackling climate change.

Further the study found that to meet the 2020 climate policy objectives of Nepal an internationally recognised performance-based system should be in place, with strong Monitoring, Reporting and Verification (MRV) for all climate finance investments, including those channelled to the local level. The study noted there has been much attention focused on managing public resources and improving the decision-making process to make clear the link between investment and results. However, the study concluded that it appears the rhetoric of the development of such systems is much in advance of the reality of present day systems. Table 1 below is an example of the process undertaken to score the links between climate expenditure and poverty outcomes. The process provides a useful insight into the potential for poverty outcomes from climate expenditure but it does not provide empirical evidence of change or return on investment, either for climate or poverty outcomes. Similar approaches are used in most PERs with some PERs extending the qualitative approach to weights developed by expert groups.

Table 1. Example of scoring system used to link climate expenditure to poverty outcomes (Nepal)

Criteria	Score
Direct and valuable contribution for following • Increase in production • Increase in Income • Minimization of poverty • Equitable distribution • Improvement in productive resources	Very Good
Indirectly and specially contribute for the above	Good
Indirectly and generally contribute for the above	Satisfactory/general
Very low contribution for the above	Low

4.3 Indonesia: Climate Public Expenditure and Institutional Review (CPEIR)

Several Provincial Climate Public Expenditure and Institutional Reviews were conducted in Indonesia. The Bangka Belitung (Babel) Province Climate Public Expenditure and Institutional Review (CPEIR) is one of sub-national CPEIRs carried out in Indonesia with support from UNDP and UN Environment. Unlike other CPEIRs, the Babel CPEIR was intended to introduce gender and poverty sensitivity analyses into the review of mitigation and adaptation actions and expenditure. Its expenditure focus is on province level climate expenditure from all sources, i.e. provincial and central government, private sector and NGOs.

The Babel CPEIR vulnerability assessment identifies fisheries and their coastal and coral reef areas, forestry, water supply, health and disaster response sectors as the most climate sensitive sectors in Babel Province. Fisheries and their coastal and coral reef areas are a unique feature of the Babel study and concluded it is perhaps the most vulnerable and economically important for the fishery industry due to coral bleaching and coral reef damage caused by seabed tin mining. It was also noted that fishing communities have limited resilience.

The core tool used to guide the identification and weighting of climate change relevant expenditure in the CPEIR was the Climate Change Relevance Index for Public Expenditure Classification. This is presented in the UNDP Bangkok Regional Hub CPEIR Methodological Guidebook (January 2015, Table 3: CPEIR Climate Relevance Index). For the Babel CPEIR study the indices from the handbook were adjusted for Babel's specific climate vulnerabilities. The study indicated that, because of their high risks in the Babel context, water supplies, coastal and coral reef protection, forest protection and conservations and non-mining income for those in poverty and at risk of climate change should be in the high relevance category. In terms of poverty, two-thirds of climate relevant activity has been found to have high and medium poverty co-benefits, i.e. the added benefits to poverty achieved as a result of addressing climate change.

However, the report concluded the climate-poverty analysis was severely constrained by a lack of poverty data that could be linked to climate issues. While the scale of poverty in Babel Province is known, the CPEIR team could not find data about who the poor are and their demographic and socio-economic characteristics. There was clear evidence that poverty in the province fell from 9.7% in 2005 to 5.3% in 2013, compared with a national average of 11.4% in 2013. Poverty is higher in rural areas of Babel at 7%, compared with an urban poverty level of 3.5% in 2013. However, the report could not explain if these differences were climate related or driven by other factors.

Stakeholder vulnerability mapping carried out by the CPEIR team at the province and sub-district levels suggests that fishing communities are poor and particularly at risk from climate change. However, further information is required to understand who the impoverished are and where they are located in order to make links to specific natural resources and the impacts of climate expenditure.

The scoring approach used is similar to that used in the Nepal CPEIR, however the scoring included categories based on the relevance of climate expenditure. The study found there were both increases and decreases in climate related funding over time and further those changes could be observed at the provincial level. Like the Nepal results the study does not provide empirical results that can be used to calculate return on investment and target future investment.

The Babel CPEIR provides useful insights with respect to taking into account scale – in this particular case comparing national and provincial results (see Table 2 below).

Table 2. Babel CPEIR national and local vulnerability approaches

Vulnerability seen from the National Level	Vulnerability in the Local Context	Combined Vulnerability Assessment
Climate variability	Climate trends and disaster events	Extreme climate events increased in frequency in recent years. Rainy season start and duration are now unpredictable leading to unpredictable fishing seasons. Sea water inundation. Floods, droughts and high wind events expected to double by 2050.
Population density	Population growth and the needs of food	Annual population growth rate high at 2.2% per year. Low productivity of food crops production. Babel highly dependent on food imports and 80% of food needs imported. Babel agricultural potential very limited due to poor soil fertility and acidification.
Ecological sensitivity and its exposure	Geographical Features, ecosystem goods and services and food security	Forest and environmental degradation resulting from unregulated tin mining. Watershed damage common and causing flooding. Increases in area of land in critical condition due to unsustainable land use. Coastal abrasion and marine (coral reef) damage and sea level rise. Agriculture dominated by monoculture plantation such as palm oil, peppers and rubber. Population groups most directly affected by CC are fishing communities.
Adaptive capacity	Food security, health, income, poverty, gender, HDI	Health issues related to climate are malaria, dengue fever and diarrhoea. These reduce adaptive capacity and resilience. The poverty rate for Babel decreased from 9.7% in 2005 to 5.4% in 2012, compared to a national average rate of 11.6% (BPS, 2014) but it has not been able to ensure prosperity for the general population.

4.4 PER assessment summary

In general, the above PERs appear to be thorough and comprehensive. There appears to be a significant focus on the collection of expenditure data across many agencies. The high-level focus of the reviews appears to be aligned but there are subtle differences in how the results are reported which appears to be driven by government policy priorities and the expertise (experience) of those undertaking the reviews. The following are a set of observations that are generally common across all the above PERs:

The reports claim to address effectiveness, efficiency and accountability, however in practise they are focused on fiscal responsibility. They do not provide information that can be used to undertake an assessment of economic effectiveness and efficiency which is needed to inform return on investment and link expenditure to outcomes.

The concept of environmental wealth is recognised as important however there does not appear to be any data collected to inform whether the environmental wealth is changing as a result of government expenditure.

A variety of government instruments are used to deliver on biodiversity and climate objectives with each instrument collecting standalone data to evaluate its effectiveness in producing outcomes. This is resulting in significant measurement and reporting differences for each government instrument preventing a comparison across instruments.

The reviews recognise that an internationally recognised performance-based system is needed for climate and biodiversity finance investments, including those channelled to the local level. This observation was also strongly linked to the need for better Monitoring, Reporting and Verification (MRV). However, the PERs did not identify a suitable approach.

Clearly there is a link between environment and climate change expenditure and poverty which was evidenced in the findings of the Babel CPEIR (Indonesia). It concluded that in terms of poverty, two thirds of climate relevant activity have been found to have high and medium poverty co-benefits.

The reviews highlighted that further information is required to understand who and where the impoverished are and to make links to specific environmental assets and the impacts of environment and climate change expenditure.

The measurement of expenditure needs to account for scale and take into consideration local and national contexts and the spatial location of the expenditure is important for linking changes in environmental assets to changes in poverty.

These results indicate that current approaches to expenditure reviews do not provide information on cost-effectiveness or return on investment that can be used to assess the performance of government programs and whether they are achieving the Government's policy outcomes and objectives. Further, there is no evidence to suggest the reviews are linked or applied in budgetary processes in an ongoing and systematic manner.

The next section will build on these observations and consider how outcomes from government expenditure may be assessed using an environmental economic accounting based approaches. The results can be used to make recommendations on how current PERs may be enhanced to better measure outcomes and link them to government expenditure and budgetary processes in a more systematic manner.

5. Outcome-based public expenditure reviews

Based on the findings of the PER review in the preceding section it is clear that for a PER to inform future investment and policy decisions there is a requirement to better link and quantify the relationship between expenditure and the outcomes produced. Expenditure in this case refers to public spending that aims to influence the extent and condition of environmental assets (noting that not all climate expenditure is targeted towards the management of environmental assets) to produce environmental, climate and poverty outcomes.

There are three key relationships that are important to understand from an expenditure and outcomes point of view:

1. Environment-Climate: This relationship looks at the role environmental assets (land, soil, water, forests, etc.) play in climate change. For instance, forests sequester carbon to help reduce greenhouse gases and mangroves can also act as carbon sink and protect the shoreline from erosion and flooding to address climate induced sea-level rise. There is also the impact on environmental assets from climate induced changing temperatures and rainfall that may increase the occurrence of drought that impacts on forests (and crops) or there may be increases in rainfall that causes floods that result severe soil erosion and loss of productive land.

2. Environment-Biodiversity: Biodiversity refers to the variety of plant and animal life in the world or in a particular habitat, where a high level is usually considered to be important and desirable. Environmental assets, especially terrestrial assets may be measured from the aspect of diversity. For instance, is there a diversity of terrestrial environmental assets to ensure there is landscape resilience and habitat for a range of species. Alternatively, biodiversity can be viewed from a species point of view and refer to the number of fauna (flora) that are supported by (contained within) environmental assets or the diversity in fauna (flora) within a given environmental asset.

3. Environment-Poverty: The link between poverty and the environment focuses on the dependencies between environmental assets and people. For instance, people may take food and fibre from an environmental asset (forest) to live and produce energy or the environmental asset (mangroves) may protect them from flood and rising sea levels. Environmental conditions such as quality of water, air and soil also play an important role in the health and resilience of poor communities.

A common feature of the three relationships is the connection between environmental assets and poverty. Expenditure associated with environmental assets for climate or biodiversity reasons may change the extent and condition of environmental assets. The key to linking biodiversity and climate change expenditure to poverty is to consider how changes in the underlying environmental assets are impacting on different aspects of poverty. For instance, from a poverty perspective, outcomes may include the supply of and access to clean water, exposure to air pollution, exposure to flood and access to forest wood products for energy. Whereas from an environmental perspective, the outcomes may be viewed as changes in the condition of the lake or river supplying clean water, urban tree density to reduce air pollution, mangrove extent and condition to minimise exposure to floods and the condition and extent of forests that provide wood for energy.

Box 1 below provides a set of principles developed by the Australian Government, Department of Finance for application when reviews of government programs or activities are undertaken. When assessing programs or activities against the principles, evidence must be used to demonstrate whether or not the programs are an appropriate, efficient and effective way to achieve a Government's outcomes and objectives.

Box 1 Expenditure Review Principles[10]

1. Appropriateness

a. Activity is directed to areas where there is a role for government to fill a gap left by the market:

i. social inclusion – government activity should address social inequity by redistributing resources in ways that improve opportunity and support for individuals, families and communities, allowing them to participate in the economy and society consistent with the Government's social inclusion agenda; or

ii. market failure – government activity should address market failures by improving social and economic welfare through improved resource allocation, where the benefits of government intervention outweigh its cost (including in the provision of public goods, for example, in environmental sustainability, national security and defence); and

b. Activity is undertaken by the most appropriate level of government – whether expenditure is better undertaken by the Government or a lower level of government.

2. Effectiveness

a. Activities to have clear and consistent objectives and be effective in achieving their objectives and represent value for money for the expenditure of taxpayer funds; and

b. Activity involving tax expenditures or financial instruments (for example, guarantees, loans or investments) to demonstrate why an outlay program is likely to be less effective in achieving the activity's objective(s).

3. Efficiency

a. Government programs to be administered and delivered in the most efficient way achievable, taking into account both short and long term economic and fiscal consequences;

b. Activity targeting market failure in one market to not unnecessarily reduce economic efficiency in other markets; and

c. Consideration to be given as to whether part or all of the cost of a Government activity should be recouped directly from the beneficiaries of that activity.

4) Integration

a. Government agencies to be able to work together effectively to consistently deliver the Government's policy objectives within clearly defined lines of responsibility.

5) Performance assessment

a. Government activity to be subject to robust performance assessment and measurement.

6) Strategic Policy Alignment

a. Proposals to address whether the activity is consistent with the Government's strategic long-term policy priorities, in particular to areas that help sustain economic growth through improved productivity and participation.

10 https://www.finance.gov.au/budget/budget-process/expenditure-review-principles.html

Using the findings of the PER assessment above the following comments look at the review principles in Box 1. First, it is noted that there is not consideration of 'appropriateness' in the current PER however it is assumed that the government programs are in place to address social issues and address potential market failures. The issue of market failure and government expenditure review is more relevant to developed economies and is in place to ensure markets are not subsidised or supported inappropriately. However, from a government expenditure point of view in developing economics it useful to consider micro-economic reform to improve the allocation, pricing and access to environmental assets.

As noted above the PERs assessed above do not provide sufficient information (evidence) to support the analysis of effectiveness and efficiency. A number of the reviews noted the importance of 'integration' across government and the need to coordinate activities at both the national and local level. In some ways, the process of undertaking a PER by the countries indicates there is an attempt to undertake a government 'performance assessment'. The question remains as to whether they are robust and provide sufficient measures. Due to the intended link between government budgetary processes and PERs it could also be argued that the expenditure is strategically 'policy aligned'. In most instances, there is usually quite a lengthy coverage of government policies in the reviews but there is a lack of linking those government policies to expenditure effectiveness.

In the following three sections, the principles will be considered when describing the different approaches to expenditure reviews and comment provided with respect to each approach providing evidence. The principles of 'effectiveness' and 'efficiency' will be the focus with reference made to 'integration' and 'performance' assessment where useful.

5.1 Economic approach to public expenditure reviews

The focus of this section is to explore economic approaches to quantifying the impacts of expenditure to help inform future allocations and identify expenditure gaps. The application of economic principles, including wealth accounting, economic efficiency and cost effectiveness provides an opportunity to extend the current approach to conducting expenditure reviews. An economic efficiency approach focuses on the issue of resource scarcity and the optimal production and distribution or those scarce resources to achieve environmental and poverty related outcomes. There are a number of approaches to measuring efficiency including:

- Productive efficiency is when the maximum number of goods and services are produced with a given amount of inputs.
- Allocative efficiency is when markets use scarce resources to make the products and provide the services that society demands and desires.
- Dynamic efficiency refers to the introduction of new technology and working practises to reduce costs over time.
- Social efficiency is when externalities are taken into consideration and occurs at an output where the social cost of production equates to the social benefit.
- Distributive efficiency is concerned with allocating goods and services according to who needs them most, an equitable distribution.

From an economic point of view, all forms of efficiency are relevant and pursued by government agencies. However, to ensure government funds are expended efficiently and the greatest level of outcomes are achieved, productive efficiency is generally the area of focus. The World Bank Independent Evaluation Group (WBIEG) defines efficiency as the extent to which a program has converted or is expected to convert its resources/inputs (such as funds, expertise, time, etc.) economically into results to achieve the maximum possible outputs, outcomes, and impacts with the minimum possible inputs.[11] The WBIEG approach is essentially focusing on productive efficiency. This approach to defining and measuring efficiency is quite different from current PERs which tend to focus on the fiscal responsibility.

Based on the PER review above it appears they interpret fiscal responsibility as a form of cost effectiveness. For instance, many of them assessed whether a government agency has spent the funds allocated to a biodiversity or

11 World Bank (2007) Sourcebook for Evaluating Global and Regional Partnership Programs, Indicative Principles and Standards, Independent Evaluation Group.

climate program and if all funds have been expended in the assigned time then the PER would assess the government agency to have spent the money responsibly and being cost effective. An economic approach to cost effectiveness on the other hand focuses on the per unit outcomes for dollars spent and providing measures of the relative cost of outcomes for alternative government programs.

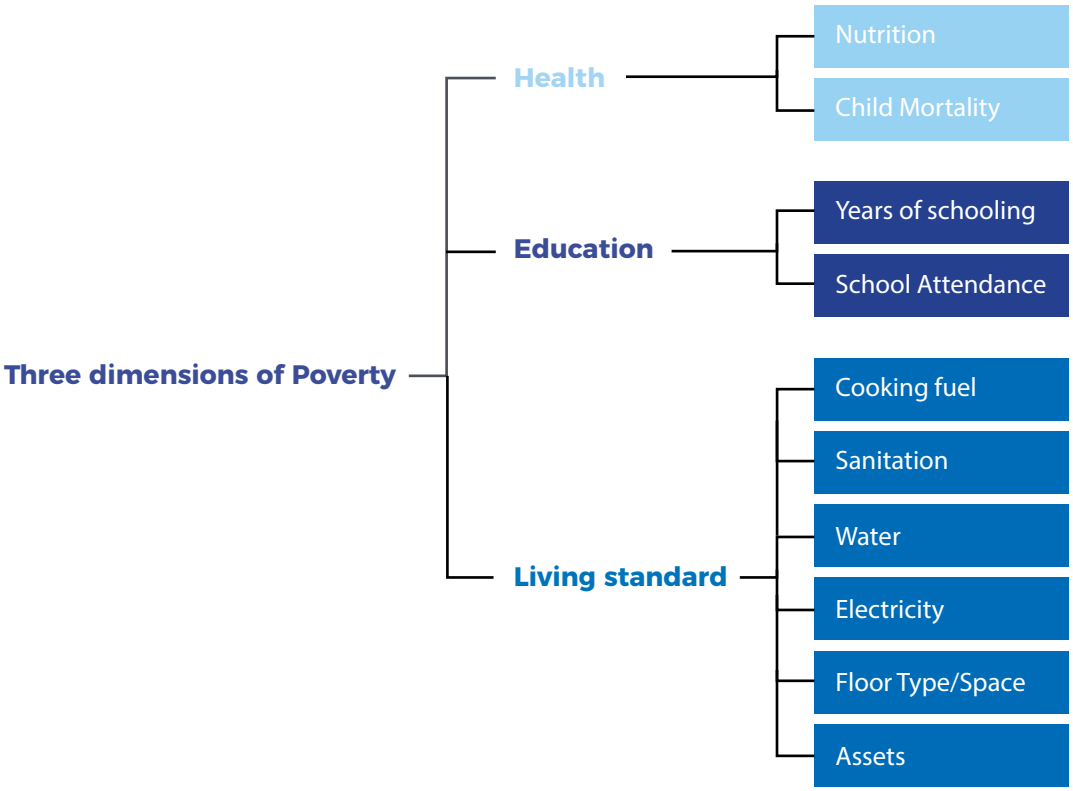
Productive efficiency focuses on the efficiency of a specific program whereas cost effectiveness takes the results of each programs productive efficiency and compares them from a cost per unit point of view (ie. the relative cost per unit outcome from each program). Cost effectiveness analysis is an important extension to an expenditure review that would allow users to understand how well respective programs are performing compared to other programs and approaches. The WBIEG define cost-effectiveness as the extent to which a program has achieved or is expected to achieve its results at a lower cost compared with alternatives. Shortcomings in cost-effectiveness approaches occur when a program is not the least-cost alternative or approach to achieving the same or similar outputs and outcomes. Thus, it important to compare cost effectiveness across programs.

For the both the cost effectiveness and economic efficiency analysis to be worthwhile (within and between countries) a coherent framework for data collection and collation is needed. In other words the evidence base must be consistent and integrated to allow for a comparison across effectiveness and efficiency results. In section 5.3 below an accounting approach is discussed to guide the collection and collation of data to address both the need to extend the expenditure review process and enable effectiveness and efficiency analysis to be undertaken.

5.2 Indicator approach to public expenditure reviews

Another approach to describing the links between poverty and the environment is the use of indicators or indices. In general indicators are not used to analyse government expenditure, however they are often used to indicate whether there have been changes in poverty (environment) and by analogy are used make arguments are made for more or less government funds depending on the direction of the indicator (up or down). Figure 1 below is an example of an MPI that includes health, education and living standard indicators. Within each of the indicators there are sub-indices, for instance the health indicator includes indicators on nutrition and child mortality.

Figure 1. Multi-dimensional poverty index (MPI)



Generally, MPIs make reference to elements of the environment but they cannot be used to understand the causal links between the environment and poverty to inform policy and decision making. For example, in Figure 1 above, the environment may be implicitly recognised in the sub-indices of water and assets, but it is not clear how the quality of environmental assets or access to them is taken into account nor are the linkages between environmental indicators and other dimensions of poverty made apparent.

There are efforts underway to incorporate additional environmental factors into an MPI framework and Human Development Indices (HDI) such as a "green HDI". However, even if additional indicators or sub-indicators are incorporated to reflect the environmental concerns of the poor, there is no underpinning rationale for the selection and weighting of these indicators within the overall index (a problem that besets most composite indicators). As a result, interpretation of the results and the ability to use the information to inform policy responses and link with underlying environment assets is limited.

More recently work undertaken by Thiry, Alkire et al. 2017[12], with support from PEI, has offered an approach to extending current approaches to multidimensional poverty measurements to include environmental deprivations. Thiry et al note there is no widely used multidimensional poverty measure that identify the socio-economically poor that are affected by environment and natural resource (ENR) issues. They go on to highlight the need for georeferenced data to observe and understand environmental risk and the need for it to be integrated and overlaid with poverty data. A key challenge that is preventing the implementation of an MPI that includes ENR is the lack of spatial coherence in data collection that allows for the alignment of both poverty and environmental data in a systematic manner. In earlier work they describe this as the 'units problem' which requires identifying how spatially explicit changes in an environmental asset (say extent of a forest, or soil degradation) can be linked to the impacts on the poor.[13] In their recent work, they go on to suggest there is a need for new conventions to prepare environmental data and sensitivity tests to determine the impacts of including environmental data in an MPI on final MPI results.

At the aggregate level MPI may be useful in providing information on general trends in poverty and if ENR is included they may also provide information on the links to the environment and how it is driving changes in the MPI. The MPI may then be used to guide or target specific areas for further detailed analysis.

The following section will discuss how an accounting approach can be used to provide a data set for the development of ENR extended MPIs. The accounting data set is useful for improving multidimensional poverty measurements because it will allow for the incorporation of environmental data in a systematic manner and deal with the spatial unit's issue but it is still unlikely that an extended multidimensional poverty measurements can play a role in expenditure reviews.

5.3 An accounting approach to public expenditure reviews

In 2016, the Poverty Environment Initiative developed a discussion paper that looked at using the SEEA as a guide to measuring the links between poverty and the environment. The report titled Poverty Environment Accounting Framework (PEAF)[14] is an application of the accounting principles described in the System of Environmental-Economic Accounting (SEEA) to advance the measurement and analysis of the Poverty Environment Nexus (Eigenraam 2016, UNDP-UNEP PEI). The PEAF is an integrating framework for poverty-environment data, information and statistics can be used to help understand how effective institutional policies and programs are at addressing the PEN, improve and support the application of extended MPIs. The information set strengthens the ability of institutions to evaluate poverty-environment related policies and programs in a systematic and coordinated manner.

The key feature of the SEEA, and in turn the PEAF extension, is the spatial linking of environmental assets to people (specifically those in poverty) and the services they receive from them (see Figure 2). In the core accounting model shown in Figure 2 below the benefits from environmental assets are aligned with the beneficiaries, in this case those in poverty. The data associated with both the assets and the beneficiaries are spatially explicit so the links between the assets and poverty can be analysed in an integrated and systematic manner.

12 Thiry, G., Alkire, S., Schleicher, J (2017) Incorporating environmental and natural resources within analyses of multidimensional poverty, Oxford Poverty and Human Development Initiative (OPHI), Department of International Development, University of Oxford

13 Alkire, S., J. E. Foster, S. Seth, M. E. Santos, J. M. Roche and P. Ballon (2015). Multidimensional Poverty Measuremnet and Analysis, Oxford University Press.

14 http://www.unpei.org/latest-news/data-crunch-how-do-we-measure-the-complicated-relationship-between-poverty-and-the-environment

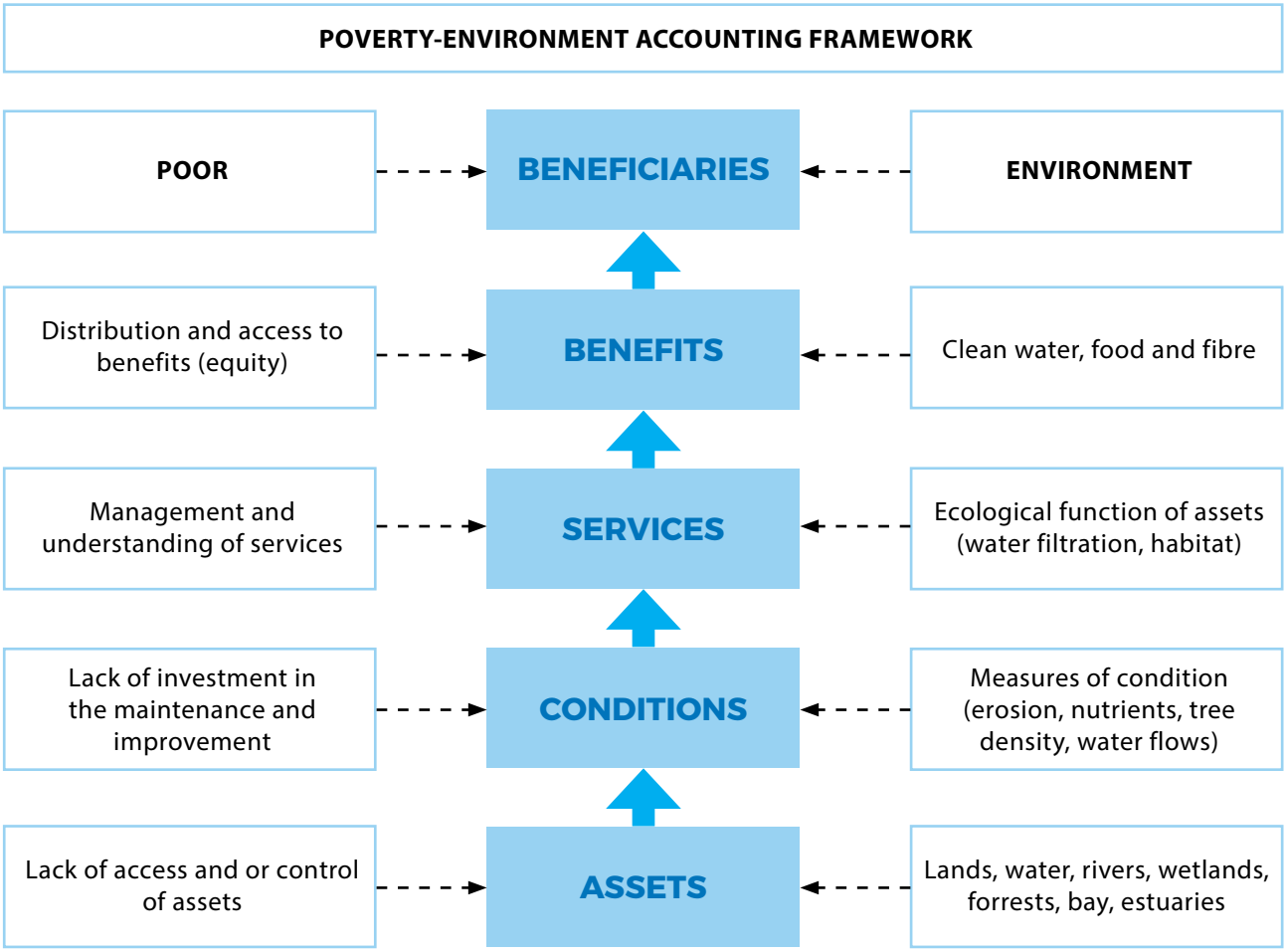
Figure 2 Environmental-Economic Accounting – Core Model

Current expenditure review approaches infer outcomes by assigning weights to the environment and climate change expenditure. For instance, for a given level of expenditure by government current PER approaches may infer that 20% of the expenditure is linked to poverty outcomes and the remaining 80% is linked to environmental outcomes. They do not make the explicit link between the benefits received from an environmental asset and the asset's extent and condition. They do not provide empirical information on changes in environmental assets and benefits which an accounting approach is designed to do. In the following sections, further detail is provided to show how a poverty-environment accounting approach can be used to provide integrated estimates of environment, climate and poverty outcomes that result from government (or private) expenditure.

6. Poverty-Environment Accounting Framework (PEAF)

In this section, the PEAF is used to guide the accounting links between poverty and the environment. Figure 3 below shows how the PEAF is used to make the link between the poor and the environment. In line with the SEEA EEA, the foundation of the PEAF is the spatial units of environmental assets. It is the access to, and management of, spatial areas – i.e. specific environmental assets including land, ecosystems, rivers, wetland, forests - by people, both the poor and the wealthy, that underpins the link between the environment and human activity. By framing the poverty-environment nexus in terms of spatial areas, the accounting framework provides a means by which a wide range of data can be integrated. Using estimates of environmental asset extent, condition, services and benefits elements of the accounting core model, the PEAF is used to produce basic data tables and accounts to support analysis of alternative management and policy approaches to improving the condition of environmental assets and reducing levels of poverty.

Figure 3 Poverty-Environment Accounting Framework (PEAF)



6.1 Environmental Assets

It is critical to understand where the poor and natural resources are located. The PEAF incorporates information on the location of environmental assets and their condition which can be used to quantify the benefits (food, fibre, etc.) that assets provide. Location is also an important factor or driver of poverty in terms of geographic distribution of assets and the access the poor may have to them. Asset location can be linked to the spatial distribution of poverty (e.g. in terms of the location of numbers of people below certain income levels) to assess potential impacts on access, common property issues, travel and mobility in times of hardship and stress and importantly the substitutability of environmental assets in a spatial context. For instance, environmental accounting of assets can be used to assess if there a sufficient number and extent (say forest areas) to provide food and fibre without any one asset being overused.

PEAF accounts that consider location can also be used to understand rural-urban migration patterns and potential drivers, such as situations in which rural environmental assets are being degraded or otherwise used unsustainably which may be driving migration to cities. Alternatively, the accounts can focus on urban areas and account for locational changes in urban amenity linked with environmental changes including air and water pollution and health impacts.

By combining the spatial location of assets and poverty, it is possible to develop a spatial map that shows the distribution and condition of assets and the location of the poor. This information can be used to help understand how distance from environmental assets and location impact on multiple dimensions of poverty.

6.2 Environmental Asset Condition

Measures of environmental asset condition (quality) are essential to understanding the capacity of assets to provide services and benefits. The PEAF incorporates condition accounts at a spatial level and reports on the quantity of benefits (goods and services) being provided by environmental assets.

Environment asset condition accounts can be used to highlight measures of degradation and report on changes in environmental assets due to human use and or changes due to natural disasters (e.g. flood, cyclone, drought). This information can then be used to quantify the three key relationships between poverty, biodiversity and climate.

6.3 Ecosystem Services

By combining information on asset extent (size) and condition it is possible to develop estimates of ecosystem services including:

- Provisioning services which reflect material and energy contributions generated by or in an ecosystem, for example a fish or a plant with pharmaceutical properties.
- Regulating services result from the capacity of ecosystems to regulate climate, hydrological and bio-chemical cycles, earth surface processes, and a variety of biological processes. These services often have an important spatial aspect. For instance, the flood control service of an upper watershed forest is only relevant in the flood zone downstream of the forest.
- Cultural services are generated from the physical settings, locations or situations which give rise to intellectual and symbolic benefits that people obtain from ecosystems through recreation, knowledge development, relaxation, and spiritual reflection. This may involve actual visits to an area, indirectly enjoying the ecosystem (e.g. through nature movies), or gaining satisfaction from the knowledge that an ecosystem containing important biodiversity or cultural monuments will be preserved.

Different ecosystem services provide different types of benefits. For instance, a healthy wetland can provide clean water (regulating) that is of benefit to those consuming water, because they don't have to buy it. Another common example is a forest grows wood (provisioning) that is harvested by people and burnt for energy in houses.

6.4 Benefits provided by environmental assets

Ecosystem services are the key link to the benefits people gain from environmental assets. Government investments in environmental assets to increase their area or condition is key to changing the supply of ecosystem services. How the ecosystem is used and managed also influences the future flow of ecosystem services. For instance, if too many trees are harvested for energy purposes at some stage the forest will degrade and not be able to provide ongoing services.

As noted above the achievement of PEN over time is an investment path problem. Using the core accounting model of the PEAF the following information can be systematically collected and collated to support decision-making and optimise the investment path over time.

- Measures of the physical environment (land, water, forests) that can be extended and linked to the impacts of economic and political choices on the environment and poverty outcomes.
- Clearly defined units of measurement to ensure consistent and coherent measurement of the asset base including the stock and condition of assets. The units' approach needs to be amenable to observing, reporting and accounting for change over time (undertake analysis of dynamic intergenerational change).
- The information set needs to be amenable to producing indicators and quantifiable targets, undertaking inter-temporal cost-benefit analysis and be integrated at relevant scales (local versus national) to meet user needs.
- Spatial dependencies need to be explicitly incorporated to ensure outcomes and policy goals can be jointly analysed for both the environment and poverty.

Looking back at the economic and indicator approaches the PEAF can be used as the framework to collect and collate data in an integrated and coherent manner. Further the data can be used to undertake cost effective and efficiency analysis. The next section outlines an integrated approach to undertaking an extended PER using the PEAF and environmental-economic accounting principles more generally.

6.5 An integrated approach to Public Expenditure Reviews using the PEAF

National and sub-national governments have many assets they need to manage and invest in including environmental (natural), social[15] and economic (includes built assets like roads and infrastructure). Generally, they create line agencies (government departments) that focus on each of these assets and take responsibility for their maintenance and investment. For instance, agencies generally exist for land planning, agriculture, environment, social security, health, forestry, marine, minerals etc. It is through these agencies that economic and political choices are made and investment programs are delivered.

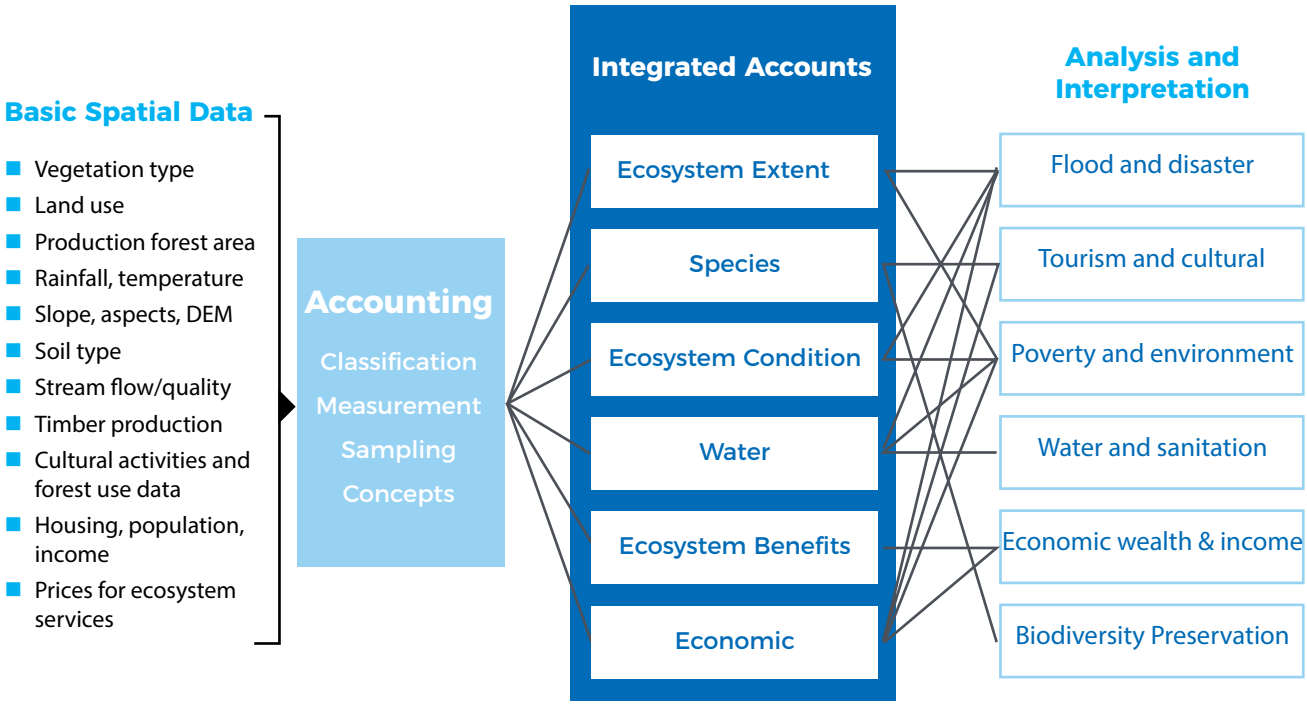
Central agencies, in contrast to line agencies, generally include treasury, finance and national planning authorities that are responsible for allocating resources across the line agencies to achieve national objectives. A key challenge for central agencies is how to allocate funds across line agencies and for line agencies the challenge is how to invest effectively to achieve national objectives cost effectively and efficiently and generate the greatest benefits to the society as a whole within the earth's carrying capacity and without compromising the ability of future generations to meet their own needs.

For both central agencies and line agencies there are also geographic considerations. For instance, they need to consider whether funding is spread evenly across a country or should be targeted to specific regions. The remainder of this section will focus on environmental assets and how agencies can use an accounting framework to gather data in an integrated manner to inform expenditure and budgeting processes.

A major challenge in integrating environmental issues into core economic decision-making and sectoral investment decisions is the fragmentation of environmental data across multiple agencies and the lack of coherent and harmonized collection and analysis of data that can be used to inform public policy performance assessment and investment decisions. Figure 4 below shows a conceptual model linking basic spatial data to analysis and interpretation by agencies via the Poverty-Environment accounting framework. In this conceptual model, the basic spatial data are sought from many agencies, academics and other institutions with the classification and collection undertaken in a coordinated and coherent manner. For instance, there is a clear understanding by all agencies about the classification of environmental assets, environmental condition, ecosystem services and the benefits and beneficiaries (See Figure 2 above – the core accounting model).

15 In a social context reference is commonly made to 'social capital'.

Figure 4 Conceptual model linking institutional analysis to spatial environmental data



7. Environmental accounting demonstration case studies

Building on the PEAF the following sections provide a series of examples aimed to guide the collection data by institutions and how the data is used in accounting and an analysis of efficiency and cost-effectiveness. For each of the examples below Table 3 provides an overview of the types of questions that need to be answered with respect to data collection with each question focusing on an element of the core accounting model.

Table 3. Example data

	Assets	Condition	Services	Benefits
Environmental data	What is the spatial extent of asset before and after the investment? Where are the assets located?	How has the condition of the asset (existing and new) changed?	How does the change in extent and condition of the asset impacts on ecosystem services?	What are the environmental benefits?
Social data	Who (and how many) were employed to deliver the program? What groups or industries are reliant upon asset as a natural resource?	Does a change in the condition provide benefits to people either directly or indirectly through changes in ecosystem services?	What are the ecosystem services that change as a result of the investment?	What are the benefits to society (individuals or groups) that result from the investment?

The questions in Table 3 above concerning environmental data help to understand changes in the endowment of environmental assets (or changes in wealth and value) and the state of the environmental assets (condition). For instance, an increase in the extent of an asset that provides benefits to society reflects an increase in the endowment of environmental assets. The level of change in asset extent, condition and services can be combined with the cost of an environmental program to calculate the return on investment. For instance, dollars per hectare change in extent or dollars per hectare change in condition of environmental condition. The return on investment calculations are important for comparing between programs and across regions were different programs are delivered. Further, there are many different approaches to delivering programs (e.g. removing weeds and pests to improve condition, or providing nutrients to improve condition) and having a single measure of return on investment allows for comparison.

Calculating the dollar cost of a change in an asset, say a condition metric, does not in any way imply that is the value (price) of the asset. It is a measure of how much it costs to achieve a given change and can be used for comparative purposes across different projects and programs. This principle can also be applied to change in say cultural values, if a metric of cultural significance could be developed and applied to environmental assets in a meaningful and replicable manner.

Finally changes in asset extent and condition can be used to estimate (model) changes in environmental benefits. The benefits are linked directly to those that are benefiting, the beneficiaries. Beneficiaries may include both the poor and non-poor. Answering this question is a part of the social data collection process.

In the context of the PEAF the social data questions are strongly tied to the location of the environmental assets. If there is an increase in the endowment of an environmental asset, are the beneficiaries close to the asset or separated by some distance? For instance, an increase in the area of mangroves is more likely to have many local beneficiaries

whereas an increase in forests may have both local beneficiaries and others that are distant to the forest (downstream).

The key to environmental and social data collection is to ensure spatial specificity is understood and maintained, following the conceptual model above across agencies. The following examples apply equally to environment or climate expenditure. For each of the examples below the core accounting model is applied and cost effectiveness and efficiency discussed.

7.1 Mangrove Case Study

In this example, an investment has been made in the expansion and improvement of coastal mangroves. The motivation for the investment could be viewed as either biodiversity or climate. From a biodiversity point of view the mangroves are an important habitat for species and a breeding ground for many marine species, and from a climate point of view the mangroves protect the coastline from rising sea levels, storms, floods and coastal erosion and act as an important carbon sink.

In this example, there are 3 investment programs, A, B and C valued as $2m, $2m and $3m, respectively. The table below provides summary data on the environmental impacts of each investment. Each program has contributed to an increase in the extent of mangroves and in some instance an improvement in their condition (Programs B and C).

There are about 60 species of trees and shrubs belonging to about 20 genera in over 15 families that are recognized throughout the world as being mangrove.[16] For this example, the mangrove type is assumed to be similar so the change in extent of the mangroves can be compared. However, it may be useful to differentiate type in a detailed study since different mangrove species will provide different ecosystem services (wood versus flood protection). Generally, mangroves are included in "land accounts as forest cover" or "forest accounts as mangroves" or in ecosystem accounts with all species reported.

Table 4. Environmental outcomes for investment in coastal mangroves

	Mangrove asset extent (before/ after)	Mangrove condition (before/after[a])	Change in ecosystem services	Change in benefits (before/after)
Program A ($2m)	(100ha / 120ha)	(0.7 / 0.7)	Storm and flood protection Habitat for prawn and fish breeding	Probability of loss of lifeb in flood and storm event (70% / 60%) Annual prawn and fish catch (80t / 85t)
Program B ($2m)	(50ha / 70ha)	(0.3 / 0.4)	Habitat for prawn and fish breeding	Annual prawn and fish catch (60t / 72t)
Program C ($3m)	(300ha / 310ha)	(0.5 / 0.7)	Storm and flood protection Habitat for prawn and fish breeding	Probability of loss of life in flood and storm event (85% / 90%)

(a) The score ranges from zero to one, reflecting poor to very good condition

The condition measure is also consistent across each program and used to estimate changes in ecosystem services. For this example and others below the ecosystem services are described qualitatively, however it is possible (in most

16 P. B. Tomlinson (1986) The botany of mangroves. New York, Cambridge University Press

instances) to model and report them empirically. For instance, the extent (area) of mangroves may be combined with a condition measure (say density and canopy cover) to estimate flood protection in terms of lowland inundation. Similarly, information on lowland inundation can be linked to probabilities of flood and in turn linked to the number of people (or villages) affected (protected). The changes in prawn catch are also directly linked to the extent and condition of mangroves which could be measured in economic terms or in terms of food value depending on the use of the catch and the context. In many instances the catch may not be sold for economic gain but used locally by the poor as the main source of food, the most appropriate measure may then be "food value", protein.

If an expenditure review approach were followed the results would be that total environmental expenditure was $7m, the government was accountable and spent of the money and the projects were associated with poverty outcomes. The poverty outcomes for projects A, B and C could be ranked High, Low and Medium, respectively. The qualitative ranking may vary between review processes based on their views of the benefits and how much information they have at hand. Normally in a PER the quantitative data in the table would not be available (other than the $7m) and there would only be qualitative data describing the benefits as listed in the last column.

By collecting spatial data on mangrove (asset) extent and condition and quantifying the benefits it is possible to calculate a return on investment and undertake an analysis of cost-effectiveness. There are several approaches to calculating the return on investment using the data in the table:

- Area based return of investment (ROI): Program B is the lowest cost, or highest return on investment per ha.
- Condition based ROI: Program C is the lowest cost, or highest return on investment per unit change in condition.
- Services based ROI: a qualitative assessment of changes in services would suggest Program A offers the greatest ROI because it provides changes in both flood protection and fish and prawn breeding.
- Benefits based ROI: Program A is the lowest cost for a reduction in the probability of storm and flood events. Program B is lowest cost for increases in the prawn and fish catch.

The decision to use any one of the ROI approaches or a combination is based on the objectives of the program and policy priorities. However, the collection of additional spatially specific ecosystem asset data means making a choice between programs can be done more transparently. Further, the data can be used to understand the ROI from future programs of a similar nature and located in similar spatial circumstances.

The table below provides a more in-depth analysis of the social outcomes associated with the changes in the mangrove assets. Poverty outcomes can be defined here as contribution to income, basic needs (food, energy), capacity (education – skills, knowledge, technology transfer) and resilience to natural hazards.

Table 5. Social outcomes for investment in coastal mangroves

Social Outcomes	Population	Change in Capacity building	Benefits (before/after)
Program A ($2m)	Several villages = 25,000 people (10% are classed as poor and most are living in low lying areas prone to flood and storm events)	Educated 15 people on mangrove planting	Probability of loss of life[a] in flood and storm event (70% / 60%) Annual prawn and fish catch (80t / 85t)

(50ha / 70ha)	Small village = 5,000 people 50% of the village rely upon the mangroves for their protein source (fish and prawns) 12% of the village considered poor	Educated 50 people on mangrove planting and pest control in mangroves	Annual prawn and fish catch (60t / 72t) The prawn and fish catch are one of the main sources of food and income for the village All of the poor rely directly on the prawn and fishing industry either for employment or for food when caught directly
Program C ($3m)	Many villages = 75,000 people (10% are classed as poor and 20% are living in low lying areas prone to flood and storm events)	No one was educated but local people we employed to undertake the work	Probability of loss of life in flood and storm event (85% / 90%)

(a) Percentages measured per 1,000 people

If the ROI were based solely on poverty or social outcomes Program A is the lowest cost per the number of people protected in low lying areas (2,500 in Program A and 1,500 in Program C). From a capacity building and longer-term sustainability point of view Program B has educated the greatest number of people. Program C on the other hand spent most of the funds locally but did not provide capacity building. Program B ROI could also be measured based on the number of people that benefit from increases in local food sources. Increased annual prawn and fish catch benefits both the poor and those selling the catch to generate income.

From an accounting point of view the land accounts (change in extent of mangroves) can be linked to change in social outcomes (people/villages protected). Each program can be compared for effectiveness using change in extent, change in condition, change in benefits or change in people protected. The measure used may depend on the agency undertaking the project/s. For instance a social program may use the change in people protected whereas an environmental agency may use the change in extent of mangroves. The key point is that the information set collected in fully integrated and can be used for many purposes, following the conceptual model presented in Figure 4 above.

This information can be used to inform pro-poor policies and expenditure (investment). If there are other small villages like those impacted by Program B then it would be possible to use the cost and ROI data to estimate the level of investment required. This is often referred to a "gap" analysis. What is the gap in financing needed to ensure the poor in small villages have access to a regular food source from local mangroves? Because the data for both the villages and the ecosystem asset, mangroves, are spatially linked it is possible to clearly communicate the benefits of future investments and they can be spatially targeted to generate the greatest outcomes. The outcomes which can be defined according to country contexts but would typically focus on social equity, environmental conservation and economic sustainability.

7.2 Forest management and restoration

Many countries have land management and restoration programs to mitigate greenhouse gases and protect and conserve habitat for rare and threatened species. The Babel provincial government have a large forest and peat program that includes the control of land and forest fires, management of network systems, water management, forest and land rehabilitation, management of industrial, plantation forest, community forest, combating illegal logging, prevention of deforestation and empowering communities. The expenditure review indicated that expenditure had increased and there were high levels of realisation (a measure of fiscal compliance). However, the information

contained in the Babel expenditure review is not sufficient to calculate a ROI. The following example can be used to provide guidance on the type of data that may be collected in the future in order to calculate ROI.

In this example, there are 3 forest investment programs, A, B and C valued as $5m, $5m and $5m, respectively. Both program A and C focus on planting and extending the area of native forests to improve species and water quality. Program C focuses on extending the area of plantation forests for future harvesting and income but there are also benefits in water quality and carbon sequestration. The table below provides summary data on the environmental impacts of each investment.

In accounting terms, the results are similar to those for mangroves. Generally, forests are included in "land accounts as forest cover" or "forest accounts as forest type" or in ecosystem accounts with all forest species groups reported. Forest extent accounting is more complex than mangrove accounting since there are many for forest species groups and larger number of ecosystem services and a greater range of benefits. The changes in ecosystem services and benefits is further complicated by the location of the forest in the landscape having the ability to provide services and benefits both in situ and ex situ.

Table 6. Environmental outcomes for investment in forest management and restoration

	Mangrove asset extent (before/ after)	Mangrove condition (before/after[a])	Change in ecosystem services	Change in benefits (before/ after)
Program A ($2m)	(1000ha / 1200ha) Native forest	(0.7 / 0.7)	SIncreased soil retention Increase habitat Carbon sequestratio	River health (water quality) (20t/y – 2t/y) Increase in species (rare bird) (500t/y – 550t/y)
Program B ($2m)	(1000ha / 1500ha) Plantation forest	(0.9 / 0.9)	Increased soil retention Carbon sequestration	Annual prawn and fish catch (60t / 72t)
Program C ($3m)	(1000ha / 1300ha) Native forest	(0.5 / 0.7)	Increased soil retention Increase habitat Carbon sequestration	River and dam health (water quality) (50t/y – 10t/y) Reduced risk of species loss (500t/y – 550t/y) Increase in firewood

Following an expenditure review approach, the total expenditure is $15m and there were both climate mitigation and biodiversity benefits. From a poverty or social point of view all three programs had an impact through improvements in forest health (food and fibre) and river health (water quality). It is difficult to provide a ranking without knowing what the relative importance is for each of the social outcomes.

We can calculate a number of ROIs using the data in the table:

- Area based ROI: Program B is the lowest cost, or highest return on investment per ha of forest area increase.
- Condition based ROI: Program C is the lowest cost, or highest return on investment per unit change in condition.
- Services based ROI: a qualitative assessment of changes in services would suggest Program C offers the greatest ROI because it provides changes in the greatest number of services.

- Benefits based ROI: Program B is the lowest cost for each unit of carbon sequestered over time. However, this is coming from a non-native forest say may not be seen as having biodiversity benefits. All three are providing river health benefits which link to biodiversity benefits with Program C providing the greatest ROI tonnes per year erosion reductions.

A key outcome for current expenditure review processes is the possibility to improve their application through the collection of additional spatially specific data. It can be seen from the data in this example that there were quite large reductions in erosion from Program C on a per annum basis because the location was in the mountains where the soils were very susceptible erosion. In the table below the social outcomes of the programs are listed.

Table 7. Social outcomes for investment in forest management and restoration

Social Outcomes	Population	Change in Capacity building	Benefits (before/after)
Program A ($2m)	Small village = 3,000 people (10% are classed as poor and most are living in low lying areas prone to flood and storm events)	Education (native forest management) and employment of local villagers Tourism employment	Drinking water quality (Expenditure on bottled water, $1000/y - $200/y) Flood protection Increase in tourism income to view rare bird ($5,000/y - $7,000/y)
Program B ($2m)	Nearby towns (using water from a local dam)	Not applicable – all work was undertaken by professional contractors from another area	Drinking water quality (Reduced water filtration costs for nearby towns, $1000/y - $950/y per ML)
Program C ($3m)	arge village = 25,000 people (10% are classed as poor and 70% use wood for heating and cooking)	Education (native forest management) and employment of local villagers	River and dam health (water quality) (50t/y – 10t/y) Reduced risk of species loss (500t/y – 550t/y) Increase in firewood

If the ROI were based on social outcomes they could be ranked by changes in drinking water quality, tourism income to locals or increases in firewood for energy production. From an accounting point of view the changes in forest extent for Program A are providing benefits, ex situ, to the poor in low lying areas subject to flood and storm events. Further, since the extent, condition and ecosystem service accounts are based ecological principles and applied consistently across all programs it is possible to use them for a number of different policy purposes following the conceptual model presented in Figure 4 above.

The examples above have focused on site specific examples, whereas PER are normally done at the national and sectoral level. However, the aggregate data provided by those approaches do not provide information about regional and site-specific outcomes. If data were collected like the examples above at the site level it is always possible to aggregate that data to the national and sectoral level. Further if programs and projects are designed at the outset to collect and report data based on site level outcomes then reporting changes in environmental and poverty outcomes would be routine similar to the collection of other business accounting information currently collected.

8. Implementation of an integrated approach to PER using the PEAF

The results of the PER assessment indicate that current approaches to expenditure reviews do not provide information on cost-effectiveness or return on investment that can be used to assess the performance of government programs and whether they are achieving the Government's outcomes and objectives. Further, there is no evidence to suggest the reviews are linked or applied in budgetary processes in an ongoing and systematic manner. As a result, they do not effectively make the connection between environmental assets and poverty outcomes, and particularly how government budgets are impacting on those domains.

To move beyond the current PER approach, this paper proposes recognising that the achievement of PEN over time is an investment path problem which requires a temporal set of information for the purpose of investment analysis. Using the core accounting model of the PEAF, the information can be systematically collected and collated to support decision-making and optimise the investment path over time and hence make a clear connection between environmental assets and poverty outcomes.

8.1 Sustainable development and PEN as an investment pathway problem

Based on the discussion in this paper the following comments address each of the investment path challenges highlighted in the introduction.

- Sustainability in the context of the PEN encompasses more than the physical environment (land, water, forests) with the challenge being how to measure and report the impacts of economic and institutional (regulation, laws) choices on the poverty and environment outcomes.

  An accounting framework provides measures of the physical environment (land, water, forests) that can be extended and linked to the impacts of economic and political choices on the environment and poverty outcomes.

- The concept of sustainability is a dynamic intergenerational and inter-temporal notion. Therefore, investments made today need to incorporate future income and account for future impacts on the asset base in which investments rely upon (both natural and built). The challenge is how to specifically consider the extent and condition of environmental assets as key to understanding the PEN and the impacts of investments made today over different temporal scales.

  An accounting framework clearly defines units of measurement to ensure consistent and coherent measurement of the asset base, including the stock and condition of assets. The accounting units' based approach is amenable to observing, reporting and accounting for change over time and undertaking an analysis of dynamic intergenerational change.

- Traditional aggregate measures of wealth and income such as Gross Domestic Product (GDP) and Multidimensional Poverty Indices (MPI) do not reflect local conditions or address the spatial dependences between the environment and the poor. The challenge is developing an approach that can measure and report on local conditions and spatial dependencies an in an integrated and systematic manner.

  An accounting information set is suited to developing measurable indicators and quantifiable targets, undertaking inter-temporal cost-benefit analysis and be integrated at relevant scales (local versus national) to meet user needs.

- The analysis of the links between the environment and social wellbeing has been undertaken at the aggregate level lacking spatial specificity. The abstract concept of sustainable development needs to be operationalised, which raises the challenge on how to develop measurable indicators and quantifiable targets for inter-spatial cost-benefit analysis and a framework for coherent and integrated monitoring and reporting that is relevant and scalable (local versus national) to stakeholder needs.

An accounting approach incorporates spatial dependencies explicitly to ensure outcomes and policy goals can be jointly analysed from environmental, climate and poverty perspectives.

Once applied a clearly defined and integrated set of accounting data can be used to develop consistent and coherent indicators to track and monitor the spatial distributional impacts of the government expenditure in environmental asset management (income, job, health, resilience) across income groups, gender, age or disadvantaged areas.

Finally, an accounting approach can be used to understand the link between changes in the wealth or endowment of environmental assets and changes in those dependent upon its existence. Understanding this linkage is key to achieving both sustainability and PEN goals.

- Expansion of human choices and well-being will need to be within planetary boundaries, which leads to the need to measure and report on environmental thresholds. How to operationalize an approach to thresholds in terms of investment decision-making is another challenge in the discussion on poverty-environment nexus.

  Thresholds concerning the extent and condition of environmental assets are important to understand so that policies and programs can be put in place to prevent complete system failure. A key feature of the PEAF is that the design of the asset and condition accounts is based on ecological principles that can take into consideration ecological thresholds and the resilience of natural and social systems. However, further work is required to develop empirical measures and incorporate them explicitly into temporal measures of change in environmental assets and social health.

8.2 An outcome-based public expenditure reviews

Within an outcome based approach, three key relationships are evident: Environment-Climate, Environment–Biodiversity and Environment–Poverty. A common feature of these three relationships is the connection to environmental assets. Since expenditure associated with environmental assets for climate or biodiversity reasons may change the extent and condition of environmental assets, the key to linking biodiversity and climate change expenditure to poverty is to consider how changes in the underlying environmental assets are impacting on different aspects of poverty.

Within this broad policy context, the paper highlights how the PEAF can be used as a framework for multiple policy purposes. PEAF can provide the National Statistics Office and the Ministries of Planning, Finance and Environment with an integrated set of data and information for monitoring and reporting on poverty (environmental) policies and plans, and support monitoring of SDG implementation progress. Another potential application of the PEAF is producing a set of information to measure and report the cost effectiveness and efficiency across all forms of capital including environmental, economic and social.

The key difference of the PEAF from traditional approaches is the deliberate attempt to produce an information set that is inherently integrated and spatially specific. An integrated information set allows for the coherent quantification and empirical examination of the poverty-environment nexus (PEN), and can be used to inform policy and decision making – both from a planning, budgeting, investment decision-making, monitoring, reporting and performance assessment perspective.

Overall, by using an accounting approach to build an integrated and spatially explicit information set it is possible to undertake cost effectiveness and efficiency analysis of government expenditure. The case studies provide examples of the type of data that is useful to collect to undertake the analysis. The case studies can be used as a guide for future data collection but further detailed work is required to support capacity building for governments so the collection of data is seen as a standard part of program delivery. In this regard, it is observed that most countries collect data that is amenable to environmental-economic accounting but refinements are required in data collection and guidelines need to be developed to support publishing and collation.

At the aggregate level, the MPI may be useful in providing information on general trends in poverty and if ENR is included they may also provide information on the links to the environment and how it is driving changes in the MPI. The MPI may then be used to guide or target specific areas for further detailed analysis. The PEAF can provide foundational data for ENR extended MPIs. If the environmental-economic accounting principles are used to build a fundamental data set that is used in an ENR extended MPI and a modified PER approach, then both approaches can complement one another in government policy and programs. However, if an extended MPI uses or develops an

alternative approach to the collection of data on ENR there may be significant policy issues for both approaches and the transaction costs for government may increase substantially.

Indeed, by combining information from different accounts, a range of sustainability indicators can be developed, including an ENR extended MPI. For example, indicators can be derived that reflect the flow of services and benefits relative to the changing condition of environmental assets. Such measures can also be linked to spatial statistics on poverty to help inform the PEN in an empirical manner. The design of information produced using the PEAF explicitly recognises the importance of time series information to understand the current and future use of resources and to find pathways towards sustainable use. From a PEN perspective, understanding sustainability supports answering questions such as how the current flow of services and benefits can be sustained into the future; and whether the current rate of degradation can be sustained without investment in resource condition (or at what point an irreversible threshold may be reached). The PEAF provides a framework for the collection of data and information that can underpin an economic assessment of government expenditure, support the development of extended MPIs to include links to changes in the environment and extend current approaches to PER to ensure they provide information relevant to government budgetary and policy processes. These extensions to current measurement and analytical approaches are can further promote integrated policy making and investments that are necessary for achieving the Sustainable Development Goals.

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