Using InVEST to Establish Land-Based Carbon Offsets

InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) is a freely-available software tool developed by the Natural Capital Project – a partnership of Stanford University, The Nature Conservancy (TNC) and World Wildlife Fund (WWF) – and applied in more than ten places around the world. InVEST can be a useful tool for informing the design of land-based carbon offset projects that aim to provide additional 'co-benefits', by adding a multiple ecosystem service (ES) perspective to carbon accounting. This document provides guidance on how the current 'Tier 1' of InVEST can be used at each typical step of a land-based carbon offset project.

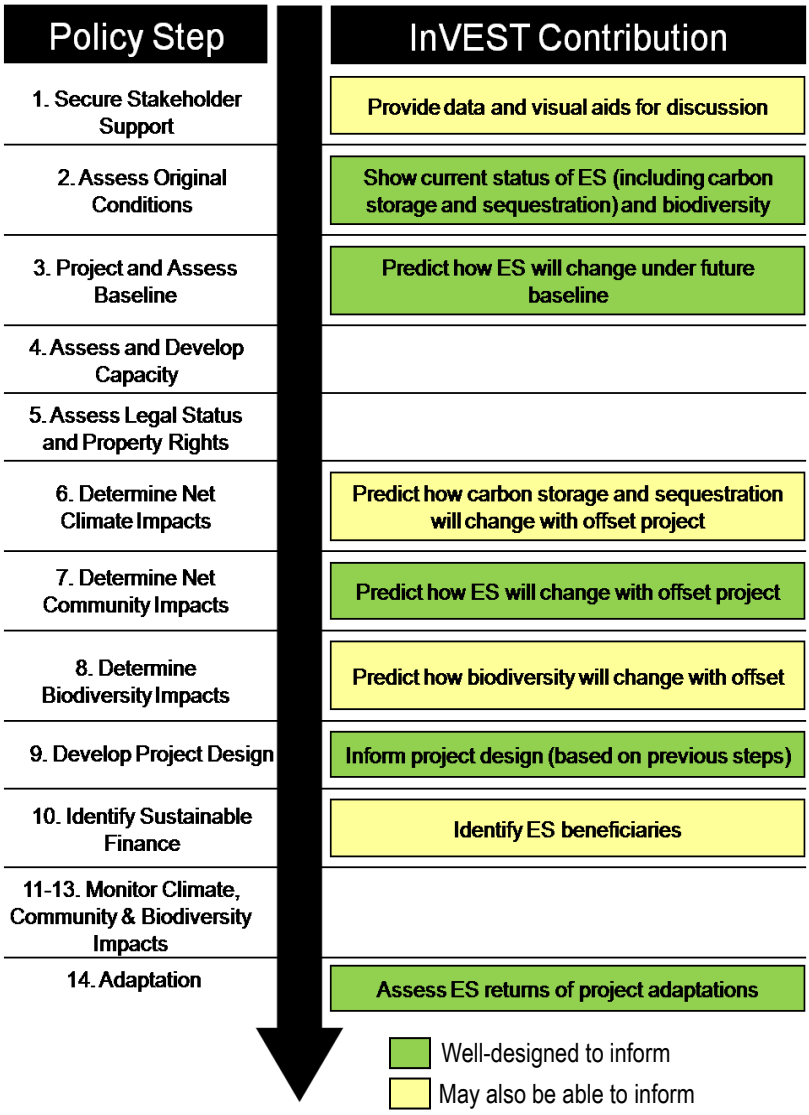
Voluntary carbon markets involve the buying and selling of carbon credits by organizations and individuals to offset their greenhouse gas (GHG) emissions and limit their contribution to climate change. A carbon credit represents an additional ton of carbon dioxide (CO_2) sequestered or not emitted. The voluntary carbon market is not regulated, and the credits are not used to meet any legally binding targets. However, various standards have been developed to assess the quality of carbon offsets and develop buyer confidence in the market. The voluntary market offers many land-based offsets that involve reforestation, agroforestry or reduced deforestation. Deforestation and other land use conversions account for 30 percent of GHG emissions (IPCC, 2007). Reducing land-based emissions can be a cost-effective method of addressing climate change (Stern, 2007).

InVEST and Carbon Offsets

Land-based carbon projects often provide benefits in addition to carbon sequestration, such as biodiversity conservation, diversification of agriculture, soil and water protection, employment, and ecotourism (CCBA, 2008). InVEST can help support land-based carbon offset projects by identifying how and where these 'co-benefits' from carbon investments can be maximized. Such information can be used to guide the selection of projects for investment, improve the efficiency of chosen projects and estimate the likely level of co-benefits, possibly allowing entry into a niche market for environmentally-friendly carbon offsets.

Given the wide range of formulations carbon offset projects can take, the contributions InVEST can make will vary. Nevertheless, InVEST is better suited to certain steps of land-based carbon offset projects than others. Here, we provide initial guidance on how InVEST can be used at each typical step (Fig. 1). We focus on offsets that provide co-benefits, following the standards of the Climate, Community and Biodiversity Alliance (CCBA). The aim is to give new InVEST users realistic expectations about when InVEST is – and is not – likely to be appropriate and helpful.

Figure 1. InVEST Contributions to Typical Carbon Offset Steps



Further Details on InVEST Contributions to Carbon Offset Steps

Step 1: Secure stakeholder support for offset project

Offsets affect a variety of stakeholders, who need to be informed and meaningfully consulted throughout the project. To ensure an offset project is acceptable and implementable, stakeholders should be involved in offset evaluation, selection, design, implementation and monitoring. Relevant stakeholders need to be identified and a process established for their engagement. Although this primarily relies on stakeholder engagement methods, InVEST can identify where ecosystem services are supplied and delivered, and how this is affected by different offset arrangements, giving a general indication of which stakeholders will be affected by proposed projects. InVEST's ecosystem service maps can provide visual aids and scientific information for stakeholder engagement, stimulating discussion.

Step 2: Assess original conditions in project area

This step involves gaining an understanding of current conditions in the project area. This includes collecting and analyzing data on biophysical parameters, such as vegetation types, levels of biodiversity, and provision of ecosystem services. It also includes data on local communities, such as socio-economic information and identification of areas that support the basic needs of the community or have cultural significance. This step may involve calculating the land-based carbon stocks currently in the project area to assess the business case for investment. InVEST can estimate the amount and distribution of carbon storage and sequestration along with other ecosystem services and biodiversity in the project landscape. However, depending on the project, additional methods, including field observations, remote sensing or more sophisticated models for individual services, may be required to provide the level of certainty and detail desired.

Step 3: Project and assess baseline

This step involves describing the expected future conditions of the project area in the absence of the carbon offset project, called the baseline. The baseline can then be used as a reference point to estimate the likely relative returns from the proposed project (see Steps 6, 7 and 8). A future land-use scenario must be projected to represent the landscape without the project. InVEST cannot currently generate these land-use projections. However, once a scenario map is created, InVEST can estimate the impacts on carbon sequestration, other ecosystem services and biodiversity. However, InVEST's biodiversity module is relatively simple; it proxies biodiversity through measures of habitat integrity and rarity, so alternative biodiversity assessment methods may be needed.

Step 4: Assess and develop capacity

Projects often include capacity building to ensure there is a strong team to implement and sustain the project, with skills in community engagement, biodiversity assessment, and carbon measurement and monitoring. InVEST is not suitable here.

Step 5: Assess regulatory requirements and property rights

The next step is to assess legal and regulatory requirements which affect the project's viability. Assessments of local property and use rights for the land and ecosystem services are usually required. The project should resolve any land tenure or illegal natural resource extraction issues. InVEST is not designed for this step.

Step 6: Net positive climate impacts

The land use changes resulting from the project must reduce greenhouse gas emissions over the project lifetime. Demonstrating this involves estimating the net change in carbon stocks, CO_2 and other GHG emissions from the project – equal to the difference between carbon stock changes with and without the project. The project must also quantify and mitigate any activities that might result elsewhere and increase GHG emissions (known as 'leakage'). InVEST can estimate the net change in carbon storage and sequestration in the project and surrounding area once an appropriate baseline has been determined. However, additional analyses – using field observations, remote sensing or more sophisticated models for individual services – may be required if a greater level of certainty is needed.

Step 7: Net positive community impacts

To meet CCB standards, a carbon offset project must demonstrate that it generates net positive impacts on the social and economic well-being of communities. It

should also ensure that costs and benefits are equitably shared among community members. This includes mitigating any negative impacts on the well-being of stakeholders outside the project area. InVEST is particularly useful at this step for estimating the net change in ecosystem services likely to result from the project. Many of these ecosystem services contribute to the social and economic well-being of communities, such as water yield for hydropower and irrigation, crop pollination, flood control, erosion control and non-timber forest products, among others. InVEST can assess ecosystem service impacts outside the project area, so long as the scale of analysis is large enough. However, additional analyses are likely to be required, for example to evaluate how the project is likely to affect the local economy and employment.

Step 8: Net positive biodiversity impacts

The project plan must demonstrate that it generates net positive impacts on biodiversity, mitigating any negative impacts that occur outside the project area. InVEST is suitable for estimating changes in biodiversity as a result of the project, including offsite biodiversity impacts so long as the scale of the analysis is large enough. However, InVEST's biodiversity models are relatively simple, based on habitat rarity and integrity; more sophisticated biodiversity models may be more appropriate in data-rich contexts.

Step 9: Project design

The next step is to design a project plan, laying out the objectives, and using all the previous steps to determine the activities that will help achieve those goals. All of the previous steps feed into the project design, to create an effective and sustainable project that meets standards effectively.

Step 10: Identify sustainable finance

Offsets require a source of sustainable finance. InVEST can assess where ecosystem services are delivered to, which can help determine the location of stakeholders who might have an interest in financing the offset for its additional co-benefits. InVEST analysis will need to be supplemented with additional social, economic and demographic information, and direct discussions with potential financiers to determine whether they are able and willing to fund the offset.

Step 11: Climate impact monitoring

Carbon pools, GHG emissions, and leakage must all be monitored over the project life time. InVEST is not a real time monitoring tool, and is therefore not suitable for this step.

Step 12: Community impact monitoring

Changes in social and economic well-being resulting from the project also need to be monitored. InVEST is not designed for this type of monitoring.

Step 13: Biodiversity impact monitoring

A plan must be in place to monitor changes in biodiversity resulting from the project. InVEST is not suitable here.

Step 14: Adaptive management

As carbon offset projects are monitored and evaluated, they can be adapted to improve performance to fit changing economic and environmental conditions. InVEST can be used to evaluate the ecosystem service impacts of alternative possible adaptations of carbon offset projects and thereby inform adaptive management.

Overarching Issues with Using InVEST for Carbon Offsets

Ecosystem services included: InVEST can model carbon storage and sequestration. However, its unique strength for informing carbon offset projects lies in its ability to model other ecosystem services that provide co-benefits. InVEST can model avoided reservoir sedimentation, hydropower production, open-access harvest (includes many non-timber forest products), timber production, water purification and crop pollination. Future releases will include models for flood control, irrigation water for agriculture, and agricultural production. InVEST also has a simple biodiversity module, that estimates habitat integrity and rarity as a proxy for biodiversity.

Scale: Many services in InVEST involve hydrologic processes that are best described at the sub-basin or larger scales. If hydrological services are important co-benefits, this may make InVEST inappropriate for small scales.

Relative vs. absolute values: Without calibration, InVEST is most useful for identifying where to focus carbon offset projects, based on relative contributions of ecosystem services across the landscape. However, if

InVEST models are calibrated and there is good correlation between modeled results and observations, InVEST can be used for carbon offset decisions based on absolute values.

Biophysical vs. economic terms: InVEST can quantify ecosystem services in biophysical terms (e.g. cubic meters of water), which can be useful for targeting offsets across landscapes. It can also estimate economic values, in dollar terms, using a range of techniques such as avoided damage or treatment costs and market valuation. Valuation can only be done once the biophysical parts of the models are calibrated to time series data. Given the simplifications in the biophysical and economic models, economic value estimates should be treated as first estimates only, for example, for gaining support for land-based carbon offset projects.

Time and resources required: The skill and data requirements for InVEST are relatively light. The scale, scope, and availability of data all affect the amount of time and capacity required. In general, it will take 1-3 people two months to a year to compile data and run the InVEST models. A full application of InVEST results within the context of carbon offsets will take longer. The team would need someone with basic GIS proficiency and may also require a hydrologist if hydrological co-benefits are important for the carbon offset. For more detail on data requirements, see the InVEST user's guide.

Temporal scale: The current InVEST hydrological models only provide estimates of ecosystem services on an annual average basis. When monthly or seasonal patterns in hydrological service provision are of interest, InVEST is not a useful assessment tool.

Further reading on InVEST and Carbon Offsets

The Natural Capital Project:	www.naturalcapitalproject.org
InVEST User's Guide:	http://www.naturalcapitalproject.org/InVEST.html
InVEST download:	http://invest.ecoinformatics.org

CCBA. (2008). Climate, Community, & Biodiversity Project Design Standards, 2nd ed. CCBA.

IPCC. (2007). Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. [Core Writing Team, Pachauri, R.K., and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland.

Stern, N. (2007). Stern Review on the Economics of Climate Change. HM Treasury, London, UK.

InVEST in Practice is a series of short introductory materials to show potential InVEST users how the currently available Tier 1 version of the InVEST tool can be applied to existing policy and planning processes. The guidance here is based on The Natural Capital Project's experiences developing and applying InVEST in more than ten places around the world. Each issue indicates how and when InVEST is likely to be helpful for each stage of a specific policy or planning context, and when it may be inappropriate. Our goal is to give users realistic expectations about the tool, based on the current understanding of its strengths and weaknesses. As more is learned about the tool through further testing, this guidance will be refined and updated. Every context is different. Experience thus far has shown that the applicability of InVEST to different decision contexts depends on the quality and availability of data and other ecosystem service tools, local modeling capacity, local institutional and governance structures and the policy time-frame. The guidance provided here should therefore be considered in light of the local context where InVEST may be applied. Additional tools and approaches will always be needed to complement InVEST when designing and implementing land-based carbon offset projects.

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