Using InVEST to Establish Biodiversity 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 used in more than ten places around the world. InVEST can be a useful tool for integrating ecosystem service considerations into biodiversity offsets. This document provides guidance on how the current Tier 1 of InVEST can be used at each typical step of an offset project.

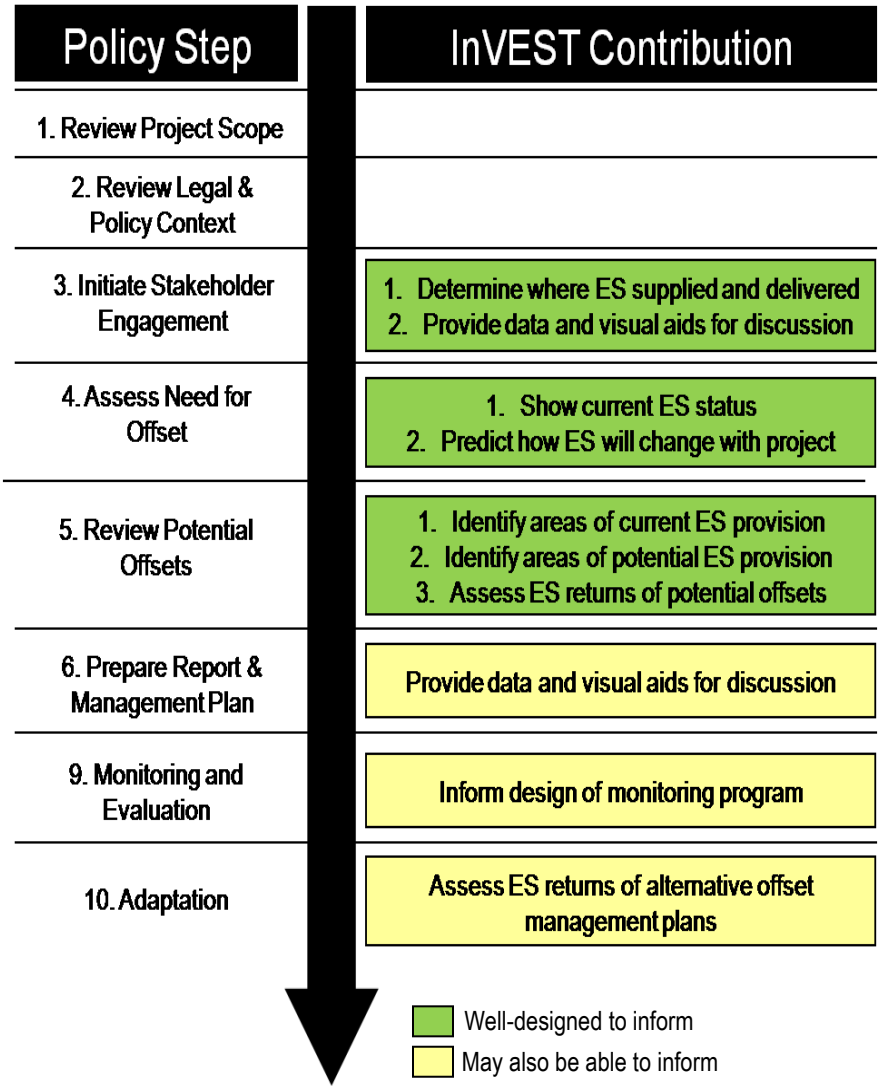
Biodiversity offsets are conservation actions intended to compensate for the residual, unavoidable harm to biodiversity caused by development projects, so as to ensure no net loss of biodiversity (IUCN and Insight Investment, 2004). Offset programs can be expanded to include actions that compensate for loss of ecosystem services, such as erosion control and water purification. Offsets follow a mitigation hierarchy, where harmful impacts are preferably avoided, then mitigated, and finally offset.

InVEST and Offsets

There is still debate over whether offsets discourage avoidance and mitigation of harmful biodiversity impacts. Further controversies occur over whether offsets lead to an overall loss of biodiversity and cause an unfair redistribution of benefits among stakeholders. Nevertheless, interest in biodiversity offsets is growing (Ten Kate et al, 2004) along with interest in expanding offsets to include ecosystem services. InVEST can help support the design and implementation of offset projects by identifying whether projects are likely to degrade ecosystem services, guiding selection of offset locations, and improving the efficiency of offset activities.

Offsets can vary in the ecosystem services included, their institutional arrangements and the scale of projects. Given the wide range of formulations offset projects can take, the contributions InVEST can make will vary. Nevertheless, InVEST is better suited to certain steps of offset design and implementation than others. Here, we provide initial guidance on how InVEST can be used at each typical step (Fig. 1). 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 Offset Steps



Further Details on InVEST Contributions to General Offset Steps

Step 1: Review project scope

This step involves assessing the purpose of the development project and the activities likely to take place throughout the project's lifetime. Specificity about the type, location, timing, frequency, and duration of activities enables later determination of the project impacts that need to be avoided, mitigated or offset. This step requires a detailed assessment of project plans in close consultation with developers. InVEST is not suitable here.

Step 2: Review legal and policy context

This step involves reviewing the laws, regulations and policies that shape an offset program, including policies of national and local government, financial institutions and companies. Regulations may specifically require offsets for projects in certain sectors or habitats, or require offsets in response to Environmental Impact Assessment and planning requirements. InVEST is not suitable for this step.

Step 3: Initiate stakeholder participation

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 the project and offset alternatives, giving a general indication of affected stakeholders. For example, InVEST can identify which reservoirs would be affected by projects that degrade upstream watersheds, thereby affecting erosion control and dredging costs. InVEST outputs, such as ecosystem service maps, can provide visual aids to communicate with stakeholders about how projects and offsets would affect them.

Step 4: Determine the need for an offset

This step involves determining whether – after avoidance and mitigation actions – a development project has remaining harmful effects that must be offset. InVEST is suitable for assessing the location and magnitude of biodiversity and ecosystem service impacts of a project, estimating the necessary level of mitigation and identifying the best places on the landscape to target offsetting to get the highest ecosystem service or biodiversity return. 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. The services InVEST can currently assess most reliably in an impact and mitigation context are avoided reservoir sedimentation, water purification (nutrients), carbon storage and sequestration, pollination (at small scales) and timber. InVEST cannot deal well in this context with water retention and water supply-related services when groundwater is a significant component of yield, or when impacts will largely affect groundwater or the balance between ground and surface water. It will be necessary to use additional assessment methods to estimate the total environmental impacts of projects. For example, coal mining causes large impacts on water quality from chemical point source pollution. The InVEST water purification model cannot represent these impacts or the possibility for their mitigation.

Step 5: Review potential offset locations and activities

If development projects still have harmful impacts after avoidance and mitigation actions, the next step is to identify locations and activities where these impacts could be offset. Regional plans are often used to identify available areas that are nearby and similar to the affected site. InVEST can determine locations where equivalent levels of ecosystem services are currently supplied compared to the affected site. It can also identify locations where similar levels of ecosystem services could potentially be restored and maintained through offset activities. If InVEST is going to be used to determine the amount of mitigation required, it should be calibrated with local time series data and reviewed by local experts. Alternative models, including collection of field-based observations, may be required to address the full set of project-related impacts and offsets. National Biodiversity Strategy and Action Plans should be consulted to identify conservation priorities. Social, economic and demographic information will also be required to assess how the offset will affect the distribution of benefits among different stakeholders.

Step 6: Prepare report & management plan

A report describes the offset location and activities, the resulting biodiversity and ecosystem service losses and gains for different stakeholders, and the fit with regulatory and policy requirements. InVEST does not itself generate reports, but InVEST's outputs, with additional analysis, can provide data and visuals, such as ecosystem service maps and summary tables. These visuals can stimulate discussion and dialogue on the final plan.

Step 7: Monitoring and evaluation

The long-term effectiveness of offsets requires that biodiversity and ecosystem services are actually delivered by offset activities. Ideally, there will be monitoring of relevant, reliable and measurable indicators that enable evaluation of the effectiveness of the offset. InVEST is not a real-time monitoring device; it models how ecosystem services are expected to alter under land-use arrangements, and is therefore not useful for directly assessing the performance of offset activities. It is not a substitute for field measures of actual delivery towards objectives. However, InVEST can be used to determine where to place monitoring stations thereby improving the efficiency of the monitoring design.

Step 8: Adaptive management

As offsets are monitored and evaluated, they should be adapted to improve performance to fit changing economic and environmental conditions. Just as in Step 5, InVEST can be used to evaluate the ecosystem service impacts of alternative possible adaptations of the scheme and thereby inform evolving offset projects.

Overarching Issues with Using InVEST for Offsets

Applicable ecosystem services: The InVEST service models most appropriate for offset and mitigation projects are avoided reservoir sedimentation, carbon storage and sequestration, crop pollination, open-access harvest (includes non-timber forest products), water purification and timber production. In the future, InVEST will also include models for flood control, irrigation water for agriculture, and agricultural production. However, InVEST cannot deal with well in the offset context with water retention and water supply-related services when groundwater is a significant component of yield, or when impacts will largely affect groundwater or the balance between ground and surface water. InVEST also has a simple biodiversity module, that estimates habitat integrity and rarity as a proxy for biodiversity. Alternative biodiversity assessment methods will usually be needed for biodiversity offsets.

Geographic scale: Many ecosystem services in InVEST involve hydrologic processes that are best described at the sub-basin or larger scales. This makes InVEST inappropriate for analyzing offsets at a scale smaller than sub-basins.

Relative vs. absolute values: Without calibration, InVEST is most useful for identifying where to focus offsets, 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 offset decisions based on absolute values, such as determining whether two sites provide equivalent quantities of particular services.

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 offset projects.

Time and resources required: The skill and data requirements needed to apply InVEST are relatively limited. The 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 offsets will take longer. For more detail on data requirements, see the InVEST user's guide.

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

Further reading on InVEST and Offsets

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

Business and Biodiversity Offsets Programme (BBOP). (2009). Biodiversity Offset Design Handbook. BBOP, Washington, D. C.

Business and Biodiversity Offsets Programme (BBOP). (2009). Biodiversity Offset Implementation Handbook. BBOP, Washington, D. C.

Ten Kate, K., Bishop, J., Bayon, R. (2004). Biodiversity offsets: Views, experience and the business case. IUCN and Insight Investment.

InVEST in Practice is a series of short introductory materials to show potential InVEST users how the currently available Tier 1 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 mitigation and offset projects.



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