Theory and Practice of 'Stacking' and 'Bundling' Ecosystem Goods and Services: A Resource Paper






BBOP
Business and Biodiversity Offsets Programme

This paper is by Forest Trends

Publication Data
Suggested citation: von Hase, Amrei and Cassin, Jan. 2018. Theory and Practice of 'Stacking' and 'Bundling' Ecosystem Goods and Services: a Resource Paper. Business and Biodiversity Offsets Programme (BBOP). Forest Trends, 2018, Washington, D.C.

Available from https://www.forest-trends.org/bbop_pubs/stacking_and_bundling

Cover and graphic design by Rima Design and Forest Trends

Published on 1 November 2018

Forest Trends and the Wildlife Conservation Society provided the Secretariat for BBOP during the third phase of the programme's work (2012 – 2018).

About this Document

This Resource Paper has been prepared for the Business and Biodiversity Offsets Programme (BBOP) by Forest Trends[1]. BBOP ran from 2004-2018 to help developers, conservation groups, communities, governments and financial institutions develop and apply best practice towards achieving no net loss and preferably a net gain of biodiversity through the thorough application of the mitigation hierarchy (avoid, minimise, rehabilitate/restore, offset). The Principles, Standard and Handbooks published by BBOP were developed and tested by members of the BBOP Secretariat and Advisory Group and all the BBOP documents have benefited from contributions and suggestions from many people who registered on the BBOP consultation website and numerous others who joined us for discussions in meetings and webinars.

All BBOP Advisory Group members support the Principles, and many companies and governments have integrated them into their own commitments and also use the Standard and other tools. We commend the full set of BBOP materials to readers as a source of guidance on which to draw when considering, designing and implementing projects as well as policies that aim for the best outcomes for biodiversity in the context of development.

BBOP has now concluded its work but best practice in this area is still developing. We hope the legacy of BBOP is that its materials continue to be used and the concepts and methodologies presented here are refined over time based on practical experience, research and broad debate within society. All those involved in BBOP are grateful to the companies who volunteered pilot projects, the members that developed and applied draft versions of the Standard and other tools as they were developed.

To learn more, see: https://www.forest-trends.org/bbop/

[1] This paper was prepared by Amrei von Hase and Jan Cassin with input from Kerry ten Kate (Forest Trends), and reflects comments received during workshops and conferences.

Acknowledgements

We are grateful to the Swiss Agency for Development and Cooperation (SDC) for supporting the work that led to this publication.

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

We are grateful to the many other donors and members who have supported the work of BBOP, listed at https://www.forest-trends.org/bbop/bbop-who-why-what/bbop-funding/

Contents

Theory and Practice of 'Stacking' and 'Bundling' Ecosystem Goods and Services 5

Summary 5

1. Introduction 6

2. Definitions 7

2.1 What are programmes doing in practice? 8

3. Anticipated benefits 10

4. Risks and challenges and how these may be overcome 11

4.1 Demonstrating additionality 12

4.2 Inadequate and incomplete accounting and asymmetry on impact and offset sides 12

4.3 Uncertainties relating to the complexity of ecological systems 14

4.4 Awareness of these risks amongst project managers and policy makers 15

4.5 Capacity to oversee and manage robust approaches and systems 15

4.6 Credit value and oversupply 16

5. Key recommendations and conclusions 16

5.1 Possible approaches for reducing risks associated with stacking approaches 16

5.2 Improvements needed in practice to facilitate stacking and/or bundling approaches: 18

5.3 Conclusions 19

6. Selected references 20

7. Annex 1. List of programmes and projects reviewed 21

8. Annex 2 Selected examples of programmes and projects illustrating bundling and stacking in offsets and conservation incentive schemes 21

Theory and Practice of 'Stacking' and 'Bundling' Ecosystem Goods and Services

Summary

- The terms 'stacking and bundling' (S&B) refer to different ways of packaging multiple ecosystem goods and services including biodiversity for sale in environmental compensation schemes or to attract incentive-based conservation funding. An important question in policy and practice is how to maximise the benefits and limit the risks associated with packaging ecosystem services in different ways and in different contexts. Much of the current thinking on this has emerged from the United States but is also relevant elsewhere.
- This resource paper reviews the theory of S&B (definitions, concepts, possible benefits and risks) and the practice in selected compensation schemes and in more general programmes on payments for ecosystem services (PES) in various parts of the world. In particular, it focuses on stacking of biodiversity and ecosystem services (BES) and of related payments. This approach seems to be of most interest to potential BES providers wanting to improve the rewards they obtain when providing multiple BES. Yet, stacking approaches, if not carefully designed, also involve the greatest risk in terms of achieving sound environmental outcomes.
- The main risks - and significant theoretical and practical hurdles - relate to stacking in compensation schemes. Particularly controversial is the concept of stacking and unbundling BES credits and payments ('true stacking'), i.e. situations where separate payments are received to compensate for impacts on biodiversity and different ecosystem services produced on the same piece of land (e.g. carbon sequestered, biodiversity conserved, water filtered or produced, etc.). The greatest concern with this is the risk of an overall (net) loss of services due to lack of additionality, asymmetrical accounting (i.e. accounting differently on impact and offset side), and ecological complexity. Additional concerns relate to a lack of awareness and capacity limitations particularly amongst those responsible for oversight in assuring the integrity of schemes involving stacking. Unclear or unproven costs and benefits associated with these approaches are also a limitation.
- There is confusion regarding the terms and concepts associated with S&B of BES. Few policies or standards provide explicit and consistent guidance on the topic. In practice, however, 'true stacking' is rare: the review found only one or two examples of this practice in action (in a wetland bank in the United States) or enabled in policy (in an Australian Offset Policy). Instead, certain 'hybrid' approaches are being piloted in projects: these involve the stacking of selected services and credits without unbundling (e.g. in the USA, Germany). These projects aim to develop robust approaches that could limit the risks while offering some of the benefits of stacking for various stakeholders, including offset providers, and for the environment.
- The recommendations and 'rules of thumb' in this resource paper are inspired by suggestions put forward by other researchers and practitioners[2] and based on the findings from the review. The recommendations include the need for significantly improvement is in the approaches used to account for BES outcomes and payments; transparent recording;; robust and practical ways of demonstrating additionality; equivalent accounting on impact and offset sides in compensation exchanges; increasing the awareness and capacity of those who need to check the validity of the systems; stacking without unbundling services, credits and payments; and generally not stacking ecosystem-based credits and functions. Another recommendation is that policy makers and project managers should address the subject of S&B more thoroughly, for example applying lessons from existing pilot projects. Further pilot projects on S&B would help explore and test relevant approaches, including their feasibility and desirability, costs and benefits. This would help with appropriate system design.

[2] We acknowledge particularly publications by Cooley and Olander (2012), Gardner and Fox (2013) and Robertson et al. (2014), which are essential reading on the topic of stacking.

1. Introduction

Ecosystems provide a wide range of goods and services ('biodiversity and ecosystem services - BES' henceforth) that underpin human well-being. For example, natural systems such as wetlands or forests and their constituent biodiversity can play an important role in flood control, nutrient filtering and cycling, while also providing wildlife habitat, storing carbon, regulating temperature and the water cycle, offering opportunities for recreational activities, and providing food, medicines, and other resources such as timber. Increasing recognition of the benefits associated with these services has led to the emergence of various BES-focused schemes aimed at conserving and improving the production of important services. Such schemes include environmental compensation markets in the USA, Australia and Germany and incentive-based Payments for Ecosystem Services (PES) programmes in Costa Rica, South Africa, and Mexico.

Many schemes, however, focus on single or just a few related services, such as those related to carbon sequestration. While such schemes may be reasonably straightforward to administer and understand, they tend not to promote the provision of multiple services or 'co-benefits' in addition to the principal valued service. This may result in trade-offs between the different ecosystem services produced by an ecosystem, with a single service maximised to the detriment of a larger and more varied suite of ecosystem services. Often, 'co-benefits' (where they occur) are unacknowledged and provided 'for free' along with the service for which explicit payments are received. The concepts of 'stacking' and 'bundling' of BES produced on a single piece of land have emerged partly in response to the challenge of obtaining enough investment to maintain the full suite of ecosystem services. S&B may also provide opportunities to 'scale up' PES-type approaches, by adequately and more explicitly rewarding land managers for a wider range of BES produced. The hope is that S&B mechanisms could promote the delivery of multiple sets of services that are often interlinked, in return for appropriate rewards to service providers, while also achieving integrated ecosystem-based management and good conservation outcomes.

Yet there are many questions around these approaches, such as what they actually entail, when they may best be applied, when they should not be used and why and what the benefits and risks may be. Another question is how robust programmes and policies can be developed to maximise the potential benefits for participants in the scheme and for the environment. This resource paper, based on an extensive review of the theory and the practice of BES 'stacking' and 'bundling', aims to answer some of these questions. As part of the review we looked at recent literature, most of which is based on the experience in the United States of America (US) with environmental compensation markets. Despite being quite context-specific, the US experience is valuable for other situations. For example, it has helped to clarify some of the basic definitions and highlight potential benefits of S&B approaches, enable discussion of the risks and concerns raised by various stakeholders especially with respect to stacking, and set out solutions or recommendations, many of which are broadly applicable. In addition, we undertook a survey of a number of schemes across the world (listed in Annex 1) with the aim of understanding the 'state of S&B practice', including how well S&B approaches are understood, what is being done where, and what is emerging in terms of good practice. Our findings, with an emphasis on stacking approaches, are summarised below.

2. Definitions

While there is significant interest in stacking and bundling approaches, there is also much confusion. Some of this relates to the terms 'stacking' and 'bundling' and the various ways in which they have been used in the past. The definitions given in Textbox 1 and illustrated in Figures 1 and 2 can help with this.

TEXTBOX 1: DEFINITIONS

'Stacking' and 'bundling' describe two ways of packaging BES for sale in an environmental compensation market or incentive-based PES scheme.

'**Bundling'** is when a suite of ecosystem services produced on a piece of land is sold as a single package (typically as a single unit of trade or credit) to the same buyer. There is one payment for an aggregated set of overlapping services. The extent to which the range of services making up the bundle are explicitly identified and measured varies significantly. Often, the bundle is represented only through a very general proxy, e.g. such as an area of forest or wetland that is assumed to be associated with a wide range of services. This is sometimes known as 'implicit bundling'. In addition, a single service or several services (but not all of them) may be explicitly measured (e.g. tonnes of carbon stored). If a bundle is very well defined and subsets of the services within it are measured and quantified, such an explicit bundle closely resembles a 'stack' of services. However, an important difference is how they can be traded: a bundle represents a single unit of trade and can only ever be sold as a single, aggregated set of services. By contrast, a stack may be disaggregated into separate units of trade that are sold separately, depending on the rules or standards in place.

'**Stacking'** is when various overlapping ecosystem services produced on a given piece of land are measured and separately 'packaged' into a range of different credit types or units of trade that together form a stack. The components of the stack can then be sold individually to different buyers and separate payments received for each set of services. Stacking has been loosely used to describe a range of situations. Two of these, which have been much debated in environmental markets, are worth highlighting:

'**True stacking'** (also called '**stacking with unbundling'** or '**payment stacking**') is when each credit type is treated as independent from the other credit types in the stack and separate payments can be received for all credit types and the service/s they represent.

Alternatively, the credit types forming part of the stack may be expressly linked in which case they cannot be sold independently. In this case, any component credit type may be chosen by the service provider as the **'leading service or credit'** and sold on condition that the associated credit types (and services) in the stack are simultaneously retired and cannot be sold separately. This means there is choice regarding which type of credit is sold, but only one payment is received for the full suite of linked services and credits. This model, which is essentially a **hybrid of a stacking and bundling approach**, is often referred to as '**credit stacking' or 'stacking without unbundling**'.

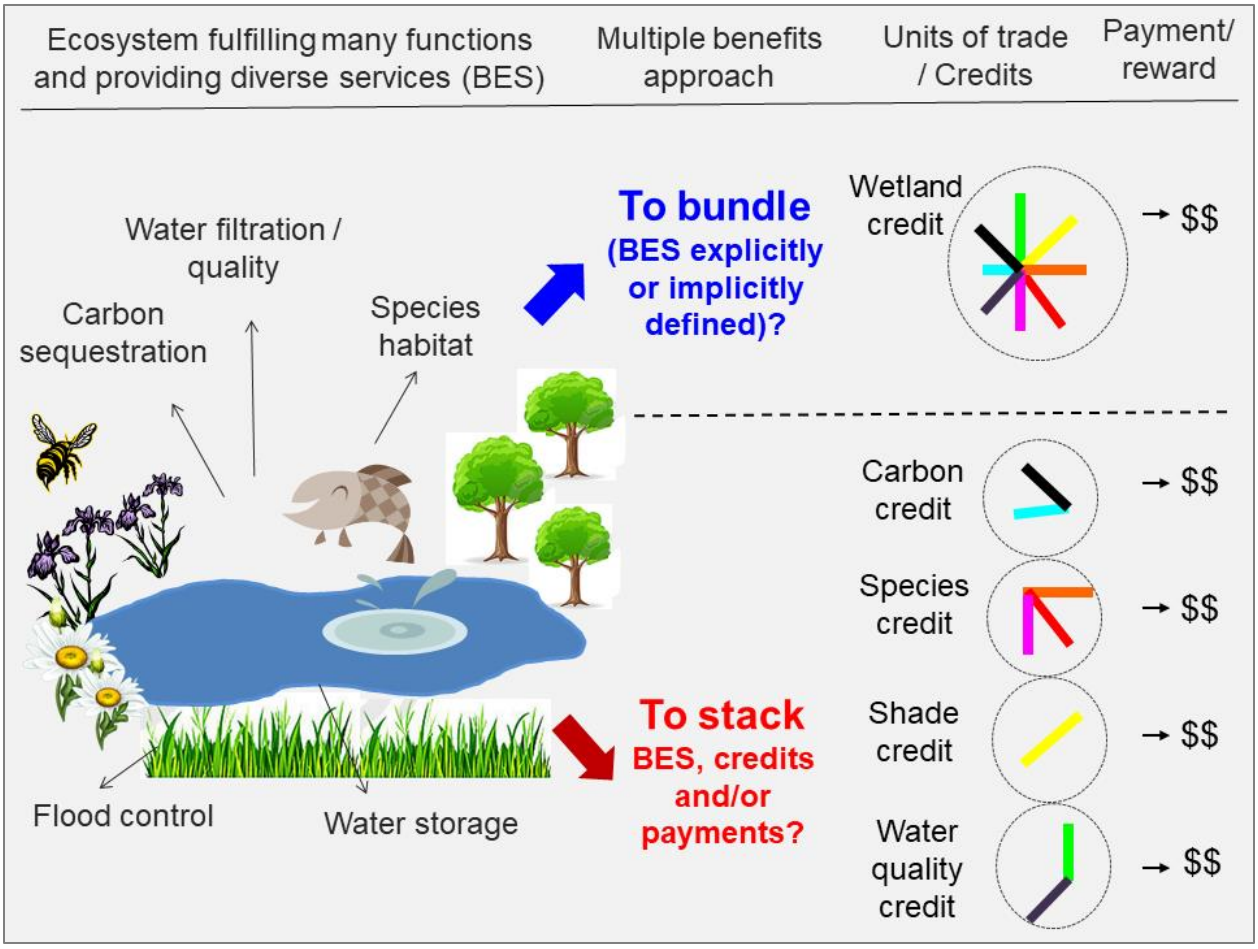

Figure 1. This sketch illustrates selected functions and services provided by a wetland and how biodiversity and ecosystem goods and services (BES) can be packaged into different credits. One option is to bundle them into a single wetland credit type, covering a wide range of functions and services. Such credits are traded in US wetland mitigation markets. They are sold by service providers producing the suite of services on their land and bought by project developers with offset requirements. Another option is to package various spatially overlapping services into different credit types that are said to be stacked. If the stacked credits are then unbundled and sold separately to different buyers / into separate markets, this would be a case of 'true stacking' (see Textbox 1).

2.1 What are programmes doing in practice?

The state of practice review focused on twenty one conservation-incentive and compensation schemes across the world (Annex 1) to identify how they deal with multiple benefits. The review classifies the programmes into conservation-incentive schemes involving PES (7 of 21), compensation or offset schemes or projects (11) and initiatives involving both conservation-incentive and compensation or offset payments (3). It is difficult neatly to categorise what the programmes are doing according to the precise definitions in Textbox 1, but the review uses the best available information to determine the approach of each scheme to multiple benefits and whether the scheme involves stacking or bundling. A lack of transparent information and explicit accounting of BES outcomes and payments, in particular, make it difficult to verify definite instances of stacking in practice. The findings are summarised below:

Most of the conservation-incentive schemes serve as examples of bundling different services and payments. There is currently no evidence that any of these are deliberately or explicitly stacking outcomes or unbundling BES and payments in practice. While most of these programmes obtain funding from numerous sources, little if any of this appears to be specifically for compensation purposes. In all of the schemes, the additionality requirements and the accounting of both outcomes and payments were too general to identify clear cases of stacking. However, in their search for sustainable conservation financing many of the programmes expressed an interest in receiving payments related to compensation or offset requirements (e.g. carbon or biodiversity offsets). Interestingly, the US Agriculture Department permits the sale of environmental credits (which could be used to satisfy compensation requirements) from lands enrolled in conservation incentive programmes under the US Farm Bill. This opens the door to possible credit and payment stacking. Pilot projects looking at credible stacking protocols (e.g. the Willamette Partnership) have included mechanisms for handling such situations and limiting the associated risks.

Of the 11 compensation or offset schemes and projects, only one scheme (the New South Wales Offset Policy for Major Projects in Australia) explicitly allows stacking with unbundling. It is not known whether any such cases have been implemented under this policy at this point in time. One project (the NeuCon wetland bank in the United States, US) stacked and unbundled ecosystem-based wetland credits and water quality credits. This was done with permission from the authorities but the practice has since been disallowed. Another project (the Brandenburg Flaechenargentur in Germany) has developed useful methods to stack credits but without unbundling these. Two or more individual projects (in the US, and Australia) enable a limited amount of stacking and unbundling specifically of species credits, provided that additional outcomes (e.g. due to species-specific conservation activities) are demonstrated for each species (and component of the 'stack')[3].

Three projects in the US involve conservation-incentive (e.g. from public conservation incentive programmes under the US Farm Bill) and offset payments linked to compensation markets. These projects are piloting responsible approaches to providing multiple BES and credits through stacking, but without unbundling credits or payments. The Willamette Partnership in particular has invested significant effort and resources in developing robust procedures for stacking without unbundling credits and payments.

A selection of the programmes is briefly described in Annex 2, including examples of the following situations:

1. Bundling in incentive-based conservation programmes (US Farm Bill and other national PES schemes)
2. Bundling in compensation/ offset schemes (Wetland Mitigation Banking, USA and the Voluntary Carbon Standard with Conservation, Communities and Biodiversity Standards, VCS and CCBS)
3. True stacking (NSW Offset Policy for Major Projects and Neu-Con Bank, USA)
4. Stacking without unbundling involving offsets only or offsets and conservation-incentive schemes (Willamette Partnership Pilot and Brandenburg Flaechenargentur)

[3] Note, however, that US Fish and Wildlife Service generally does not permit two different species credits derived from the same land parcel in a conservation bank to be unbundled and sold separately to offset impacts of different development projects. This is to assure additionality and is quite clearly stated as follows: 'When an acre of habitat is used by only one species, it is only available for impacts to that species. But when an acre of habitat is occupied by more than one species, *it is available for either species, or as a multi-species acre for impacts to habitat that affects the same combination of species*. When a multi-species acre is used for a single species, the other species credits will be debited accordingly' (Memorandum from the U.S. Fish & Wildlife Serv., *supra* note 60, at 9, in Gardner and Fox, 2013)

The survey revealed great interest in stacking approaches in particular, but there seemed to be limited understanding of the risks involved. This applied especially on the part of programmes not already involved in stacking. The potential advantages (see Section 3) were relatively well understood by all programmes, although it is presently hard to demonstrate clear, consistent benefits in practice.

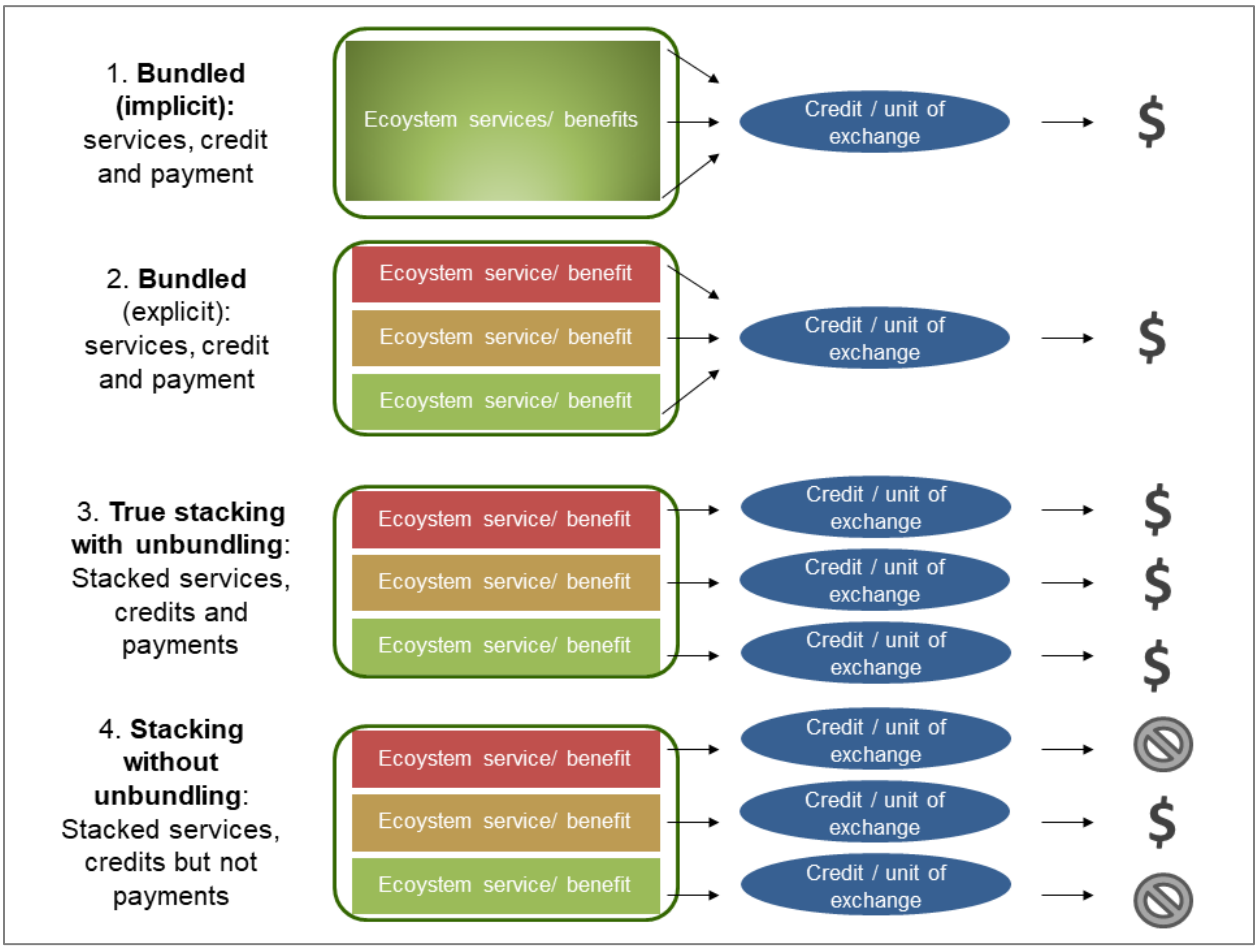

Figure 2. This illustrates the different approaches to accounting for and transacting BES: implicit and explicit bundling, true stacking and stacking without unbundling (as described in Textbox 1)[4].

3. Anticipated benefits

Two of the most commonly mentioned benefits apply to stacking and to bundling approaches. The first is the expectation that service providers would obtain greater rewards if a large, varied suite of services were explicitly valued and paid for. This could help to meet opportunity costs, improve the resilience of PES-type projects, and increase the number of participants and area of land engaged in such schemes. A second linked benefit would be more and better outcomes for the environment and for people. The expectation here is that land management explicitly involving a variety of BES would be more ecologically focused and would thus mean higher quality conservation outcomes and fewer trade-offs amongst BES.

[4] Adapted from Gillenwater (2011)

In the case of bundling, improved rewards for land managers producing a range of BES could come in the form of a premium. This would be paid to land managers offering a main service along with a diversity of recognised co-benefits rather than only the main ecosystem service. Thus, projects that address climate change, support local communities and protect biodiversity, and which are certified under the Voluntary Carbon Standard and the Climate, Community and Biodiversity Standard (VCS and CCBS), for example, would receive a premium for delivering a diverse bundle of BES compared with projects delivering only climate change-related benefits. In practice, there appears to be limited evidence of a significant premium being paid at present. Yet, offering a diverse bundle that explicitly identifies valued services and benefits may facilitate market entry, which is an important consideration. In the case of stacking, service providers who produce a range of services and translate these into different types of credits (or units of trade) could receive multiple payments for the services generated on a given area of land. Instead of receiving a payment for producing wetland credits through restoring a wetland, they might be paid for the delivery of a range of functions and services, such as water quality improvements, habitat provision for threatened species, flood control, and sediment retention.

Two further advantages may be associated with stacking approaches in particular. First, given the need explicitly to identify and measure various sets of services that make up the components of a stack, this may lead to improved accounting of the services produced and provided. Currently, inadequate BES accounting is a limitation of most BES transactions and schemes, whether they are incentive-based conservation programmes that operate through PES mechanisms or environmental compensation schemes. Second, stacking may offer buyers the opportunity to obtain exactly the services that they want, rather than paying for ancillary services they do not require.

For various reasons, most of these potential benefits were not be clearly observed in practice in the review. A significant price premium for bundles comprising a diverse set of BES was not evident and t was not possible to demonstrate significantly higher revenue for service providers offering these, although there may be other subtler benefits not elicited in the review. In addition, stacking approaches have not been enabled at scale as yet (given significant theoretical and practical hurdles, see Section 4), making conclusions hard to draw at present. There are isolated examples of true stacking which seem to have resulted in significant additional revenue for the service provider (a US wetland mitigation bank) but this may have come with negative implications for the environment. Where robust stacking (e.g. without unbundling) is being trialled, this is through pilot projects that are operating without a large scale demand driver and they have not yet led to clear findings regarding the full suite of benefits.

4. Risks and challenges and how these may be overcome

The debate around the challenges and risks associated with S&B involves a number of issues such as how to assure additionality and adequate measurement and accounting, the importance of recognizing ecological complexity and limitations to our knowledge, understanding the market implications of stacking and bundling mechanisms and the merit of bearing the higher costs incurred for additional certification. The lack of awareness amongst policy makers and project managers of the risks involved in unmanaged stacking approaches and capacity requirements are also raised. Most of the concern centres on stacking in schemes that are designed to deliver compensation or offsets for permitted impacts on BES. Bundling approaches and purely incentive-based conservation schemes involving PES are considered much less controversial and risky because these are not intended to address and compensate for BES impacts.

4.1 Demonstrating additionality

Environmental compensation schemes enable service providers to supply conservation outcomes (gains) to project developers needing to address the environmental damages (residual losses) caused by their projects. This makes it crucial for conservation outcomes to be additional (e.g. over and above what would happen if there were no impacts and associated offsets). Otherwise impacts would remain uncompensated, leading to an overall loss of ecosystem integrity and services. Demonstrating additionality already presents significant challenges in many compensation schemes. Introducing stacking approaches would further complicate additionality requirements and, if not managed very carefully, would increase the risk of 'double dipping'. This is where the same environmental outcome is sold more than once to different buyers to compensate for separate impacts (see Textbox 2). Not only would this mean bad environmental outcomes but it would also lead to a loss in the credibility of compensation markets and schemes.

TEXT BOX 2: EXAMPLE OF LACK OF ADDITIONALITY AND 'DOUBLE DIPPING'

A landowner restores a degraded freshwater tidal wetland and sells the resulting wetland credits to a port expansion project needing to offset its residual impacts on a nearby tidal wetland. If the landowner subsequently converts the carbon sequestered by the restored wetland into a set of credits and sells them on the international market to a buyer wanting to offset its CO_2 emissions, there is a case of double dipping. The same environmental outcome is sold more than once to different buyers to compensate for separate sets of impacts - a case of 'true stacking' or payment stacking. The carbon credits are not additional in this case, which would lead to an overall loss in this service. The carbon sequestered by the restored wetland would have been part of the original wetland credit used to offset a wide range of services and functions performed by the tidal wetland that was affected by the port expansion.

By contrast, conservation incentive schemes that involve PES aim to improve environmental practices and outcomes without intending to counterbalance negative environmental impacts. Often, these schemes do not entail strict or explicit additionality requirements, so there is a chance that some stacking approaches may lead to the same BES outcomes being paid for twice. While this would be an inefficient use of conservation funds, there is no risk of uncompensated loss in these instances unless offsets are involved. In the conservation incentive programmes reviewed, the accounting of BES outcomes and payments tended to be too general to determine whether any outcomes were being paid for twice. While few, if any, of the schemes involved compensation payments, most programme managers were interested in augmenting their funds through such payments.

4.2 Inadequate and incomplete accounting and asymmetry on impact and offset sides

Adequate measurement and accounting for BES is a challenge for most existing incentive-based PES schemes and compensation markets and programmes. Very often the proxies and methods used in the accounting have serious short-comings and make it difficult to know what is being produced and by whom, and what the actual outcomes are. In addition, in cases where compensation is involved, it is usually hard to track whether all the impacts on all affected BES are genuinely being counterbalanced by enough of the right gains in BES. For example, the use of wetland or forest area as a very coarse and commonly used proxy can obscure important differences in the BES outcomes delivered from one site to the next. This is in terms of both the variety of services produced and the amount. Single service programmes also help to illustrate the problem: if a single service is properly measured to determine residual impacts and compensation requirements, then there may be a wide range of undetected

services that are not accounted for in the transaction. These unrecognised services can be on the impact and/or the offset side, leading to an asymmetrical situation with the potential that some impacts remain uncompensated.

The need for better measurement and accounting in PES-type programmes in general is well recognised. As a result, many of the programmes reviewed are attempting to improve the methods they employ regardless of whether they are considering stacking approaches. As with additionality, adequate accounting is not a problem exclusive to stacking. In fact, it has been suggested that stacking may promote better measurement and accounting of a broader suite of services and this is indeed evident in projects that are piloting protocols for robust stacking or 'hybrid approaches' (see Textbox 1).

Yet stacking may also exacerbate the problem of incomplete and asymmetrical accounting. First, the incentive for fuller accounting is skewed towards service providers supplying BES and interested in increasing their revenue rather than the impacting parties who may regard more detailed accounting as incurring greater costs. This is unless there are strict requirements to address impacts on a wide range of different services. Second, when different schemes, overseeing parties, and types of BES and credits are involved, especially across jurisdictions that may range from local to global scales, the accounting can become very complex. This could raise the risk of double dipping by service providers who sell the same BES outcome twice to offset two separate impacts. The outcome for the environment would be an overall loss of services. Also, developing a system that adequately addresses these issues and risks, including through detailed, full accounting, may lead to prohibitive costs and capacity needs. This would make it difficult to establish a workable system.

Some key conclusions based on the survey of the state of practice are as follows:

- There are few instances of true stacking in the approaches reviewed with only two examples of stacking and unbundling. One where this is explicitly enabled in policy (in the New South Wales Offset Policy for Major Projects with respect to carbon and biodiversity offsets) and the other where it was implemented in practice (in the NeuCon Wetland Mitigation Bank, which stacked wetland and water quality credits with permission of the authorities). Most compensation schemes have relatively strict additionality requirements which generally seem to disallow stacking and unbundling of BES, credits and payments even if the issue of stacking is not necessarily explicitly addressed.

- There is a risk that incentive-based conservation schemes involving PES begin to get involved in providing compensation or offsets without a clear understanding of the limitations and without adequate measures to prevent double dipping and uncompensated impacts. Many offset schemes would prevent this practice due to their own strict regulations or standards, but such rules are not always in force, for instance, in the case of voluntary offsets.

- Better measurement and accounting of the services produced, of the outcomes achieved and of payments received is essential for engaging in a robust multiple benefits approach. It is especially crucial when considering any form of stacking. Many schemes appear to be making iterative improvements to their methods, protocols and systems. Yet, there are currently few examples of the kind of rigor that would be required for responsible stacking approaches. In addition, a number of schemes instead appear to be generalizing their methods and accounting in an effort to come up with simpler, often less robust systems.

- Currently, a 'hybrid' approach (stacking *without* unbundling) seems to be the most promising approach to defensible stacking. This aims to address the risks relating to lack of additionality, double dipping and incomplete and asymmetrical accounting. The hybrid approach involves establishing protocols for stacking multiple sets of BES produced on the same piece of land and translating these into different stacked credit types, clearly linking the components of the stack and then having the option of selling any one of the credits types provided the linked credits are retired. A number of pilot projects are looking at such stacking without unbundling approaches. They are investigating how to come up with robust systems that meet the demands for rigor without being prohibitively costly. A key focus in the pilot projects has been on the 'accounting': identifying services that warrant specification based on current patterns of demand and finding methods to quantify services and relate them to each other.

  Some projects are developing the approach at a relatively local scale (e.g. the Willamette Partnership, the Conservation Marketplace of the Midwest, CMM in the US) while others are looking at local and global scales (e.g. the Brandenburg Flaechenargentur). Unfortunately, no explicit cost-benefit analysis appears to have been done yet to determine what the merits and draw-backs of stacking but not unbundling services and credits may be for service providers, what the transactions costs of better and more precise accounting are and whether the income generated from having a range of credit types for sale is worth the investment in defining and measuring the relevant services and credits.

- 'Explicit bundling', where diverse sets of BES leading to a range of 'co-benefits' are defined and evaluated, is another way of promoting the delivery of multiple benefits. Several programmes or standards such as VCS-CCBS have opted for this approach. It is similar to, and perhaps a step towards, stacking without unbundling as it addresses the risks of stacking in compensation schemes and quantification of BES. Yet, this kind of explicit bundling involves a single bundled unit of trade that service providers are currently selling into a single market only (the carbon market), whereas stacking without unbundling would ultimately offer opportunities to sell credits in a range of markets.

4.3 Uncertainties relating to the complexity of ecological systems

Our limited understanding of the complex ecological dynamics that underlie the production of ecosystem services (i.e. structures, processes, functions, and their relationships and interdependencies) constrains our ability to develop sound BES programmes. Questions include how best to define BES and the underlying components of the system, how different functions, structures and services operate and interrelate, how to measure this over time and in response to different management actions, how biodiversity fits into the picture, and what limits and thresholds there are. We need to know much more, and research is only just beginning to provide crucial answers. The science and practice of ecological restoration, for example, lag far behind rapidly developing environmental markets, thereby posing a risk to achieving good environmental outcomes.

The issue is not exclusive to approaches involving stacking, but it can be especially complicated in that context to resolve the implications for environmental outcomes and integrity. This is not least because high levels of uncertainty make it difficult to develop the reliable BES accounting methods that are particularly important for stacking approaches. However, progress is being made on clarifying and aligning terms and concepts around BES and setting out suitable BES typologies. Methods will keep evolving and will support more rigorous approaches, including those involving S&B. In addition, research is improving our knowledge of different facets of ecological complexity and the implications for managing and accounting for ecosystem service. There is a growing body of

research into the relationship between biodiversity and ecosystem function, on the mechanics that govern this relationship, and what this means for ecosystem service outputs. More advanced and comprehensive proxies and metrics are continually being developed and more detailed measurement and accounting methods are being developed for a range of services, functions and their interrelations. Examples include work being done by projects aiming to develop methods for robust stacking (e.g. the Willamette Partnership, Brandenburg Flaechenargentur, and Ohio River Basin Water Quality Trading Program), projects such as the Regional Integrated Silvopastoral Ecosystem Management Project (RISEMP), the VCS and CCBS, the Business and Biodiversity Offsets Programme (BBOP) and many others.

4.4 Awareness of these risks amongst project managers and policy makers

The survey of the state of practice indicated limited appreciation amongst many practitioners and policy makers of the issues surrounding stacking and bundling, and the risks associated with stacking in particular. There is interest in the concepts and especially in the opportunities and potential benefits. In the case of project managers or service providers, the interest is especially due to the chance of increased revenue or additional funds for PES-related conservation work, given opportunity costs of conservation and funding shortfalls. In the case of companies with impacts on the environment, there seems to be an interest in reducing the size of liabilities (e.g. when a company needs different types of offsets) and delivering these in the most cost efficient way (e.g. combining biodiversity and carbon offsets). In order to take advantage of these opportunities, it will be important to manage the risks. The lack of awareness or understanding about the problems associated with S&B, and particularly with true stacking, may inadvertently lead to bad outcomes in some projects and schemes. For example, this could happen if incentive-based conservation schemes accept compensation-related payments without adequate rules and safeguards in place to prevent double dipping or asymmetrical outcomes.

Explicit guidance in policies and standards is still relatively limited on whether and what should be bundled or stacked and how this could best be done. An exception would seem to be compensation policies in the United States, such as the Wetland Mitigation Banking rules and guidance by the U.S. Fish & Wildlife Service on species banking, which explicitly disallow true stacking or 'stacking with unbundling'. But guidance provided to conservation-incentive programmes under the US Farm Bill conflicts with this as it enables the stacking of credits and payments (such as those received from sales in compensation schemes) with outcomes delivered under the incentive schemes. Clear additionality rules relating to conservation outcomes, as set out in some policies and standards (e.g. the BBOP Standard on Biodiversity Offsets, the VCS and CCBS) would generally also prevent true stacking, unless additional outcomes for different BES can be demonstrated. Yet the issue of stacking is not directly addressed. Explicit treatment of the subject in such standards and policies would improve awareness and understanding and could help prevent negative environmental outcomes.

4.5 Capacity to oversee and manage robust approaches and systems

Ensuring the integrity of environmental markets and schemes requires adequate data, resources, and capacity on the part of those tasked with oversight, whether they are regulatory agencies, certification bodies or project managers. Capacity constraints amongst these parties have been raised as a concern even in established compensation and incentive-based conservation and PES schemes, where various forms of stacking are not commonly pursued or enabled. Responsible approaches to stacking, e.g. BES and credit stacking without unbundling, would place significantly greater demands on relevant agencies and the supporting systems. A lack of resources and capacity could compromise the effectiveness and efficiency with which compensation or offsets are

provided, monitored, and verified. A key issue that must be addressed when considering credible stacking approaches, is the institutional requirements and how they could be satisfied in a given context.

4.6 Credit value and oversupply

A significant increase in the supply of different credit types could pose a challenge for developing a viable system of stacked credits. . Depending on the demand, this could lead to a significant reduction in credit prices, so the service providers might only have a very limited increase in revenue which could be outweighed by the costs involved in measuring and managing a broader suite of credits. This would depend on the demand for different credits. If compensation requirements were expanded to include a range of additional BES sets and credits within their scope, there may be less chance of an oversupply of credits.

5. Key recommendations and conclusions

The following recommendations based on this review and on ideas suggested by other researchers and practitioners[5] are intended for policy makers, developers and service providers interested in multiple benefit approaches such as S&B. The aim is to help reduce the risk and improve the practice of S&B.

5.1 Possible approaches for reducing risks associated with stacking approaches

- **Don't stack – stick to bundling**: One option is simply not to stack BES or credits at all but instead to retain a well-defined bundle as the main unit of trade. This applies particularly to programmes that already involve ecosystem-based units of trade (e.g. wetland credits in the US or vegetation-based units of trade in biodiversity offsetting in Australia). However, the current state of practice needs to be significantly improved. For example, better measures (and units of trade) should be developed to capture the condition and functions of affected ecosystems more effectively, as well as BES they provide, and to enable better detection of BES changes in response to management actions. Improved measurement, supported by robust accounting, then needs to be applied equally on the impact and offset side in compensation schemes. While improved bundling approaches would support better environmental outcomes from PES and compensation programmes, they will probably not bring significant additional revenue for service providers.

- **Stack but don't unbundle BES and credits**: This is presently the safest stacking approach to consider. One of the best examples is the Willamette Partnership's pilot approach and accounting protocol. This project has invested in significant research and development, has involved a diverse group of stakeholders, and has produced some very useful solutions. It would help schemes interested in stacking to look in more detail at this and similar models (e.g. Flaechenagentur Brandenburg, Germany, Spellbottom Mitigation Bank). These projects have taken the precautionary decision not to unbundle services and credit types for the time being but to sell the stack as a unit of composite credits. This means interrelated and potentially inseparable functions and services remain intact and aggregated. It also means that service providers receive only a single payment for each 'composite credit' sold. The advantage, however, is that service providers can select into which market to sell. A different credit type in the stack could be chosen for each transaction, e.g. depending on where the

[5] See in particular Cooley and Olander (2012), Gardner and Fox (2013) and Robertson et al. (2014).

most volume can be sold or the best price obtained. This offers some flexibility of tapping into different markets and can help with optimizing revenue streams over time.

- **Don't stack and unbundle ecosystem-based credits which represent a suite of functions**: This is a general 'rule of thumb' to help prevent BES outcomes from being sold twice: once as part of an overall ecosystem-based credit, which covers many functions and services, and once on their own[6]. This simple rule can be applied to various ecosystem-based credits in use (e.g. wetland credits in the US, vegetation-based units of trade in biodiversity offsetting in Australia and elsewhere). Wetland Mitigation Guidance in the US already includes a relevant provision. However, this would not preclude individual functions or services from being identified, measured and translated into stacked credit types for sale in a robust stacking framework (e.g. stacking without unbundling).

- **Don't allow stacking and unbundling of credits lead to an overall loss of functional ecosystems and associated BES.** This 'rule of thumb' is aimed at preventing an overall loss of habitat, which could occur if multiple species credits and ecosystem credits were allowed to be stacked and unbundled (e.g. wetland and fairy shrimp credits in the US, or different species credits in the US and Australia[7]). Several cases involving such transactions have been permitted on the basis that additional outcomes can be assured for the different species or services involved. While these projects are valid, many stakeholders are hesitant to accept an exchange involving an offset of one hectare, which provides habitat for both a threatened bird and a snake, for instance, to compensate for the loss of two hectares, one which was habitat for the bird and the other for the snake. Even where additionality of outcomes is assured and the risk of double counting limited, a problem with such arrangements is that they compound the risks to BES supply and good ecological outcomes on a single hectare (on the offset side) when previously risks were associated with separate areas (on the impact side)[8].

- **Manage areas to ensure the integrity of ecological values associated with all credit types produced:** Stacking approaches may well incentivise service providers to manage their land in ways that support the production of a diverse set of services (e.g. related to carbon, biodiversity, water) rather than optimizing management for a single service (e.g. stored carbon). This may lead to better environmental outcomes. However, even where incentives lead to the production of a range of credit type, a robust framework is needed to ensure that potential trade-offs between services are carefully assessed, monitored and managed.

- **Limit the geographic scope of schemes with stacked credits**: The risks associated with stacking could also be limited by allowing only those BES and credits to be stacked that are explicitly regulated in a specific jurisdiction. This would help address the problem of unseen losses and asymmetrical accounting, provided that there are clear requirements for all services to be equivalently assessed at impact and offset sites. Such risks

[6] For instance, water quality, species habitat, flood prevention and other functions are integral to most wetlands. Allowing one such function to be sold separately and in addition to the full ecosystem credit (both to offset a residual impact) is likely to result in an overall loss of functions and services.

[7] For example the Baralaba offset in Queensland, where a small spatial overlap in species' habitat occurs at offset sites relative to the impact sites (Cockatoo Coal Ltd: Offset Delivery Plan: Baralaba North Continued Operations Project (BNCOP) EPBC Approval 2013/7036. (Earthtrade), and the Lyonia Preserve in the United States (see Gardner and Fox, 2013).

[8] A counter argument is that aggregating outcomes for different species can bring benefits, e.g. if the alternative were numerous smaller fragmented offset sites. Yet, the precautionary rule to avoid an overall loss of habitat should be carefully considered in cases that involve offsets for various species. Stacking without unbundling approaches have been used as a solution in some instances (e.g. the Van Vleck Ranch Bank in the US in which wetland and species credits are stacked but not unbundled).

are also easier to manage in transparent bilateral trades involving stacking, where it is simpler to track the accounting and assure the requisite outcomes.[9] As long as compensation policies regulate few services, however, the reach of stacked schemes and the opportunities they may afford will remain limited. Yet, further development of stacking approaches might act as an incentive to expand policies to cover a wider range of BES.

5.2 Improvements needed in practice to facilitate stacking and/or bundling approaches:

- **Piloting**: It helps to establish pilot studies and projects early on when considering how to cater for multiple BES related benefits and trying to decide between stacking and bundling. Piloting can reveal the feasibility and likely costs and benefits of any proposed approach. It also provides opportunities to: 1) involve and consult with key stakeholders; 2) test options for a 'best fit' framework for a system, including institutional arrangements; 3) develop appropriate technical procedures (e.g. what to measure and how, determine which services are linked, what to bundle or stack, how to limit trade-offs between ecological functions or services, how to assure additionality, how to deal with public money, undertake outcomes monitoring, tracking of credits and payments etc.); and 4) review protocols and determine capacity needs. In the US, where experimental stacking protocols are most advanced, the work and experience of a handful of pilot projects has been instrumental in identifying a number of key challenges and risks, and perhaps more importantly, in setting out some possible solutions for responsible credit stacking.
- **Adequate yet pragmatic accounting is needed, including additionality tests**: Across BES programmes, there is a need for better accounting of the BES involved (e.g. identifying and measuring multiple services, defining ecological links between these and underlying functions, quantifying them relative to each other, etc.). Better accounting for the payments for specific outcomes is equally necessary. An important part of credible methods is the use of pragmatic additionality tests to assess genuine outcomes over and above 'what would have happened anyway'[10]. This will need to involve a range of BES and credits, on impact and offset sides, in the case of responsible stacking in compensation schemes in order to prevent double dipping, asymmetrical accounting and the net loss of BES. It may be useful to set up rules as to which ecosystem services should be recognised as inextricably linked and not possible to disaggregate, and when it may be feasible to separate services. Protocols designed by existing pilot projects (e.g. Willamette Partnership, Brandenburg Flaechenargentur) offer insight on how measurement and accounting could be done for various credit types and how outcomes and payments from incentive-based conservation and compensation or offsetting could be integrated.
- **Transparency** underpins the credibility of environmental compensation and incentive-based conservation schemes that involve PES alike. Many regulated and some voluntary compensation schemes already offer ways of assuring the transparency of transactions and projects (e.g. public registers). In the case of BES and credit stacking, it may be harder to achieve transparency given their potential complexity. These schemes typically involve numerous policies and regulations, separate markets, overseeing organisations, and stakeholder

[9] For instance, if credits from a restored, conserved wetland A are used to offset impacts from impacted wetland B but additional BES credits can be generated at A over and above those lost at B – those credits could then be sold (Cooley and Olander 2012).

[10] A complicating factor is that many, often very complex additionality tests are in use. Ideally these should be streamlined and simplified while still providing adequate safeguards. There are no definitive solutions in this regard, but a few practical conclusions can be drawn: It seems sensible to focus on environmental outcomes rather than complicated tests involving financial additionality, especially if outcomes can be quantified and evaluated separately. Also, while additionality rules around credit stacking should be set up at the start of a scheme, there should be an option to revise them, e.g. in case opportunities arise for new types of credits.

groups. Several multi-credit schemes are already experimenting with mechanisms to facilitate transparent procedures, including online credit tracking systems, and such mechanisms could be adapted and applied.

- **Greater awareness is needed, as well as enough resources and capacity**: It would be valuable for those considering stacking and bundling approaches to get to grips with the subject matter to ensure they understand the risks associated with stacking in particular, and how these could be managed in a specific context. Reviewing key papers and case study compilations can help, as can undertaking a pilot study, if feasible. What will ultimately be needed for sound schemes, especially those involving BES and credit stacking, and good environmental outcomes is thorough oversight and good cooperation amongst the different entities administering the relevant systems. Agencies will need effective mechanisms to verify credit types separately and to track sales and payments across the BES schemes and markets involved. This will place significant demands on overseeing agencies but it is crucial to assure the ecological validity of the transactions.

5.3 Conclusions

Both potential service providers and policy-makers wanting efficient and effective multiple benefits systems are interested in accounting for diverse BES in a given landscape. Stacking and bundling approaches offer different possible routes and each presents a number of opportunities and risks. Potential benefits include greater incentives and rewards for land managers producing multiple services as well as good conservation outcomes. The risks, especially related to stacking and compensation schemes, include lack of additionality, double dipping (getting paid twice for the same outcome) and the net loss of BES, uneven accounting of services on the impact and offset side and systematically compromising environmental outcomes by implementing approaches that fail to take into account our still limited understanding of ecological systems and their complex interactions.

There has been little clarity on key terms and approaches related to stacking and bundling. In particular, there is a lack of awareness of the possible risks in engaging with stacking. Yet, true stacking, associated with the greatest risks, does not appear to be common in practice. This may in part be because compensation-related policies often have strict additionality requirements. These generally exclude approaches to stack and unbundle services, credits and payments. To date, little experience of responsible stacking approaches exists, although there are a few instructive pilot schemes that have developed useful solutions to some of the challenges. Credible approaches that have been proposed include stacking without unbundling credits or payments, limiting the geographic scope of schemes with stacked credits, and not unbundling ecosystem-based credits or units of trade. In addition, the need for better accounting, improved transparency, and adequate resources and capacity of those administering conservation incentive and compensation schemes have been highlighted.

It is currently difficult to obtain good evidence that the anticipated benefits are indeed being realised, even in those S&B schemes that are explicitly targeting multiple services and benefits. It is equally difficult to obtain clear information on the potential costs, although well-established pilot projects may be able to undertake a high-level evaluation of costs and benefits (e.g. to service providers). The scope for scaling up these multiple benefits approaches is unclear in the absence of specific regulation of a larger suite of services (e.g. by compensation policies, thus changing demand drivers). Nevertheless, more discussion is needed to raise awareness and assist those considering S&B to avoid some of the pitfalls. Pilots and case studies can help to explore the feasibility of different approaches and identify possible solutions in specific contexts. This is relevant for those aiming for No Net Loss or a Net Gain of Biodiversity to ensure the best outcomes for developers, BES providers and society in terms of workable systems and good conservation outcomes.

6. Selected references

Business and Biodiversity Offsets Programme (BBOP). 2012. Standard on Biodiversity Offsets. BBOP, Washington, D.C. Available from https://www.forest-trends.org/publications/standard-on-biodiversity-offsets/

Cooley and Olander, 2012. Stacking Ecosystem Services Payments: Risks and Solutions. ENVIRONMENTAL LAW REPORTER 42: 10150- 10164.

Deal, Cochran, and LaRocco 2012; Deal, R. L., B. Cochran, and G. LaRocco. 2012. Bundling of ecosystem services to increase forestland value and enhance sustainable forest management. Forest Policy and Economics. Vol. 17: 69-76.

Gardner and Fox 2013; Gardner, RC and Fox, J. 2013. The Legal Status of Environmental Credit Stacking. ECOLOGY LAW QUARTERLY 40: 101-232.

Gillenwater 2011; Gillenwater M. 2012. What is additionality? Part 3: implications for stacking and unbundling. http://ghginstitute.org/wp-content/uploads/2015/04/AdditionalityPaper_Part-2ver3FINAL.pdf

Haines-Young, R.H. and Potschin, M.P. 2010A. The links between biodiversity, ecosystem services and human well-being In: Raffaelli, D. & C. Frid (eds.) Ecosystem Ecology: a new synthesis. BES Ecological Reviews Series, CUP, Cambridge.

Raudsepp-Hearne, C., Peterson, G.D. and Bennett, E.M. 2010. Ecosystem service bundles for analyzing tradeoffs in diverse landscapes PNAS. www.pnas.org/cgi/doi/10.1073/pnas.0907284107

Robertson et al. 2014; Robertson, M, BenDor, TK, Lave, R. Riggsbee, A., Ruhl, JB and Doyle, M. Stacking ecosystem services. 2014. Frontiers in Ecology and the Environment. doi:10.1890/110292

Willamette Partnership: Willamette Partnership. 2010. Ecosystem credit accounting. Portland, OR: Willamette Partnership. http://willamettepartnership.org/resources/ecas/

Willamette Partnership 2013 (Ecosystem Credit Accounting System, General Crediting Protocol Version 2.0. http://willamettepartnership.org/wp-content/uploads/2014/06/General-Crediting-Protocol-v2.0_2013_updated-2017-1.pdf

Fox, J., R. C. Gardner and Maki, T., 2011. Stacking Opportunities and Risks in Environmental Credit Markets. Environmental Law Reporter 41: 10121-10125

Woodward, R. T., 2011, "Double-dipping in environmental markets." Journal of Environmental Economics and Management 61(2): 153-169.

7. Annex 1. List of programmes and projects reviewed

Programme Type and Cases Reviewed
Conservation Incentive Programmes that involve PES
Costa Rica National PSAH
Ecuador's National Socio Bosque and Socio Paramo
US Farm Bill Conservation Payments
Water Funds (FONAG)
Los Negros PES, Bolivia
Multiple Services PES, Northern Plains, Cambodia
Regional Integrated Silvopastoral Ecosystem Management Project (RISEMP), Costa Rica, Nicaragua and Colombia
Compensation and Offset Programmes, including voluntary and regulated examples
Biodiversity Offsets (could be voluntary or regulated offsets)
Forest Carbon Markets (voluntary)
Oddar Meanchey REDD+ project, Cambodia (voluntary offsets)
US Wetland Mitigation Banking and Environmental Banc and Exchange (regulated)
US Endangered Species Habitat Banking and Van Vleck Conservation Bank (regulated)
Water Quality Trading (Ohio River Basin Water Quality Trading Program), USA (regulated)
Offset for the Baralaba mine, Queensland, Australia (regulated)
Carbon Farming Initiative, CFI Act (CFI, 2011), New South Wales Offset Policy for Major Projects and the Environmental Protection and Biodiversity Conservation Act (EPBC Act, 1999), Australia (voluntary and regulated offsets)
Flaechenagentur Brandenburg, Germany (regulated and voluntary offsets)
Programmes involving both offsets and incentive-based payments
Tualatin River Water Quality Program, USA
Willamette Partnership, USA
Conservation Marketplace of the Midwest, USA

8. Annex 2 Selected examples of programmes and projects illustrating bundling and stacking in offsets and conservation incentive schemes

1. Examples of bundling in conservation incentive schemes:
Costa Rica's national-scale, government-mediated PES scheme makes payments to land managers for forest protection, reforestation, agroforestry, and forest regeneration practices. It is a conservation incentive scheme aimed at promoting good land management to improve and/or maintain levels of four key goods and services that are essentially treated as a bundle: biodiversity, source water protection, carbon sequestration, and landscape beauty. To achieve outcomes in terms of these bundled services, payments are directed primarily to areas identified as important biodiversity hotspots or corridors as well as being important for protecting watersheds that contribute to water supply and/or water quality, with payment amounts tied to the type of land management undertaken. The individual services in the bundle are not accounted for or quantified individually.
Ecuador's National Socio Bosque and Socio Paramo: This national programme began in 2008 and provides direct economic incentives to rural communities and indigenous groups that commit to implementing specified conservation practices as structured in conservation agreements. The programme is a conservation

incentives scheme which specifically tries to align poverty alleviation objectives with conservation objectives. Incentives are provided to farmers or communities on the basis of area and the practices implemented. The programme initially focused on protecting native forest ecosystems but since 2009 has included paramo grasslands (Socio Paramo), primarily for their importance to maintaining freshwater flows (http://www.ambiente.gob.ec/?s=socio+bosque). The programme goals identify the bundle of valued BES on which conservation is focused, but they are not accounted for separately: a) conserving globally important biodiversity; b) reducing GHG emissions from deforestation; c) protecting soils and water; d) controlling natural disasters and climate adaptation; and e) increasing incomes and protecting human capital in the poorest rural communities.

United States (US) Farm Bill Conservation Payments: Publicly funded conservation incentives schemes, such as the Farm Bill programmes[11] in the US and the EU's agri-environment measures[12] aim to deliver a bundle of loosely defined services and benefits. The US Farm Bill programmes aim to promote farming practices that enhance public goods and benefit society as a whole, e.g. improving air and water quality, climate mitigation measures, conserving soil, and enhancing wildlife habitat. Farmers receive payments for practices such as managing nutrients and reducing fertilizer use, protecting wetlands, establishing conservation easements, or planting hedgerows. These activities are presumed to produce multiple benefits derived from a bundle of services that are not explicitly defined or measured.

Two key questions have been raised with relevance to S&B: Are the BES generated through public funding owned by the public or the farmer, and hence could they be sold for private profit? And can the BES generated through Farm Bill programmes be considered additional in the context of offsets or PES? Notably, the Department of Agriculture allows the sale of environmental credits from lands enrolled in the programmes and 'asserts no direct or indirect interest in these credits' (EQIP 7 CFR, 1466.36; CSP 7 CFR, 1470.37). This opens the door for credit and payment stacking. However, individual environmental compensation markets in the US have developed rules as to whether projects and credits created through public funding can be used and if so, how. Thus, farmers enrolled in the wetland reserve programme, for example, are not allowed to sell wetland credits under the regulations governing wetland mitigation in the US.

Water Funds are an increasingly popular financial mechanism for watershed-focused PES projects that also emphasize biodiversity conservation. These funds target hydrological services, but are based on the presumption that protecting existing natural areas, restoring degraded natural areas, and improving production practices in forestry and agriculture will improve water quality and supply while also providing associated biodiversity and livelihood co-benefits. These programmes are actually pooling funds from different sources – typically beverage companies, conservation groups, water utilities hydroelectric facilities – in much the same way that national PES programmes may use a variety of funding sources (e.g., taxes, tariffs, payments from individual businesses). Water funds implicitly target a bundle of services but do not typically account for the individual BES in the bundle.

Regional Integrated Silvopastoral Ecosystem Management Project (RISEMP), Costa Rica, Nicaragua and Colombia: The Regional Integrated Silvopastoral Ecosystem Management Project (Silvopastoral Project; RISEMP) was a GEF-sponsored programme implemented between 2002 and 2008 by the World Bank and CATIE. This programme was designed as a pilot project to promote silvopastoral practices through technical assistance and payments for BES in three countries. The programme was unusual in that it rewarded land managers explicitly for bundled services and used a ranking system based on the degree to which multiple services were provided. The ranking was based on an assessment of the extent to which different land

[11] E.g. the Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), Wetlands Reserve Program (WRP), Wildlife Habitat Incentives Program (WHIP), and Environmental Quality Incentives Program (EQIP)

[12] http://ec.europa.eu/agriculture/envir/measures/index_en.htm

management types contribute to a specific set of services, although still accounting for only quite few services. The programme created an BES index (ESI) related to the capacity of 28 different land uses to provide biodiversity, carbon sequestration, and a combined ('biodiversity + carbon') ecosystem service outcome. Payments were based on the ESI score, with the areas receiving the highest overall scores (i.e., where the biodiversity and carbon scores are similar and both high) receiving the largest payments. Projects resulting in the bundle of 'biodiversity + carbon' outcomes thus received a small price premium compared to projects delivering a single service.

2. Examples of bundling in compensation and offset programmes

Forest Carbon Markets (voluntary): Standards and certification systems for carbon offset projects have been developed to assure that projects focused on climate mitigation also protect or enhance other services and co-benefits. A good example is offered by the Climate, Community and Biodiversity Standards (CCB[13]). While carbon offset markets trade in credits based on units of carbon (tCO2e), buyers of CCB certified offsets are explicitly interested in carbon-related services that come with a bundle of other services. The CCB Standard explicitly requires that eligible land management projects assess and demonstrate benefits for biodiversity and local communities alongside climate mitigation services. Although GHG emissions reductions are the focal service, the result of following Voluntary Carbon Standard with CCB certification is a relatively explicit bundle of services, all of which must be delivered together: the disaggregation of the different goods and services (or sets of services) making up the bundle is not possible. This is important not least because there are no equally strict requirements on the buyers' side to determine any impacts on biodiversity or community-related services associated with their GHG emissions.

There is some evidence that carbon offsets offering a bundle of diverse services have advantages for market participants. Thus, almost half of forest/land-use carbon projects in 2012 had dual VCS+CCB certification and the volume of transactions from dual certification more than tripled between 2011-2012 (e.g. Peters-Stanley et al. 2013). This suggests that a significant and growing number of buyers of forestry carbon offsets are interested in the co-benefits associated with forest carbon. While there is virtually no price premium for carbon with bundled services, such credits may be a pre-requisite in voluntary carbon markets.

Wetland mitigation banking: The US Clean Water Act (CWA) and mitigation guidance for permitted impacts on wetlands (Section 404) states that there should be 'no net loss' of wetland functions and values. In essence, the bundle of wetland-related BES affected by a permitted impact must be replaced (e.g. through compensation / offsets) with an equivalent bundle of services. Wetland mitigation banks aim to deliver such offsets by generating wetland credits for sale to project developers. Credits are based on the 'uplift' or the amount (area) and type of wetland that has been restored and protected in the bank area. These ecosystem-based units of trade are meant to represent the full range of inter-related wetland functions and BES to be compensated, i.e. a bundle of diverse services. Traditionally, credits have been based on wetland area ('acreage') alone. This simple proxy can hide many real losses and also gains in functions, services and benefits. While this very general accounting is still used in many states in the US, there has been a move away from strictly area-based accounting towards improved measures that integrate condition or sets of functions and services (e.g. linked to hydrology, habitat, and water quality as in North Carolina). While wetland mitigation remains based on a more or less explicitly defined and bundled wetland credit, better methods to account for subsets of services that are part of a wetland credit will assist with the integrity of offset exchanges[14]. This is provided that the same methods are used on impact and offset sides so as to avoid asymmetry in losses and gains.

[13] http://www.v-c-s.org/project/ccb-program/

[14] Although wetland credits represent a bundle of services, prices are rarely linked to the quantity or quality of services in the bundle. The prices are mainly driven by credit demand and supply and by the transaction costs of establishing the bank. There is no premium per se for providing a more versus a less diverse bundle, although credit ratios are often used to determine how many credits are

More robust accounting may pave the way to stacking, although true stacking is currently not allowed. This is despite significant interest – at least amongst wetland bankers - in the potential of unbundling sets of services, credits and payments. However, the 2008 compensatory mitigation regulations by the US Army Corps and Environmental Protection Agency prevent the use of the same credits to provide mitigation for more than one permitted activity.'[15] This is because it is recognized that wetland credits already take into account a wide range of services. For instance, the Spellbottom Mitigation Bank offers three types of credit that are based on measuring the following wetland functions: temporary storage of surface water, maintenance of plant and animal communities, and removal and sequestration of elements and compounds. The credits are stacked as they arise from the same parcel of land. According to the mitigation banking agreement the different credit types have to be traded as a suite of functions, which means they can be stacked but not unbundled for sale to different project developers.

Van Vleck Conservation Bank: Three types of credits are available from the Van Vleck Ranch bank (765 acres): wetland mitigation credits under the Clean Water Act (CWA) and two types of species credits (for fairy shrimp regulated under the Endangered Species Act and for Swainson's hawk). The credits for the hawk are generated on grassland areas which are spatially separate from the wetlands, so hawk credits can be sold independently. However, some areas of the bank could be used both for species credits (vernal pool fairy shrimp) and wetlands credits (vernal pool wetlands). According to the two agencies overseeing the CWA and ESA, created vernal pools can be used to offset either impacts on fairy shrimp habitat OR impacts on wetlands, i.e. the option of selling either credit type is allowed. Once a fairy shrimp or wetland credit derived from a specific parcel of land is sold, the parcel as well as both credits are retired from the mitigation markets. The permitting agencies do not allow the unbundling of stacked credits in this situation as wetland credits already take into account habitat and wildlife services, an argument which holds both from ecological and legal perspectives.

3. Examples of true stacking in compensation/ offset schemes:

US Wetland Mitigation Banking and the Neu-Con bank: This is one of the few examples of true credit stacking with unbundling. It involved the sale of wetland and water quality credits from spatially overlapping areas on the same site into two different credit markets to offset impacts from multiple projects. The Neu-Con wetland bank was created in North Carolina in the late 1990's. The bank was certified and credits released for sale under the state's wetland mitigation banking rules. In 2000, wetland credits were sold to the North Carolina Department of Transportation (NCDOT) to compensate for wetland impacts from state transportation projects. All of the bank's wetland credits were sold. In 2009, the bank sold water quality credits (nutrient offsets in the form of nitrogen reductions) certified by the Division of Water Quality (DWQ) to the NC Ecosystem Enhancement Program, a state programme that buys environmental credits to be used to offset the impacts of development (primarily from the NCDOT). At the time of the nutrient offset credit sales, North Carolina did not have policies in place to address credit and payment stacking. While the Neu-Con bank's transactions were officially permitted, the state has since revised its banking rules and does not now allow this type of credit stacking and unbundling.

needed to offset a particular impact (e.g. 5 credits: 1 debit). As ratios may be linked to the type and quality of the outcomes at an offset site, they could serve as a very coarse tool to favor credits representing diverse or complete service bundles.

15 40 C.F.R. § 230.93(j)(1)(ii) (2013) in Gardner and Fox, 2013.

New South Wales Offset Policy for Major Projects, Carbon Farming Initiative, CFI Act (CFI, 2011), and the Environmental Protection and Biodiversity Conservation Act (EPBC Act, 1999) [16], Australia: Two federal policy instruments deal with the management and offsetting of biodiversity and of carbon on freehold and leasehold land: the Carbon Credits Act (Carbon Farming Initiative, CFI, 2011) and the Environmental Protection and Biodiversity Conservation Act (EPBC Act, 1999). The CFI enables land managers to obtain carbon credits through better land management that stores carbon or reduces greenhouse gas (GHG) emissions, e.g. through reforestation. Projects must demonstrate additionality relative to 'business as usual' levels for GHG emissions and permanence of offset outcomes. The 2012 EPBC Biodiversity Offset Policy in turn sets out the role of biodiversity offsets in environmental impact assessments for proposed developments that affect matters of national environmental significance (e.g. listed threatened species and ecological communities). The policy does not allow a biodiversity offset to be provided on top of a carbon offset developed under the CFI and the Carbon Emissions Fund. It explicitly states: '… the conservation gain achieved while participating in another scheme (such as the Carbon Farming Initiative), would also not be eligible for use as an offset.' [17]

However, several states have their own offset policies in addition to the federal policy. The New South Wales (NSW) Offset Policy for major developments provides the first instance in Australia of formally enabled credit stacking with unbundling, i.e. true stacking, specifically of biodiversity offsets and carbon offsets. The policy states: 'Land management requirements for the purpose of creating carbon credits are not considered to be legal requirements for biodiversity management under this policy. This means that the same site can potentially generate both biodiversity credits and carbon credits through the same management actions.' (State of NSW and OEH, 2014). This policy position is counter to the EPBC Biodiversity Offset Policy and the CFI and has drawn criticism from various stakeholders, including the Australian Conservation Foundation[18]. Apart from the legality of the policy position, which appears unresolved to date, concerns include the lack of additionality, the risk of double counting and associated net loss of biodiversity and BES. Only with complete, symmetrical accounting of all carbon and biodiversity losses and gains across all affected sites / operations (on impact and offset sides) could these risks be addressed.

4. Examples of stacking without unbundling in schemes involving compensation and conservation incentive programmes:

Flaechenagentur Brandenburg, Germany: In Germany, impact assessment, mitigation measures, and compensation/offsetting are regulated under federal law[19]. Compensation pools (conservation banks) which deliver ecological compensation outcomes can be established and operated by a range of institutions. The compensation agency in Brandenburg provides such compensation pools. In addition to providing compliance-driven offsets for residual ecological impacts, the agency was interested in selling voluntary carbon offsets. To resolve questions around whether or how to bundle or stack these different types of credits in a robust way the agency held discussions with key stakeholders. It was decided not to 'stack and unbundle' credits and payments but rather to implement the following two models: a) To target spatially separate lands and projects that are either compensation pools dedicated to providing ecological

[16] Australian Department of the Environment. EPBC Environmental Offsets policy. 2012. Available at http://www.environment.gov.au/epbc/publications/epbc-act-environmental-offsets-policy and Department of the Environment. Carbon Credit (Carbon Farming Initiative) Act. 2011 (updated 2017). https://www.legislation.gov.au/Series/C2011A00101 and http://www.environment.gov.au/climate-change/government/emissions-reduction-fund/about

[17] Under the EPBC policy, it is theoretically possible to provide offsets for several regulated species and ecosystems on a single site provided that additionality can be demonstrated for each affected biodiversity component. However, offsets are generally project-specific, i.e. they are provided for a particular set of residual impacts caused by a single development project rather than numerous developments, which limits the opportunity for this kind of stacking.

[18] Australian Conservation Foundation. 2-2-2015. Submission on draft assessment bilateral agreement between the Commonwealth and the State of New South Wales. https://d3n8a8pro7vhmx.cloudfront.net/auscon/pages/1054/attachments/original/1466900727/2015_EPBC_NSW_assessbilat_ACFsub.pdf

[19] Federal Nature Conservation Act of 1976 (revised in 2002 and 2010), Article 19 on impact mitigation regulation.

compensation-related credits or peat lands for voluntary carbon offsets. b) To develop projects and lands where the two credit types are quantified and explicitly related to each other using a detailed methodology and then stacked but not unbundled. The decision to stack but not to unbundle included the lack of additionality regarding ecological outcomes if true stacking were used, the need to safeguard the integrity of credits provided in order to ensure defensible outcomes and prevent the erosion of ecological services and to assure the credibility of the agency.

Willamette Partnership Counting on the Environment (COTE), **USA:** The scheme was established in 2009. A group of stakeholders (federal, state, and local governments, conservation groups, farmers), facilitated by the Willamette Partnership, agreed to pilot trading in multiple types of environmental credits. It was recognized that landowners undertaking ecological restoration provide an array of BES, only few of which are valued under existing regulations (e.g., Clean Water Act) or environmental markets (e.g., voluntary carbon offsets). The goal is to find ways of supporting rural land owners and incentivizing whole system restoration and the provision of a broad suite of services by creating robust mechanisms for trading multiple services in one marketplace[20].

An accounting and measurement protocol has been established for an initial set of four credit types – wetlands, salmonid habitat, water quality, and upland prairie. Any restoration project may generate outcomes for all or a subset of credit types. The protocol provides a credit metric based on a broad suite of ecological functions and services associated with each credit type. Thus the wetlands credit metric captures the biodiversity, flood protection, and water quality aspects of wetlands and can reflect the overall quality of a restoration project. The protocol also sets out how additionality is assessed and establishes project eligibility criteria and eligible project actions. Methods for reconciling environmental credits and funding received from public conservation incentive programmes are included. The presence and number of different credit types is determined by assessing a number of functional indicators on a given site. The same area and management activities can contribute to more than one credit type (e.g. salmon and temperature/ water quality credits). The protocol also defines the relationships between the different credit types where these form part of stack and are clearly linked. This helps govern the sale of individual credit types since associated credits need to be proportionally retired (i.e. they become unavailable for sale). The protocol rules out unbundling these credit types. When a number of wetland credits are sold, the species and temperature credits generated from the same parcel are reduced by the same proportion. The reasons for not unbundling credits are the interrelatedness of the various functions, outcomes, credits, and potential for double counting/dipping.

The programme thus offers a way to account for an explicit subset of services from a single site and project and to reward restoration projects that provide a more diverse and higher quality bundle / stack of services. By parsing out different credit types comprising a stack, land owners/ service providers are given the flexibility to sell the credit type that has the most value at any one time, and to avoid double dipping by proportionately retiring the other services in the bundle when a specific credit type is sold.

[20] For more, please see http://willamettepartnership.org/resources/market-tools-rules/

To learn more about BBOP, see:
www.forest-trends.org/BBOP