

# CES/COS/CIS paradigms for compensation and rewards to enhance environmental services

---

*Meine van Noorwijk and Beria Leimona*

Southeast Asia





# CES/COS/CIS paradigms for compensation and rewards to enhance environmental services

---

Meine van Noordwijk and Beria Leimona

Working Paper nr 100



World Agroforestry Centre  
TRANSFORMING LIVES AND LANDSCAPES

**Correct citation:**

Meine van Noordwijk and Beria Leimona. 2010. CES/COS/CIS paradigms for compensation and rewards to enhance environmental services. Working paper nr 100. World Agroforestry Centre. Bogor, Indonesia. 30p

Titles in the Working Paper Series aim to disseminate interim results on agroforestry research and practices and stimulate feedback from the scientific community. Other publication series from the World Agroforestry Centre include: Agroforestry Perspectives, Technical Manuals and Occasional Papers.

Published by  
World Agroforestry Centre  
ICRAF Southeast Asia Regional Office  
PO Box 161, Bogor 16001, Indonesia

Tel: +62 251 8625415  
Fax: +62 251 8625416  
Email: [icraf-indonesia@cgiar.org](mailto:icraf-indonesia@cgiar.org)  
<http://www.worldagroforestrycentre.org/sea>

© World Agroforestry Centre 2010  
Working Paper nr 100

The views expressed in this publication are those of the author(s) and not necessarily those of the World Agroforestry Centre.

Articles appearing in this publication may be quoted or reproduced without charge, provided the source is acknowledged.

All images remain the sole property of their source and may not be used for any purpose without written permission of the source.

## **Abstract**

The terminology of Payments for Environmental Services (PES) has rapidly gained popularity with its focus on market-based mechanism for environmental service (ES) enhancement. Current use of the term, however, covers a broad spectrum of interactions between ES-suppliers and ES-beneficiaries. A broader class of mechanisms aims at ES enhancement through compensation or rewards (CRES). Such mechanisms can be analyzed on the basis of the way they meet four principles: Realistic, Conditional, Voluntary and Pro-poor. For each principle a set of criteria is presented. Based on direct involvement in action research mode in evolving practices in Asia in the RUPES program since 2002, we examine three paradigms: 'Commoditized ES', 'Compensation for Opportunities Skipped' and 'Co-Investment in Stewardship', CES, COS and CIS, respectively. Among the RUPES action research sites in Asia, there are several examples of CIS, co-investment in and shared responsibility for stewardship, with a focus on 'assets' (natural + human + social capital) that can be expected to provide future flows of environmental services. CES, equivalent to a strict definition of PES, may represent an abstraction rather than a current reality. COS is a challenge when the legality of opportunities to reduce environmental services is contested. The primary difference between CES, COS and CIS is in the way 'conditionality' is achieved, with additional variation in the scale (individual, household, community) at which the 'voluntary' principle takes shape. CIS approaches have the biggest opportunity to be 'pro-poor', as both CES and COS presuppose property rights that the rural poor often don't have. CIS requires and reinforces trust-building after initial conflicts over the impacts of resource use on environmental services have been clarified and a 'realistic' joint appraisal is obtained. CIS will often be part of a multi-scale approach to the regeneration and survival of natural capital, alongside respect and appreciation for the guardians and stewards of landscapes

## **Keywords**

Asia, boundary organizations, criteria and indicators, livelihood, payment for environmental services, RUPES

## **Acknowledgment**

The ideas in this paper have gradually matured following discussions with partners, consideration of the results from regional workshops, global overviews and a synthesis of the Compensation and Rewards for Environmental Services (CRES) Scoping Study tasked by the International Development Research Centre (IDRC). We acknowledge Brent Swallow, Lucy Emerton, Thomas P. Tomich, Sandra J. Velarde, Mikkel Kallesoe and Madhushree Sekher for their ideas and fruitful input to earlier versions of this paper, and William C. Clark, Elisabeth McNie, Nancy Dickens and Delia Catacutan for discussions of concepts. The International Fund for Agriculture and Development (IFAD), the European Union and a National Science Foundation grant, in cooperation with Harvard University (“Boundary Organizations”), co-invested in the research presented here, but these institutions are not responsible for the content.

## Contents

1. Introduction: Payments to Enhance Environmental Services.....	1
2. Building blocks for this review.....	5
2.1 Principles for comparing compensation and rewards for ES .....	5
2.2 Prototypes in relation to the principles and criteria.....	8
2.3 RUPES action research at site and national level.....	8
2.4 CES/COS/CIS paradigms for compensation and rewards to enhance of environmental services.....	10
3. Linking Principles, Prototypes, Sites and Paradigms .....	13
3.1 Realistic .....	13
3.2 Voluntary.....	13
3.3 Conditionality.....	14
3.4 Pro-poor.....	14
3.5 Principles, criteria and prototypes .....	15
3.6 Sites, paradigms, and principles .....	18
4. Discussion: process and institutional requirements for scaling out.....	20
4.1 Compatibility and possible synergy between paradigms .....	20
4.2 Process and boundary objects of shared knowledge .....	20
4.3 Scale issues.....	21
4.4 In conclusion .....	24
References.....	25

# 1. Introduction:

## Payments to Enhance Environmental Services

Payment for Environmental Services (PES)<sup>1</sup> is widely seen as a way to ‘internalize externalities’ and provide land managers with appropriate incentives to opt for land use practices that maintain or enhance the level of environmental services that are expected, but have not so far been appreciated, by ‘downstream’ beneficiaries (Asquith and Wunder, 2008; Porras et al. 2008). In case of watershed services the term ‘downstream’ can be taken literally, where biodiversity conservation, landscape beauty or reduction of net emissions of greenhouse gasses is involved, the term is used as metaphor. Current and emerging mechanisms that use the PES terminology cover a wide range of mechanisms, ranging from subsidies for forest owners paid from levies on water or hydropower users, through trade in certificates of rights to pollute (based on certified emission reduction elsewhere), moral incentives to plant trees and ecotourism, to outcome-based contracts to reduce sediment loads of streams and rivers. Although all these mechanisms differ from a pure ‘command-and-control’ approach, there is a clear need for more careful descriptors of mechanisms as basis for comparisons of effectiveness. Signs that ‘buyers’ get uneasy with lack of service delivery are appearing (Kleijn et al., 2001; Landell-Mills and Porras, 2001). Swallow et al. (2009) proposed the term CRES (‘Compensation and Rewards for Environmental Services’) for a broader set of approaches, that have enhancement of environmental services as common goal.

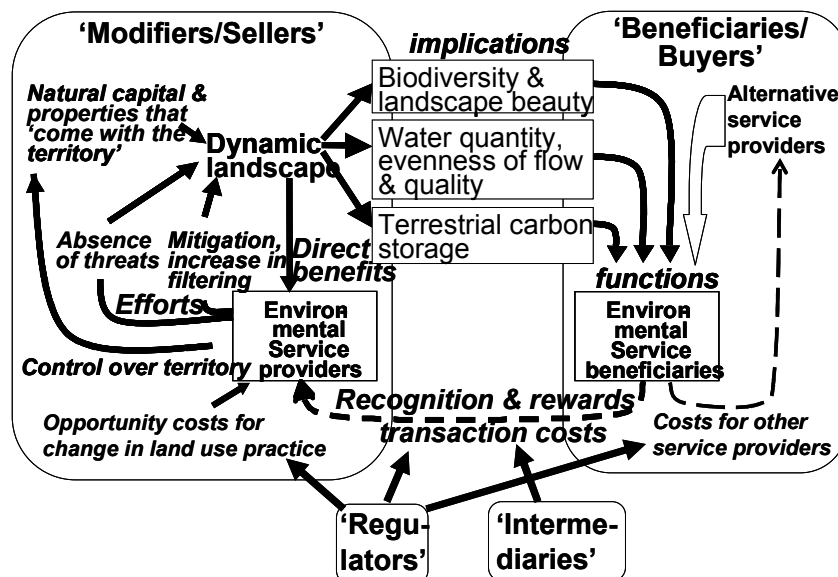
PES was defined by Wunder (2005) as “A payment for environmental services scheme is a voluntary transaction in which a well defined environmental service (ES) is bought by at least one ES buyer from a minimum of one ES provider, if and only if the provider continues to supply that service (conditionality)”. Strict use of this definition implies that PES does not currently exist in pure form, but partial matches are called ‘PES-like’ (Wunder, 2007). There is a wide range of PES-like arrangements, which vary in the type of incentive (payment or use of other currencies), the degree of voluntariness in buyers and sellers, the rights to sell and rights to buy, the degree of negotiation of the transaction, the clarity on what environmental services is provided and the way conditionality is operationalized. We derive three ‘principles’ from the PES definition: *realistic*, *conditional* and *voluntary* and find that there are many ways to (partially) achieve these. The close interactions between ‘livelihoods’ and ES has stimulated interest in ‘pro-poor’ forms of CRES (Swallow et al., 2009). Poverty arguments are relevant for ‘efficiency’ of the measures, as well as for ‘fairness’. We include it here as a fourth principle.

---

<sup>1</sup> The term ecosystem services according to Millennium Ecosystem Assessment (Carpenter et al., 2006) includes both ‘provisioning’ services (including all of agriculture and forest industries), which tend to have existing markets for goods, and regulating, supporting and cultural services that were previously labelled ‘environmental services’; we stay with the latter term in this paper (van Noordwijk et al., 2004a)



In the conceptual scheme of RUPES (van Noordwijk et al., 2004a), beyond ‘buyers’ and ‘sellers’ as in the Wunder (2005) definition, two other agents/stakeholders are included: ‘regulators’ and ‘intermediaries’ (Fig. 1).



**Figure 1.** The four categories of stakeholders ‘beneficiaries/buyers’, ‘modifiers/sellers’, ‘regulators’ and ‘intermediaries’ that are engaged in voluntary compensation and rewards for environmental services

PES in pure form may appear to link a financial flow to a flow of services derived from natural capital. Apart from the current flows of ‘environmental services’, however, there is interest in ‘investment in natural capital’ as basis for future ES (Wackernagel and Rees, 1997). The production function for environmental services (Tomich et al., 2004), however, includes both social and human capital, alongside natural capital, assisted or contravened by infrastructure (‘physical capital’), encompassing four of the five ‘capitals’ considered in livelihood analysis (Chambers and Conway, 1992). Flows of ‘financial capital’ in the form of payments need to be converted back into stocks, assets or capital form.

The interest in longer term ‘assets’ versus ‘current services’ varies among the ES and the amount of place-based investment of ES beneficiaries. For a hydropower company or drinking water reservoir the economic lifespan of the investment requires a direct matching in the time over which ES are needed. A more mobile tanker-level drinking water supplier may have more choices and less reason to invest for long time periods. Global concerns about biodiversity are focussed on slowing the rate of anthropogenic biodiversity loss, with a long term perspective. Postponing local extinctions by a few years is not interesting. Reducing net emissions of greenhouse gasses may appear to be the least place-bound (as greenhouse gasses have similar impact on the atmosphere wherever they are emitted or sequestered), Only a small part of ES can be ‘packaged’ in quantities that can be traded in open markets, detached from the place of origin of the commodity. Probably the closest approximation of full ‘commoditization’ of environmental services, but even here current contractual obligations include aspects of ‘permanence’ or the complex and low-value ‘temporary emission reduction

credits' that were created for A/R-CDM in the Kyoto protocol but found little application so far (van Noordwijk et al., 2008b).

Net C sequestration as an ES has followed separate institutional trajectories for the 'avoided emissions' and the 'restocking' activities. Potentially the first handles much larger fluxes (a ha of forest destroyed by bring some 200 t C into the atmosphere within a single year, Palm et al 2005) than restocking (2-5 t C ha<sup>-1</sup> year<sup>-1</sup>), while presence/absence of closed forest can be more easily assessed than small annual increments in stock. However, these advantages on the 'realistic' and 'conditional' fronts are apparently off-set by challenges on the 'voluntary' side: it is reasonable to compensate for effort in rehabilitation, while the attribution for not-(yet)-implementing a potential threat to an ES is complex. If the threat was small, external stakeholders may not need to pay (low 'additionality'), if the threat was high it may well have switched to another location ('leakage'), or happen soon after the contract ends ('lack of permanence'). The bargaining position may be best at intermediate level of threat, and a combination of threat and trust is needed to achieve agreements (van Noordwijk et al., 2008d).

The rehabilitation versus avoided emissions comparison may illustrate a further point: rehabilitation may require an initial investment, avoided degradation a recurrent offsetting of opportunities forgone (but still existing). The institutions for investment in projects that supposedly start a self-sustaining trajectory are more open to private sector engagement than the long-term modification of incentives. The latter may be difficult without involvement of public sector institutions. Recurrent payments versus one-off investment, and flows of environmental services versus securing assets. The simple PES paradigm is in need for revision or enrichment on both sides. Human and social capital are at least as important as the natural capital aspects of 'realistic' services: the relations of services with land use options need to be understood by all stakeholders in a similar manner before 'voluntary' agreements can emerge, while the 'fairness' of agreements may well be as important as the 'efficiency' focus on mainstream economics (Akerlof and Shiller, 2009)..

Enhancing environmental services through forms of compensation, rewards or payments requires linking knowledge and action, and as such may benefit from boundary organizations (Cash et al., 2006). In a pure PES form markets may ultimately become the mechanism to efficiently balance supply and demands for environmental services, but at this stage information is restricted, asymmetrical (Ferraro, 2008) and incomplete. Brokers are needed to provide access to knowledge and clarify bargaining positions. On the other side of the spectrum a benevolent top-down governance system that tries to impose 'fairness' in actions to enhance environmental services as 'public goods' will require detailed knowledge of how environmental services are affected by the many options and realities in land use. In between these two extreme positions, there is a need for public investment in the development of 'boundary objects' or knowledge products that can be accepted by the various stakeholders as background for their negotiations of adjusting 'action'.

Based on direct involvement in action research mode in evolving practices in Asia under the Rewarding Upland Poor for Environmental Services they provide (RUPES)<sup>2</sup> program, we will examine the paradigms encountered. We start with a tentative set of principles and criteria for realistic, conditional, voluntary and/or pro-poor enhance of environmental services within CRES (Swallow et al., 2009) and a list of ‘prototypes’ of ES enhancement. We then describe the lessons learnt in RUPES and compare three paradigms that between them capture most of the current variation in approaches. By relating criteria, paradigms and emerging experience at site level, we will review whether or not ‘PES’ and ‘PES-like’ are adequate labels for the range of approaches that is currently evolving.

---

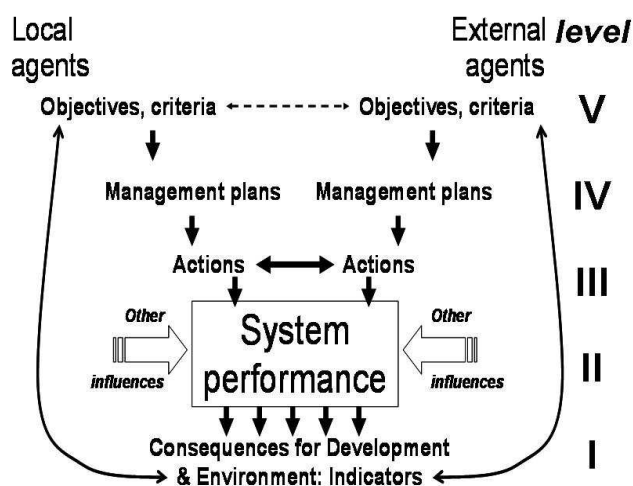
<sup>2</sup> The Rewarding Upland Poor for Environmental Services that they provide (RUPES) project Phase I was a project coordinated by the World Agroforestry Centre (2002-2007). The goal of the project was to enhance the livelihoods and reduce poverty of the upland poor while supporting environmental conservation through rewards for ES. For further reference, see <http://www.worldagroforestrycenter.org/sea/networks/rupes/index.asp>.

## 2. Building blocks for this review

### 2.1 Principles for comparing compensation and rewards for ES

Swallow et al. (2009) introduced CRES as a term that encompasses PES, PES-like and other approaches that have a shared objective of enhancement of Environmental Services. We will follow this approach and compare with a set of principles (van Noordwijk et al. 2008d) that align with partial correspondence to the Wunder (2005) definition of PES:

- (1) Realistic: tangible and sustainable *reduction* or *avoidance* of threats and/or measurable *recovery* from past degradation of environmental services, at appropriate scale, in a ‘with CRES’ relative to a ‘without CRES’ comparison.
- (2) Voluntary: engagement of both ES providers and ES beneficiaries in a negotiated scheme through free choice at individual level rather than on being the object of regulation (even if that implies a right to compensation). A weaker form of ‘voluntary’ refers to agreements at the scale of ‘collective action’ for providers and/or beneficiaries (as is common where electricity or water monopolists include a levy). Rules for ‘compensation’ may also apply where ES beneficiaries have a right to live in a pollution free world that exceeds the rights to pollute of others.
- (3) Conditional: transparency of contracts that link tangible benefits for the ES providers to the actual enhanced delivery of ES (level I), and/or maintenance of agroecosystem in a desirable state (level II), and/or performance of agreed actions to enhance ES (level III), and/or development and implementation of management plans to enhance ES (level IV) or respect for local sovereignty in managing the environment for local plus external benefits (level V)



**Figure 2.** Five levels at which agreements on ES Compensation and Reward schemes between local agents as ‘ES providers’ and external actors as ‘ES beneficiaries’ can be ‘conditional’: I. Consequences for the ES, II. Condition of the agroecosystem (e.g. tree cover), III. Input use and human activity (e.g. tree planting), IV. Management plans or V. Management objectives (modified from van Noordwijk et al., 2004b)

These three principles refer to effectiveness, when measured for effect on ES, and efficiency, when effectiveness is expressed per unit investment by ES beneficiaries. A fourth principle refers to 'fairness':

- (4) Pro-poor: CRES schemes acknowledge that they can have impacts that are differentiated by wealth or gender among ES providers and ES beneficiaries and they aim for a positive bias towards poor stakeholders in either group to comply with the Millennium Development Goals and as a step towards long term sustainability.

By reviewing literature and discussions with many stakeholders van Noordwijk et al. (2007) developed a tentative set of 'criteria' that can clarify the four principles, but that each will require 'indicators' that may have to site and situation specific.

**Table 1.** Criteria proposed for the four principles of CRES (van Noordwijk et al., 2007)

(Stage)	Principle	Criteria
<b>A. Effectiveness, Efficiency and Sustainability</b>		
<b>I. Realistic</b> <i>(Scoping stage)</i>	Effectively mitigates, reduces or avoids threats to ES for all parties involved	<ol style="list-style-type: none"> <li>1. A broadly shared perception of <i>cause-effect</i> relations links <i>threats</i> to ES or to the ecosystem that provides ES, to potential <i>activities to reduce or avoid</i> these threats by identifiable actors at a relevant temporal and spatial scale</li> <li>2. The <i>value</i> to ES-beneficiaries of reduction or avoidance of the threats, relative to alternative ways to meet their needs, is <i>substantive</i> (within the context of the key actors)</li> <li>3. There are <i>opportunity costs</i> and/or <i>resource access constraints</i> for the potential ‘ES providers’ that can be off-set or overcome without major negative ‘external effects’ (leakage)</li> <li>4. The threat to the ES and its reduction (or avoidance) by ES providers can be <i>assessed</i> and <i>monitored</i> in a transparent way, as a basis for conditional incentives</li> </ol>
<b>II. Voluntary</b> <i>(Stake-holder analysis)</i>	Engagement involves choice rather than being the object of regulation	<ol style="list-style-type: none"> <li>5. Legitimacy at individual level: representation is subject to checks and balances</li> <li>6. Effective voice of all stakeholders is heard; free and prior informed consent principles apply</li> <li>7. Adaptiveness of the mechanism includes a time frame for review on pre-agreed performance indicators and an exit strategy</li> </ol>
<b>III. Conditional</b> <i>(Negotiation &amp; implementation)</i>	Service and rewards or compensation are dynamically linked	<ol style="list-style-type: none"> <li>8. ES-reward agreements strike a balance between outcome-based rewards, activity-centered incentives, support for community-scale resource management and establishment of trust</li> <li>9. Sanctions exist to deal with non-compliance by contract partners, within the human and legal rights of both sides (linked to exit strategy in 7)</li> <li>10. ES reward agreements acknowledge the potential of environmental variability and change, ‘third-party roles’ (incl. climate change) to affect the ecosystem and its ES provision</li> </ol>
<b>B. Equity, Fairness</b>		
<b>IV. Pro-poor</b> <i>(All stages)</i>	Mechanisms selected are positively biased towards disadvantaged stakeholders	<ol style="list-style-type: none"> <li>11. ES reward mechanisms support ‘sustainable development’ pathways out of poverty for achieving Millennium Development Goals, by addressing the priorities (and criteria...) of ‘poor’ stakeholders</li> <li>12. ES reward mechanisms reduce asset insecurity (including access to land)</li> </ol>

## 2.2 Prototypes in relation to the principles and criteria

Van Noordwijk (2005) proposed a set of twelve ‘prototypes’ of CRES that each combine a typical landscape context, mechanism of influencing ES and relevance of these ES for downstream (or out-of-landscape) beneficiaries.

1. Wcons1: Total water yield for hydropower via storage lake
2. Wcons2: Regular water supply for hydro power via run-off-the-river
3. Wcons3: Drinking water provision (surface or groundwater)
4. Wcons4: Flood prevention
5. Wcons5: Landslide prevention
6. Wrehab: General watershed rehabilitation and erosion control
7. Bcons1 : Biodiversity conservation through bufferzones around protected area
8. Bcons2 : Biodiversity conservation through landscape corridors
9. Crehab : Carbon restocking of depleted landscapes
10. Ccons : Protecting soil and tree C stocks
11. Ecolabel: Guaranteeing production landscapes meet environmental standards
12. EcoTour: Providing guided access to landscapes of beauty/ heritage/ recreational value.

Porras et al. (2008) provided a global review of the current experience with such prototypes. We will here compare them with the ways the 4 principles can be achieved.

## 2.3 RUPES action research at site and national level

The RUPES program has been in operation since 2002 and developed a set of six primary ‘action research sites’ in Indonesia, Philippines and Nepal<sup>3</sup>. Questions framed at the start of RUPES were:

1. What are environmental services to whom and where?
2. How do all stakeholders know?
3. Which reward mechanisms and how do they work?
4. Which policies can support effective, efficient and equitable rewards and how?

These questions, in essence, were the basis for the exploration of the ‘realistic’, ‘voluntary’, ‘conditional’ and ‘pro-poor’ principles, respectively, as elaborated in the conceptual basis of the program (Tomich et al. 2004; van Noordwijk et al. 2004a). The four ‘principles’ as currently recognized (van Noordwijk et al. 2008a; Swallow et al. 2007a) became a major vehicle for synthesizing the main lessons learnt from the ‘action research’ mode, where researchers and project staff reflected together with local project partners on what had been achieved. An overview of the RUPES and associated sites is provided in Table 2, with characterization of the main environmental service issue, the type of conditionality and the mechanism under development.

---

<sup>3</sup> Publications in various forms are accessible through the website, with the national policy dialogues were initiated in Indonesia, Philippines and Vietnam. An international workshop for practitioners and scientists reviewed and synthesized the results of the RUPES-I project.

**Table 2.** Site level experience in the project Rewarding Upland Poor for the Environmental Services they provide (RUPES) in Asia

Site	Focus of ES	Conditionality applied (compare Fig. 2)	Type of scheme and current status
<b>Indonesia</b>			
<b>Bungo</b>  <a href="http://www.worldagroforestrycentre.org/sea/Publications/files/leaflet/LE0046-07.PDF">http://www.worldagroforestrycentre.org/sea/Publications/files/leaflet/LE0046-07.PDF</a>	Jungle rubber for conservation of the diversity of local plant species and wildlife habitat	Level IV Management plan of rubber agroforestry in general, including specified agricultural technique No slash-and-burn Conserving buffer zone and 'lubuk larangan' No intensive and commercial wild-hunt and NTFP	<ul style="list-style-type: none"> <li>• 'Hutan desa' recognition by central government for local forest management role within watershed protection forest</li> <li>• Testing mini hydropower as intermediate reward for biodiversity conservation</li> <li>• A private buyer (automotive wheel industry) showing interests for rubber for "green" vehicles</li> </ul>
<b>Cidanau</b>	Water quality and regular flow for private water companies	Level II Planting and maintaining timber and fruit trees with the total minimum of 500 trees per hectare for 5 years	<ul style="list-style-type: none"> <li>• A private water company is paying US 120/hectare for the contract</li> </ul>
<b>Singkarak (Watershed)</b>  <a href="http://worldagroforestry.org/sea/Publications/files/leaflet/LE0050-07.PDF">http://worldagroforestry.org/sea/Publications/files/leaflet/LE0050-07.PDF</a>	Water quality for hydropower, native fish conservation and ecotourism	Level IV Planting a 40-hectare grass land with timber and fruit trees	<ul style="list-style-type: none"> <li>• Conservation fund from local government to revitalize organic coffee in the upstream watershed.</li> </ul>
<b>Singkarak (CDM)</b>  <a href="http://worldagroforestry.org/sea/Publications/files/leaflet/LE0050-07.PDF">http://worldagroforestry.org/sea/Publications/files/leaflet/LE0050-07.PDF</a>	Carbon sequestration for voluntary markets under CDM setting	Level I Planting and maintaining specified number of trees to achieve agreed amount of carbon sequestered	<ul style="list-style-type: none"> <li>• Carbon market negotiated with private buyer (consumer goods distributor)</li> </ul>
<b>Sumberjaya (Community Forestry)</b>  <a href="http://worldagroforestry.org/sea/Publications/files/leaflet/LE0068-07.PDF">http://worldagroforestry.org/sea/Publications/files/leaflet/LE0068-07.PDF</a>	Watershed rehabilitation for the District Forestry Service	Level II Planting and maintaining specified number of trees with certain composition of species	<ul style="list-style-type: none"> <li>• Conditional tenure rewarded to farmer groups</li> </ul>
<b>Sumberjaya (River Care)</b>  <a href="http://worldagroforestry.org/sea/Publications/files/leaflet/LE0068-07.PDF">http://worldagroforestry.org/sea/Publications/files/leaflet/LE0068-07.PDF</a>	Water quality for hydropower	Level I Conducting collective action in riparian rehabilitation and sedimentation reduction to achieve a specified percentage (above 30%) of erosion reduction	<ul style="list-style-type: none"> <li>• Hydroelectric Power company (HEP) royalty agreements signed for River Care groups along the river</li> </ul>



## The Philippines

<b>Bakun</b> <a href="http://worldagroforestry.org/sea/Publications/files/leaflet/LE0049-07.PDF">http://worldagroforestry.org/sea/Publications/files/leaflet/LE0049-07.PDF</a>	Water quality for hydropower	Level III Setting up management plan to rehabilitate watershed, including sustainable horticulture practices.	<ul style="list-style-type: none"> <li>• HEP royalty agreements signed</li> </ul>
<b>Kalahanan</b> <a href="http://worldagroforestry.org/sea/Publications/files/leaflet/LE0047-07.PDF">http://worldagroforestry.org/sea/Publications/files/leaflet/LE0047-07.PDF</a>	Carbon sequestration under voluntary market	Level I Planting and maintaining specified number of trees to achieve agreed amount of carbon sequestered	<ul style="list-style-type: none"> <li>• Carbon market initial agreement with private buyer (automotive industry)</li> </ul>
<b>Lantapan</b> <a href="http://worldagroforestry.org/sea/Publications/files/leaflet/LE0081-08.PDF">http://worldagroforestry.org/sea/Publications/files/leaflet/LE0081-08.PDF</a>	Water amount for irrigation & amount + quality for hydropower	Under discussion	Under discussion

## Nepal

<b>Kulekhani</b> <a href="http://worldagroforestry.org/sea/Publications/files/leaflet/LE0051-07.PDF">http://worldagroforestry.org/sea/Publications/files/leaflet/LE0051-07.PDF</a>	Water quality for hydropower	Level III Setting up management plan to rehabilitate watershed, including sustainable horticulture practices	<ul style="list-style-type: none"> <li>• HEP royalty agreements signed</li> </ul>
---	------------------------------	---	---

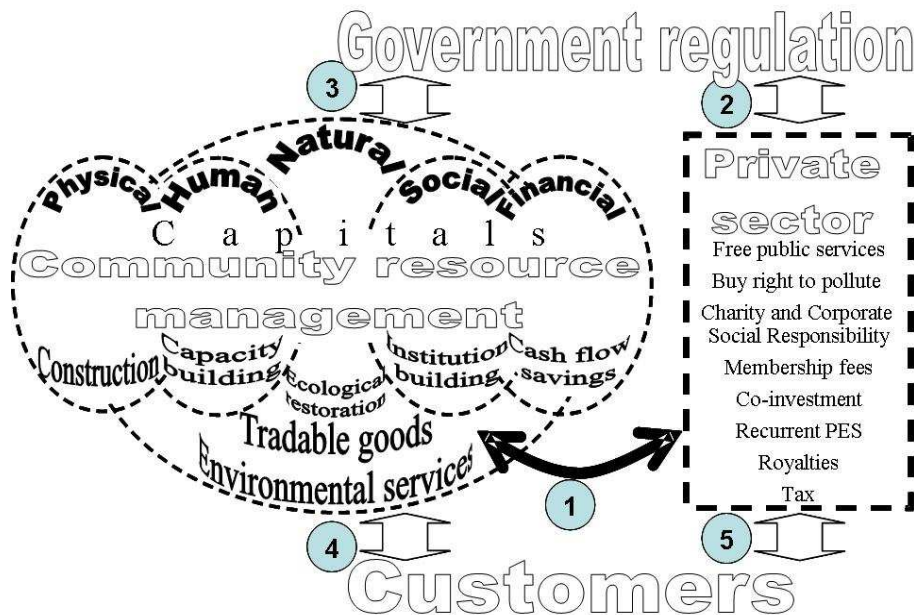
Throughout the RUPES project implementation the distinction between ‘rewards’ (which can come in any currency derived from any of the 5 livelihood capitals) and ‘payments’ (which are expected to be in monetary terms) was a recurrent topic of debate. On further reflection, three paradigms were identified in this debate: CES, COS and CIS, as explained in the next section.

## 2.4 CES/COS/CIS paradigms for compensation and rewards to enhance of environmental services

In a landscape, the community deals with five other main groups (Figure 3):

1. Private sector entities who buy marketable commodities for further processing and trade and/or use the landscape resources for added value (e.g. through hydropower or the sale of drinking water),
2. Governments imposing rules on the private sector and their interaction with ES
3. Government agencies regulating what the community is allowed to do, how it has to organize its administration and how it can be part of “development” processes prioritized at higher levels,
4. Consumers who buy local goods and may be interested in supporting ES as well,

- Consumers elsewhere in the world who opt for competitively priced goods, but also have concerns about the status of poverty indicators, natural resources and human rights in the area.



**Figure 3.** Modified livelihoods framework that relates the provision of environmental services as well as marketable goods to the community-scale and private management of the 5 capital types, and relates the primary feedback that is obtained through ‘customers’ to the efforts by external stakeholders and governments to regulate and modify local decisions in a direction of sustainable development; the CES paradigm is focussed on interaction 4, or 1+5 and links directly links providers and beneficiaries of ES; the COS paradigm is focussed on relations 2 and 3; CIS can and generally will involve all 1...5

The community, and all households and individuals contained within, thus produces both 'marketable goods' and 'environmental services' by transforming its access to five capitals: natural, human, social, physical and financial. Each of these capitals has a flow equivalent. The community can derive income from the export of labour as a third way of using its resources. The interactions with the private sector are primarily through the sale of marketable goods, but may also involve investments in provision of agricultural inputs, land clearing and technology as in 'outgrower schemes'.

The private sector transforms local marketable goods and environmental services (such as regular supply of clean water) to marketable goods with added value. It prefers to have free access to public environmental services, but will settle for a range of other options to secure continued access to the resources it needs. Options that link financial outlays to greater security and competitive edge in resource access are preferred. The private sector, however, also needs to produce goods with competitive pricing for its consumers that match their expectations of 'quality'. If the private sector needs to invest in local environmental services and human welfare, this has to be reflected in the price of goods.

The government as regulators can use three types of methods (loosely identified as carrots, sticks and sermons) to influence local resource management: financial incentives (balance between taxation and investment into the area), spatially explicit regulation of resource access and requirements for procedures and local institutional set-up, and moral persuasion. Where

the income for the regulators primarily derives from the ‘private sector’ and the votes for power-holders from the local community, a balancing act arises, that can be quite distinct (and distant) from the concerns of the external consumers.

CES, COS and CIS are three ‘paradigms’, or ways to organize thinking about and analysis of, compensation and rewards (including payments) for environmental services involving various combinations of actors. There may well be other paradigms within this domain and further sub-divisions are feasible. At this stage, however, the three represent different aspects of within approaches to enhance environmental services (EES), primarily on the basis of the type of conditionality.

**Paradigm CES:** commoditized environmental service procurement with conditionality at level 1 based on actual service delivery and direct marketability. The price level for recurrent monetary payments may be fully negotiable and provides new sources of income for those who can control land and other resources necessary in 'production of ES'. Innovations can be expected in how to cost-effectively enhance commoditized ES production. There is no explicit poverty target.

**Paradigm COS:** "Compensating for opportunities skipped", or paying land users for accepting restrictions (either voluntary or mandatory) on their use of land. COS has conditionality at level 2 or 3, depending on whether the objectively measurable condition of the (agro)-ecosystem or the expended level of efforts (or restrictions in input use) is the basis of contracts. This paradigm may involve recurrent monetary payments based on restrictions imposed by local or national government and/or voluntarily accepted on privately-owned land with possibility of collective action. The basis of financial compensation in this paradigm is the opportunity costs of foregoing economically attractive and legally permissible land use patterns that reduce environmental services. Poverty reduction targets can be added through differentiation in pay where prices are externally set, rather than freely negotiated.

**Paradigm CIS:** " Co-investment in stewardship" of landscapes for enhancing ES. CIS generally has conditionality at level 3 (or less often at levels 2 or 4). Such co-investment is mostly on collectively owned or state-owned land and can include negotiated tenure conditional on ES maintenance, reduction of land use conflicts and their collateral damage for ES, investment in improved public services, employment that doesn't damage ES and feeder roads under community control. The conditionality level 4 (“entrust the local resource management”) is where the buyers have full trust that the management plan set-up by the community will enhance the provision of ES without any clear activities taken stated in contract, and with broad sanction and monitoring requirement.

Referring to the schematic representation of figure 3, the CES paradigm is focussed on interaction 4, or 1+5, that directly links providers and beneficiaries of ES; it presupposes individual property rights and status quo on governance between the ‘freedom pollute’ and ‘freedom to live in a pollution-free world’ poles; it involved natural and financial capital; the COS paradigm is focussed on relations 2 and 3, within current ‘rights to pollute’; it adds human capital (opportunity to reduce/enhance ES); CIS can and generally will involve all the interactions labelled 1...5 in figure 3 and explicitly adds social capital to the mix; it addresses the preconditions for COS and CES and may well have to be the foundation for all such efforts.

## **3. Linking Principles, Prototypes, Sites and Paradigms**

### **3.1 Realistic**

Although the popular perception in many parts of Asia (or the world) is that only forest can provide the watershed functions required for effective use of hydropower and/or extraction of drinking water, science does not support such proposition. Many examples exist of watersheds with mosaics of forest patches, agroforestry zones and paddy rice fields that do provide a regular flow of water of low sediment load, depending on the rainfall regime. Watershed functions do not justify special treatment for ‘forest’, and user payments for watershed services may need to be allocated beyond the forest management entities. (Agus et al. 2004; Bruijnzeel and van Noordwijk, 2008; Calsder, 2001; van Noordwijk et al. 2001, 2007, 2008c). A recent turn in the global debate on ‘forests and floods’ supports a focus on actual infiltration capacity of the soils rather than ‘forest’ as land use category (van Dijk et al. 2008).

There is considerably less scope for providing full biodiversity conservation functions along with any extraction of goods or forms of agroforestry, although the ‘matrix’ of landscape mosaics within protected areas does matter for the biodiversity that can be conserved (Pfund et al. 2008; Michon et al., 2007; Schroth et al. 2004; Scherr and McNeeley, 2007). The most logical option for biodiversity conservation is to decrease or slow down the rate of biodiversity decrease by reducing its threat.

In the debate on global incentives for reducing emissions from deforestation and forest degradation (REDD) the issue of ‘realistic’ depends on the negotiated ‘reference scenario’ for national scale emissions, the specific cut-off point of the forest definition used and the local opportunities for high carbon stock sustainable development (Swallow et al. 2007b, 2008).

### **3.2 Voluntary**

Voluntary mechanisms require ‘free and prior informed consent’ (Colchester, 2004) as a basis for agreements where both sides (ES providers and ES beneficiaries) can judge whether or not there is a balance between their rights and obligations. The ‘informed’ part of this refers back to the assessment of ‘realistic’, but there is a challenge in the efficiency of delegation (not everybody has to be at every meeting) versus the risks of ‘elite capture’ and self-declared representativeness on behalf of key stakeholders. Meeting the standards for ‘voluntary’ thus requires considerable effort in ‘social mobilization’ (Leimona et al. 2008a).

The domain for ‘voluntary’ enhancement of environmental services that can qualify for rewards or payments is the complement of the mandatory protection of such services through land use restrictions in sensitive areas and rules against pollution of air, water or soil (Swallow et al., 2009). As in many Asian countries regulation is ahead of compliance in many environmental laws, there is a need for national policy dialogues (Leimona et al. 2008b) to revise legal frameworks.

### 3.3 Conditionality

A key element to distinguish PES from taxes and subsidies is the degree to which there is a ‘performance’ basis for the rewards/payments rather than an entitlement based on nominal entities such as ‘forest’, without specifying the actual services delivered by different forest types in different landscape and climatic conditions. We can distinguish conditionality at the level of input (did people spend the time to plant trees or guard the forest?), the condition of the system (are the trees growing? is the forest still intact?), or the actual outcomes for environmental services (clean water throughout the year). Shifting from ‘inputs’ to ‘condition of the system’ implies respect for local managers in their ability to fine-tune decisions on input use, but makes it more difficult to calculate a cost based on minimum wage multiplied with a number of days of work. It calls for more subtle negotiations. It also calls for clear rules for monitoring and evaluation.

Conditionality can be used for financial payments (as in most market-based delivery contracts for goods), but also for land tenure in sensitive watershed areas (Suyanto et al. 2008), with maintenance of healthy watersheds as condition for continuation of land use rights. Within the RUPES experience conditionality was not strictly enforced and lack of performance was interpreted as a ‘learning curve’ rather than contract failure.

### 3.4 Pro-poor

Rural poverty is increased by environmental degradation but may also contribute to its cause. Environmental services issues cannot be sustainably secured without reduction in poverty, but if payments focus on land owners, they may increase local inequity. The type of ‘reward’ may need to be based on the local determinants of poverty and address key local concerns.

Leimona et al. (2009) analyzed the potential for PES to have a significant impact on poverty reduction in the uplands of Asia. In terms of cash-flow, the potential is limited if expressed on a per capita basis, as the potential number of beneficiaries is large. The potential total value of financial EES transfers can be expressed relative to current income of poor ES providers. Given a total value, either a small group can benefit substantially or a large group marginally, but policy-relevant impact on rural poverty alleviation can only be expected if a large group can benefit at a daily income level that helps in meeting the \$1 per person per day threshold (or its national poverty line equivalent). Leimona (2009) expressed the per capita benefits in terms of a number of dimensionless ratios: area, population density, income, willingness to pay by downstream beneficiaries, transaction costs and offset-fraction, deriving:

$$RPu = (Ad Au^{-1}) (Pd Pu^{-1}) (Id Iu^{-1}) \beta d (1 - \alpha u) \cdot (1 - T) \dots\dots\dots(1)$$

- RPu = per capita PES benefits, expressed as fraction of the upstream income
- Ad and Au = Area, downstream and upstream, respectively, (ha),
- Pd and Pu = population density downstream and upstream, respectively, (ha<sup>-1</sup>),
- Id and Iu = per capita income downstream and upstream, respectively, (\$ day<sup>-1</sup>)
- βd = fraction of income that is potentially available for such payments.
- T = fraction of downstream payments that is needed to cover the transaction costs, and

$\alpha_u$  = fraction of what the upstream population receives that is offsetting the opportunity costs of alternative land uses that might generate more income but provide less environmental services.

Using available statistics for Indonesia, an across-the-board UB target of 5% increase in disposable income in the uplands is only feasible in specific contexts, where area and population ratios differ from the average and/or if the downstream population is willing and able to pay at least 4 percent of their income as contribution to ES provision in the upstream area. ‘Poverty traps’ (Barrett and Swallow, 2006) in other capital types, such as access to land and community-wide health and education services.

### 3.5 Principles, criteria and prototypes

Issues with the four principles, realistic, conditional, voluntary and pro-poor, can be summarized for the 12 CRES prototypes of van Noordwijk (2005). These prototypes also relate to the CES, COS, CIS paradigms in different ways (Table 3).

**Table 3.** Prototypes of ES rewards (van Noordwijk, 2005) and their stereotypes relation to the criteria realistic, conditional, voluntary and pro-poor

<i>Prototype Environmental service</i>	<b>Principles</b>			
	<b>Realistic</b>	<b>Voluntary</b>	<b>Conditional</b>	<b>Pro-poor</b>
<b>Wcons1: Total water yield for hydro power via storage lake</b>	Impacts on total water yield small; reservoir sedimentation issue may dominate the debate; option for sediment traps and landscape filters	Consumer satisfaction depends on continued functioning; high project investment costs, little subsequent management flexibility	Intercepting sediment flows rather than avoiding them is generally easier to accomplish; sediment flows out of well-managed upper catchments may still be high because of geological and geomorphological processes	Rural poor may not have access to electricity and ‘in-kind’ rewards may be appropriate
<b>Wcons2: Regular water supply for hydro power via run off the river</b>	A change from soil quick flow (saturated forest soils) to overland flow will reduce flow-persistence and buffering of river flows, affecting hydropower operation time		Interventions influencing the speed of drainage (linked to paths, roads and drains) have the most direct effect on buffering at larger scales	Rural poor may not have access to electricity and ‘in-kind’ rewards may be appropriate

<b>Wcons3: Drinking water provision (surface or groundwater)</b>	Intensive agriculture and horticulture will cause rapid pollution of surface flows and slow but persistent pollution of groundwater flows with nitrogen and pesticides; people residing around streams cause pollution E.coli and diseases	Willingness to pay for drinking water depends on hygienic quality assurance, taste and 'branding'	Slow response of groundwater flows to changes in the pollutant status make 'regulation' a more effective solution than results based markets	Rural poor may not have access to clean drinking water and 'in-kind' rewards may be appropriate
<b>Wcons4: Flood prevention</b>	Land use effects strongest for flow buffering of small-to-medium sized events, with saturation dominating the large events	Relevance of upland land use depends on location ('flood-plains') and engineering solutions (dykes, storage reservoirs)	Risk avoidance for the rare category of large events	Rural poor living in river beds and flood absorption sites may well be among the most vulnerable
<b>Wcons5: Landslide prevention</b>	Mortality of deep-rooted trees ('anchors') causes temporary increase in landslide risk	Relevance depends strongly on location in the flow paths	Deep landslides are little affected by land cover	Location determines vulnerability
<b>Wrehab: General watershed rehabilitation and erosion control</b>	Promoting tree cover and permanence of litter layer protecting the soil is a good precaution	'Holistic' perception of watershed functions survives despite the lack of clear impacts on specifics	Communication gap with scientists who try to enhance clarity	
<b>Bcons1: Biodiversity bufferzones around protected area</b>	Use value of buffer zones depend on hunting restrictions, presence of human-life threatening species	Flagship species still dominate the public perception of value	Push and pull factors in human land use; livelihoods operate at larger scales than most conservation plans acknowledge	Local use rights for forest products require careful consideration and thresholds of over-use
<b>Bcons2: Biodiversity landscape corridors</b>	Still new concept in agriculture /forest land use mosaics in the tropics; use value of patches in the	Relevance depends on dispersion properties of the species of main interest; some-	Ex ante impact assessment of effectivity is still difficult	

	'stepping stones' similar to the buffer zone case	times higher connectivity not desirable; relevance increases with climate change concerns		
<b>Crehab: Carbon restocking of depleted landscapes</b>	Options for profitable tree restocking primarily depend on policy reform	Demand is for Certified Emission Reduction (CER) rather than carbon	Forest definition and additionality issues in A/R-CDM; high transaction cost	
<b>Ccons: Protecting soil and tree C stocks</b>	Road construction (accessibility) is main determinant of 'opportunity costs' for non-conversion		REDD debate focus on partial solutions and partial C accounting	
<b>Ecolabel: Guaranteeing production landscapes meet environmental standards</b>	Where the 'eco-label' process starts from the consumer side, there can be a substantial gap in communication and trust, leading to high transaction costs	Consumers with high sense of personal responsibility; gradually replaced by the introduction of standards and the raising of baselines of 'acceptable' behavior	Relevance of global standards in the face of variation in local conditions; transparency of the standards and compliance monitoring; transaction costs	Enhanced local ES may be a major 'co-benefit' of specific relevance to rural poor
<b>EcoTour: Providing guided access to landscapes of beauty/heritage/recreational value</b>	The local and international appreciation for landscape beauty depends on culture and time (fashion); rewards are for roles as guide and provider of accommodation, food, transport and handicrafts; gender aspects of provider roles may be prominent	The appreciation of landscape beauty and cultural traditions does not reduce the need to provide security and comfort to potential tourists	Global ecotourism is a highly volatile market where security and political concerns can interfere	Enhancement of skills needed for rural poor to have a chance to benefit



### **3.6 Sites, paradigms, and principles**

Within the RUPES experience the carbon-based sub-projects have attained the clearest relation between land use and ES. An interesting experiment with ‘river care’ or performance based payments for reducing sediment load in streams met considerable challenges in unravelling climatic variability and landscape condition on the performance parameter (‘sediment concentration’), as well as in the collective action required at local level (Leimona et al. 2008a).

Within the RUPES experience, collective rather than individual household decisions received most attention, with reliance on existing local perceptions of rights and responsibilities. Leimona et al. (2009) summarized evidence on the ‘pro-poor’ performance of the RUPES-I sites, however, suggests that the rewards may address Such a scheme may require a ‘livelihood’ approach that considers the five capital types (human, social, physical, financial and natural) in their interactions across scale. This CIS paradigm aligns well with the robustness of social-ecological systems (Anderies et al., 2004). At the interface of vulnerability to environmental hazards linked to climate change, land use options that serve both mitigation and adaptation for rural poor deserve special attention (Verchot et al., 2007).

**Table 4.** Experience relevant to three contrasting EES paradigms across the RUPES sites (listed in Table 2)

	Paradigm CES: 'Commoditized ES' or markets for commoditized environmental service procurement or land cover proxies	Paradigm COS: Compensating opportunities skipped for (legally) reducing ES or compensating/ paying land users for accepting mandatory/ voluntary restrictions on their use of land	Paradigm CIS: Co-investment in stewardship of assets and co-management of landscapes for reducing poverty and enhancing ES
Examples in global literature	Most of the voluntary carbon market	Proambiente program, Brazil (Southgate and Wunder 2009) Pimampiro, Ecuador (Echavarria et al 2003, Wunder and Alban 2008) PSA Program, Costa Rica  Most of the payment schemes for (assumed) watershed functions in Latin America (Southgate and Wunder 2009)	Grain for Green project, China  Andes, Bolivia (Asquith et al 2008)
Examples studies in RUPES	Sumberjaya (River Care) Singkarak (CDM) Kalahan (CDM)	Cidanau	Bungo Singkarak (Waterhed) Sumberjaya (Community Forestry) Bakun Kulekhani
Ways to meet EES principles:			
Realistic	Yes, as long as ES is measurable	Only if correctly targeted	Mostly long-term
Voluntary	Yes, for those who are in a position to control and enhance ES	Yes, for those with rights and opportunity to reduce ES	Yes, depending on local 'social capital' and decisions
Conditionality type	I	II – III	II – V
Pro-poor	Maybe not: pre-supposes tenure security	Maybe yes, depending on allocation rules	Mostly yes, depending on local institutions
Primary strength	The output is based on the ES provision, ensuring the effectiveness of the project.	Relative easy to monitor with 'tangible' indicators at 'system' rather than outcome level	Trust-building and reciprocity redresses past inequalities
Primary challenge	Considerable risk to the ES providers if their efforts don't pay off. The monitoring process requires technical capacity.	The conditionality might not directly link with the ES provision. Buyers have budget restriction for the financial payment	Need high trust between the seller and buyer

## **4. Discussion: process and institutional requirements for scaling out**

In considering the next steps to scale up from the site-level experience reviewed so far, we will consider the compatibility and possible synergy between the 3 paradigms, discuss their relation with the learning curve for the various actor groups and the possibilities for nesting local in national and national in global arrangements, with possible shifts in paradigm at subsystem boundaries.

### **4.1 Compatibility and possible synergy between paradigms**

A strict interpretation of realistic, conditional and voluntary PES (Paradigm ‘Commoditized ES’) appeared problematic in most sites and situations. The question ‘who deserves to be paid for improving ES’ is not simple in the face of ‘legal pluralism’ ([http://en.wikipedia.org/wiki/Legal\\_pluralism](http://en.wikipedia.org/wiki/Legal_pluralism); von Benda Beckman, 1981) and lack of clarity on tenure rights (Giller et al., 2008). The question ‘who deserves pay for not destroying natural capital?’ is morally suspect. What starts off as additional incentive may soon be seen as an entitlement. When some get paid and others not, the results may be interpreted as ‘sub-optimal level of preventing threat’ by those who did not get the prime attention. The net effect of PES to overall level of environmental services may then decline. This ‘perverse’ effect is talked about – and there are some early signs that it may be real in a number of situations. Further analysis is needed. The ‘business’ language in which PES is often expressed may be partly to blame (Wunder, 2006).

The simple conceptual scheme of ‘buyers’, ‘sellers’, ‘intermediaries’ and ‘regulators’ that was used in RUPES-I may need to be modified to incorporate a more holistic ‘livelihoods’ perspective and the combined efforts through sermons, sticks and carrots to modify local resource use decisions in the uplands. A language of ‘co-investment’ and ‘shared responsibility’ (Paradigm ‘Co-investment in Assets’) may be more conducive to the type of respect, mutual accountability and commitment to sustainable development that is needed. Yet, there are opportunities for mixed strategies: after creating a basis of respect and relationships through the paradigm of ‘Co-investment in Assets’ there may be more space for specific follow-ups in the paradigm of ‘Commoditized ES’.

### **4.2 Process and boundary objects of shared knowledge**

The interface of Knowledge (K) and Action (A) in different stages of development of a locally negotiated form of rewards for environmental services that meets the criteria of ‘realistic’, ‘voluntary’ and ‘conditional’ can be conceived as in Figure 4.

<b>1A. Scoping: <math>K \leftrightarrow K</math></b>  <i>Realistic</i>	<b>1B. Stakeholder identification:</b>  $A \leftrightarrow A$  <i>Voluntary</i>
<b>2. Negotiation: <math>(K \leftrightarrow K) \leftrightarrow (A \leftrightarrow A)</math>, aiming for (unified <math>K \leftrightarrow</math> unified <math>A</math>)</b> <i>Conditional</i>	
<b>3. Implementation, Monitoring and Learning: unified <math>K \leftrightarrow</math> unified <math>A</math></b> <b>(or reverting to <math>(K \leftrightarrow K) \leftrightarrow (A \leftrightarrow A)</math>)</b>	

**Figure 4.** Steps in linking knowledge (K) with action (A) in multi-stakeholder processes that lead to enhancement of environmental services (EES) while meeting the principles of ‘realistic’, ‘voluntary’, ‘conditional’ and ‘pro-poor’

To achieve these criteria, a new type of ‘integrative science’ (Tomich et al. 2007; Cash et al., 2006) of the forest margins and derived tropical landscapes is needed, that links public/policy discourse, local ecological knowledge and the best of bio-economic/ ecological modelling of landscape mosaics (Joshi et al. 2004; Jeanes et al., 2006; Kuncoro et al., 2006)..

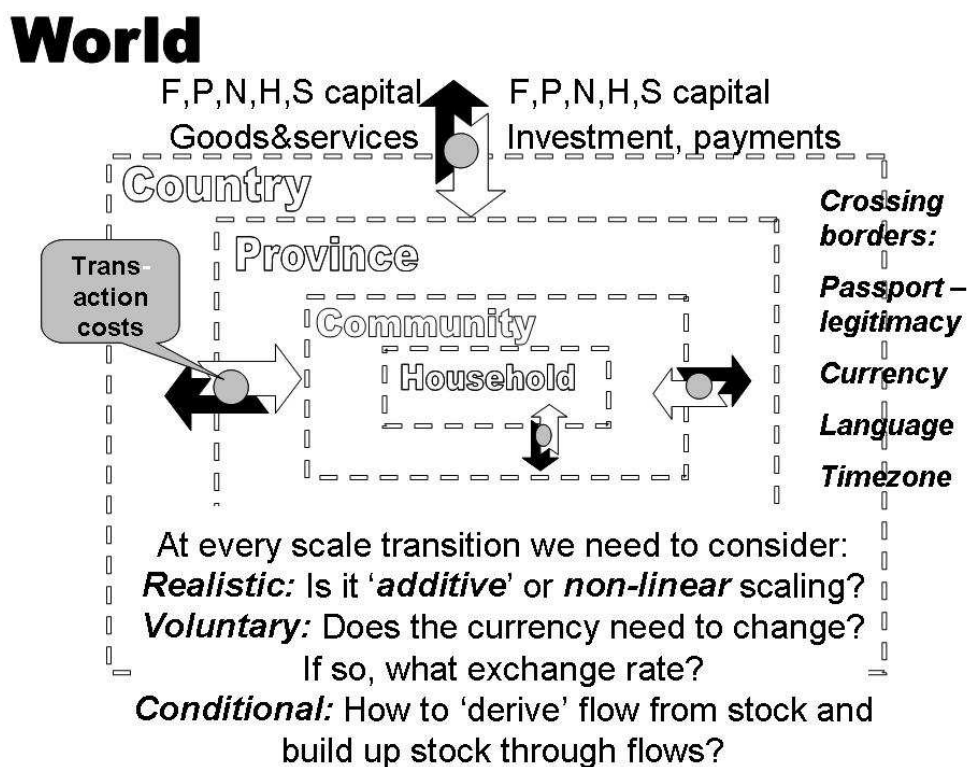
### 4.3 Scale issues

Within any of the CES/COS/CIS paradigms the financial rewards obtained by voluntary enhancement of environmental services must at least offset the real ‘opportunity cost’ of modified land use (and opportunities foregone), after paying for the transaction costs. Levels of reward higher than this will provide real benefit, but the benefits may also be thought to derive from local spinoffs through enhanced local environmental services. In Paradigm C this cost-benefit approach is considerably broadened. The function of total capital value -  $f(\text{Natural, Human, Social, Physical, Financial})$  – supplied to ES-providers through various forms of investment and rewards must match their opportunity cost in terms of  $f(\text{Natural, Human, Social, Physical, Financial})$  plus transaction costs. Transaction costs may themselves have a positive aspect of relation-building and external communication that can be valued. This broader approach involves tradeoffs between capital types, as well as tradeoffs between land use practices that vary in their provision of goods and services. It may defy quantitative analysis.

With global concerns over climate change past the ‘tipping point’ (Rockstrom et al., 2009), the global architecture of incentives to reduce emissions from land use and land use change (including forestry) is under debate. Proposals at the negotiation table for REDD (Reducing Emissions from Deforestation and Degradation) deal with part of the broader issue, and may need to be embedded in REALU (Reducing emissions from any land use) to have measurable impact on reducing net emissions (van Noordwijk et al., 2008b; Verchot et al. 2008). For current negotiations and bargaining positions the paradigm of ‘ES Opportunity Costs’ is important in the international arena and potentially in the sub-national financial arrangements and considerations of a ‘fair price’. The COS paradigm may thus be the primary PES concept

in the discussion of REDD, but that does not exclude expectations of CES ('C markets') or CIS (focus on asset protection).

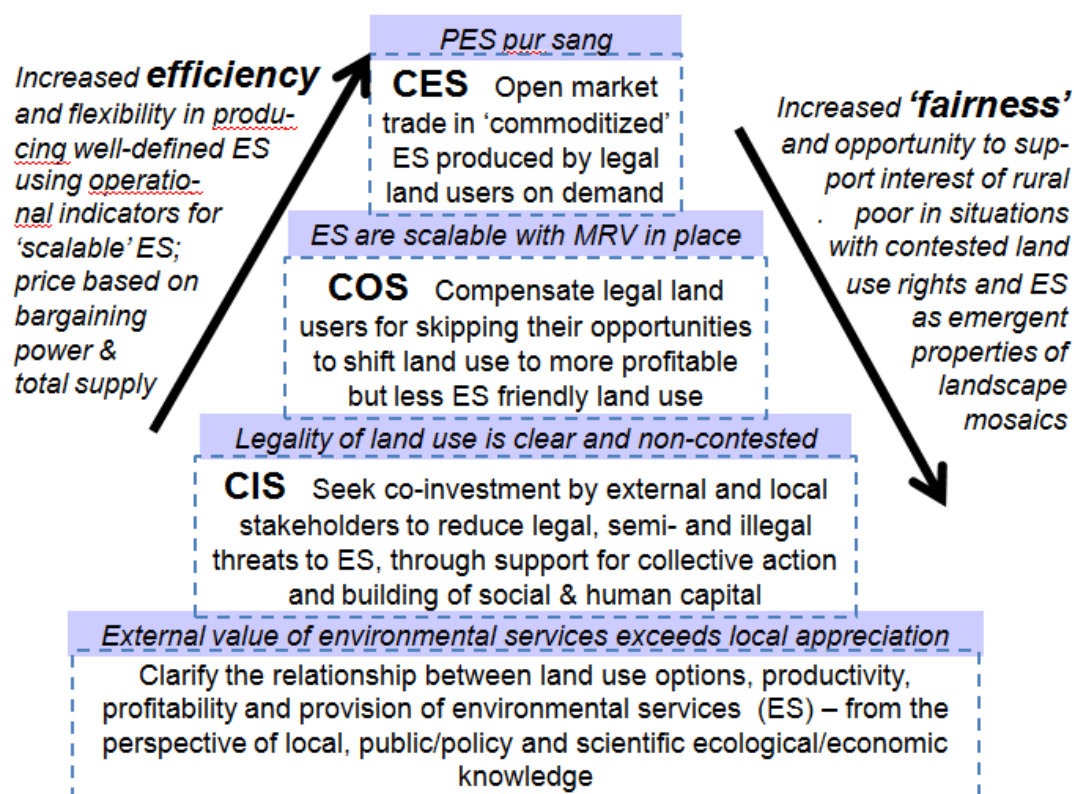
The criteria of realistic, voluntary, conditional and pro-poor apply at the global scale of interactions between countries, as much as they apply at the local scale of RES/PES, but there is considerable scope for 'nested' systems that allow countries to exchange greenhouse gas emissions for financial incentives at the national border, but use this for an array of local incentives for forms of sustainable development that are compatible with 'high carbon stock livelihoods' (van Noordwijk et al. 2008b; Swallow et al. 2007b, 2008). The existing legal framework for forest management may need to be adjusted to get the 'conditionality' appropriately regulated (Galudra et al. 2008). At the local level a number of barriers to farmer tree planting and community based forest management have been identified, such as lack of land use rights, good planting material, know-how on tree management and access to markets for tree products (van Noordwijk et al. 2008e; Roshetko et al. 2008).



**Figure 5.** Multiple scale links in the transactions between flows derived from natural (N), human (H), Social (S), physical (P) and financial (F) capital between household and global scales; at every scale transition legitimacy, currency, language and time-zone may shift, but all have to meet criteria of being realistic (representing underlying values), conditional (linked to performance) and voluntary (based on free and prior informed consent)

Any border crossing may involve a change in currency, language, legal status (passport and visa) and/or time zone (Figure 5). The multiple scale relations for an effective system that provides incentives for local resource management that matches global concerns, may similarly change language, currency, legality and time frame at the various sub-system boundaries. The type of exchange influences 'transaction costs'. Where the financial incentives at country scale may relate to achievement of emission reduction goals for

greenhouse gasses, a major way to achieve this may be agreements on land use rights for local communities – the financial transactions do not need to scale down to this level, as long as the ‘real’ constraints are addressed at each scale interface. The value chain for REDD is rather complex and requires net benefits for all key stakeholders, as each level as an effective ‘veto’. A multi-scale approach may use Paradigm A in the relationship between countries, exchanging financial capital for verifiable and agreed emission reduction, while the government uses the funds so obtained (or the loans that can be repaid in such a way) for mechanisms that are based on the ‘ES Opportunity Cost’ paradigm and/or a ‘Co-investment in Assets’ paradigm, providing co-investment in generic environmental services that happen to have carbon co-benefits, rather than targeting emission reduction as their primary goal.



**Figure 6.** Tentative relationship between the CES, COS and CIS paradigms and the overriding principles of ‘fairness’ and ‘efficiency’

1. Is there a clear link between land use practices and the provision of environmental services (= ecosystem services beyond the private benefits from extraction of goods)?	
Yes.....	2
No.....	7a
2. Is local appreciation of ES sufficient to guarantee their provision at external optimum level?	
Yes.....	7b
No.....	3
3. Are property rights clear and non-contested at community or individual level?	
Yes.....	4
No.....	7c
4. Are all 'illegal' threats to environmental services handled by appropriate law enforcement?	
Yes.....	5
No.....	7c
5. Can environmental services be measured and partitioned/attributed to actions in an additive manner?	
Yes.....	6
No.....	7c
6. Are 'ES providers' able to absorb or insure against risk of non-delivery of ES by <i>force majeure</i> or temporal inability to secure ES?	
Yes.....	7e
No.....	7d
7a. Accept that environmental services will further degrade or first clarify ES production	
7b. No external incentives are needed, ES-maximization will be the local land use of choice	
7c. Try 'Co-investment in environmental Stewardship, CIS' as approach	
7d. Try 'Compensation for opportunities skipped, COS' approach	
7e. Try 'Commoditization of environmental services, CES' approach	

**Figure 7.** Tentative decision tree to choose among the CES, COS and CIS paradigms as starting point for local action to enhance environmental services

#### 4.4 In conclusion

Building on earlier exploration of the conceptual basis of 'rewards' for environmental services, we explored the juxtaposition and possibility for synergy between 'fairness' and 'efficiency' in the broad arena of efforts to enhance the global, national and local supply of 'environmental services'. We introduced three paradigms, CES or commoditized environmental services, COS or compensation for opportunities skipped and CIS or co-investment in stewardship, that jointly cover the emerging practice labeled as 'payments for environmental services' (PES). The CES concept matches the widely used definition of PES, but is not easily applied as the basic assumptions of clarity of land ownership (or tenure) and the legality of current activities threatening ES are not usually met. The COS concept primarily relates to publicly funded schemes at a broad 'land use' level, often with a weak relationship to actual ES; the REDD discussion may be largely framed within this subconcept of PES. The CIS concept appears to describe most of current reality, at least as encountered in Asia. It probably is the 'entry level' approach.

## References

- Agus, F., Farida and Van Noordwijk, M. (Eds), 2004. Hydrological Impacts of Forest, Agroforestry and Upland Cropping as a Basis for Rewarding Environmental Service Providers in Indonesia. Proceedings of a workshop in Padang/Singkarak, West Sumatra, Indonesia. 25-28 February 2004. ICRAF-SEA, Bogor, Indonesia
- Akerlof G-A, Shiller R-J, 2009. Animal spirits: how human psychology drives the economy and its matters for global capitalism. Princeton and Oxford: Princeton University Press.
- Anderies J-M, M-A Janssen, E Ostrom, 2004. A framework to analyse the robustness of social-ecological systems from an institutional perspective. *Ecological and Society* 9(1):18. [online] URL:<http://www.ecologyandsociety.org/vol9/iss1/art18/>.
- Asquith, N. and S. Wunder (eds). 2008. Payments for Watershed Services: The Bellagio Conversations. Fundación Natura. Santa Cruz de la Sierra, Bolivia
- Barrett C.B., Swallow, B.M., 2006. Fractal poverty traps. *World Development* 34: 1-15
- Bruijnzeel, S., Noordwijk, M. van. 2008. Deforestation and the multiple functions of tropical watersheds: are tropical forests indispensable for regulating rainfall and ensuring clean and reliable water supplies? ASB Policy Briefs 08. Nairobi: ASB Partnerships for the Tropical Forest Margins, 4p.  
[http://www.asb.cgiar.org/publications/view.asp?Pub\\_ID=1002](http://www.asb.cgiar.org/publications/view.asp?Pub_ID=1002)
- Calder, I., 2001, 'Forest valuation and water – the need to reconcile public and science perceptions', in Verweij, P., (ed), *Understanding and Capturing the Multiple Values of Tropical Forest*. Tropenbos International, Netherlands.
- Carpenter, S.R., DeFries, R., Dietz, T., Mooney, H.A., Polasky, S., Reid, W.V. and Scholes, R.J., 2006. Millennium Ecosystem Assessment: Research Needs. *Science* 314: 257-258.
- Cash D-W, W- N Adger, F Berkes, P Garden, L Lebel, P Olsson, L Pritchard, O. Young, 2006. Scale and cross-scale dynamics: governance and information in a multilevel world. *Ecology and Society* 11(2): 8. [online]  
<http://www.ecologyandsociety.org/vol11/iss2/art8/>
- Challen, R. 2000. Institutions, Transaction Costs, and Environmental Policy: Institutional Reform for Water Resources. Edward Elgar. Cheltenham. UK.
- Chambers, R., Conway, G.R., 1992. Sustainable rural livelihoods : practical concepts for the 21st century. IDS Discussion Paper. Institute of Development Studies, Brighton, England, p. 42.
- Colchester, M., 2004. Conservation policy and indigenous peoples. *Environmental Science & Policy* 7, 145-153.
- Echavarria, M., J. Vogel, M. Albán, and F. Meneses. 2003. The impacts of payments for watershed services in Ecuador. Emerging lessons from Pimampiro and Cuenca. International Institute for Environment and Development, London



- Ferraro, P.J. 2008. Asymmetric information and contract design for payments for environmental services. *Ecological Economics* 65, 810-821
- Galudra G, van Noordwijk M, Leimona B and Sakuntaladewi N. 2008. The Indonesian Forestry Laws as Basis for a REDD Regime?. RECOFTC.  
[http://www.recoftc.org/site/fileadmin/docs/e-letter-documents/eletter2008/CF\\_E-News\\_June\\_\\_2008\\_web.html](http://www.recoftc.org/site/fileadmin/docs/e-letter-documents/eletter2008/CF_E-News_June__2008_web.html)
- Giller K-E, Leeuwis C, Andersson J-A, Andriessse W, Brouwer A, Frost P, Hebinck P, Heitkönig I, van Ittersum M-K, Koning N, Ruben R, Slingerland M, Udo H, Veldkamp T, van de Vijver C, van Wijk M-T, and Windmeijer P, 2008. Competing claims on natural resources: what role for science?. *Ecology and Society* 13(2): 34. [online] URL: <http://www.ecologyandsociety.org/vol13/iss2/art34/>
- Jeanes K, van Noordwijk M, Joshi L, Widayati A, Farida and Leimona B. 2006. Rapid Hydrological Appraisal in the context of environmental service rewards. Bogor, Indonesia. World Agroforestry Centre - ICRAF, SEA Regional Office. 56 p.
- Joshi, L., Schalenbourg, W., Johansson, L., Khasanah, N., Stefanus, E., Fagerström, M.H. and van Noordwijk, M., 2004. Soil and water movement: combining local ecological knowledge with that of modellers when scaling up from plot to landscape level. In: van Noordwijk, M., Cadisch, G. and Ong, C.K. (Eds.) *Belowground Interactions in Tropical Agroecosystems*, CAB International, Wallingford (UK). pp. 349-364
- Kleijn, D., Berendse, F., Smit, R. and Gilissen, N., 2001. Agri-environment schemes do not effectively protect biodiversity in Dutch agricultural landscapes. *Nature* 413: 723 – 725
- Kuncoro SA, van Noordwijk M and Martini, E., Saipothong, P., Areskou, V., Ekadinata, A., and O'Connor, T., 2006. Rapid Agrobiodiversity Appraisal (RABA) in the context of environmental service rewards: protocols for data collection and case studies in rubber agroforest in Bungo district, Jambi, Indonesia and fragmented forest in north Thailand. Worldagroforestry Centre, ICRAF-Bogor (Indonesia) 106 pp.  
<http://icrafnt2:88/Publications/currentpub.asp?publishid=1496>
- Kusters, K., de Foresta, H., Ekadinata, A. and van Noordwijk, M., 2007. Towards solutions for state vs. local community conflicts over forestland: the impact of formal recognition of user rights in Krui, Sumatra, Indonesia. *Human Ecology* 10.1007/s10745-006-9103-4
- Landell-Mills, N. and I. Porras, 2001, *Silver Bullet or Fools' Gold: A global review of markets for forest environmental services and their impact on the poor*, International Institute for Environment and Development, London
- Leimona B, van Noordwijk M, Villamor GB, Fauzi A, Upadhyaya S and Farida . 2008a. Social Mobilization and Local Awareness of Rights and Opportunities for Environmental Services Market. Bogor, Indonesia. World Agroforestry Centre - ICRAF, SEA Regional Office.  
<http://www.worldagroforestry.org/sea/Publications/searchpub.asp?publishid=1930>

- Leimona B, van Noordwijk M, Villamor GB and Galudra G. 2008b. National Policy Dialogue on Environmental Services Supply through Regulation, Voluntary Agreements and Markets. Bogor, Indonesia. World Agroforestry Centre - ICRAF, SEA Regional Office.  
<http://www.worldagroforestry.org/sea/Publications/searchpub.asp?publishid=1931>
- Leimona, B., Joshi, L. and van Noordwijk, M., 2009. Can rewards for environmental services benefit the poor? Lessons from Asia. *International Journal of the Commons* 3: 82-107. [online] URL:  
<http://www.thecommonsjournal.org/index.php/ijc/article/view/121>
- Michon G, De Foresta H, Levang P and Verdeaux F, 2007. Domestic forests: a new paradigm for integrating local communities' forestry into tropical forest science. *Ecology and Society* 12(2): 1. [online] URL:  
<http://www.ecologyandsociety.org/vol12/iss2/art1/>
- Pfund, J.L, Koponen, P. , O'Connor, T., Boffa, J.M., van Noordwijk, M. and Sorg, J.P., 2008. Biodiversity conservation and sustainable livelihoods in tropical forest landscapes; In: Laforteza, R.; Chen, J.; Sanesi, G.; Crow, Th.R. (Eds.) *Patterns and Processes in Forest Landscapes: Multiple Use and Sustainable Management*. Springer, Berlin.
- Palm, C.A., Van Noordwijk, M., Woomer, P.L., Alegre, J., Arevalo, L., Castilla, C., Cordeiro, D.G., Hairiah, K., Kotto-same, J., Moukam, A., Parton, W.J., Ricse, A., Rodrigues, V. and Sitompul, S.M., 2005 Carbon losses and sequestration following land use change in the humid tropics. In: C.A.Palm, S.A. Vosti, P.A. Sanchez and P.J. Ericksen (Eds.) *Slash and Burn: The Search for Alternatives*. Columbia University Press, New York (USA) pp 41-63
- Porrás, I., Grieg-Gran, M. and Neves, N., 2008. All that glitters: A review of payments for watershed services in developing countries. International Institute for Environment and Development, London (UK)
- Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin, III, E. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. Schellnhuber, B. Nykvist, C. A. De Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P. K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J. Foley. 2009. Planetary boundaries: exploring the safe operating space for humanity. *Ecology and Society* 14(2): 32. [online] URL: <http://www.ecologyandsociety.org/vol14/iss2/art32/>
- Roshetko, J.M. , Snelder, D.J., Lasco R.D. and Van Noordwijk, M., 2008. Future Challenge: A Paradigm Shift in the Forestry Sector. In: Denyse J. Snelder and Rodel D. Lasco (Eds.) *Smallholder Tree Growing for Rural Development and Environmental Services: Lessons from Asia*. *Advances in Agroforestry Volume 5*, Springer, Berlin. pp 451- 483
- Scherr, S.J. and McNeely, J.A. (eds.). 2007. *Farming with Nature: The Science and Practice of Ecoagriculture*. Island Press, Washington DC

- Schroth, G., da Fonseca, G.A.B., Harvey, C.A. Gascon, C., Vasconcelos, H.L. and Izac, A.N. (Editors) 2007. *Agroforestry and Biodiversity Conservation in Tropical Landscapes*
- Southgate, D. and Wunder, S., 2009 Paying for watershed services in Latin America: a review of current initiatives *Journal of Sustainable Forestry*, 28:497–524
- Suyanto S, Leimona B, van Noordwijk M and Galudra G. 2008. *Conditional Tenure as a Reward for Environmental Services*. Bogor, Indonesia. World Agroforestry Centre - ICRAF, SEA Regional Office.  
<http://www.worldagroforestry.org/sea/Publications/searchpub.asp?publishid=1924>
- Suyanto S, Permana RP, Khususiyah N and Joshi L. 2004. Land tenure agroforestry adoption and reduction of fire hazard in a forest: a case study from Lampung, Sumatra Indonesia. *Agroforestry Systems*. 65(1):P. 1-11
- Swallow, B., Kallesoe, M., Iftikhar, U., van Noordwijk, M., Bracer, C., Scherr, S., Raju, K.V., Poats, S., Duraiappah, A., Ochieng, B., Mallee, H. and Rumley, R., 2007a. *Compensation and Rewards for Environmental Services in the Developing World: Framing Pan-Tropical Analysis and Comparison*. Working Paper 32. Nairobi: World Agroforestry Centre.
- Swallow BM, van Noordwijk M, Dewi S, Murdiyarso D, White D, Gockowski J, Hyman G, Budidarsono S, Robiglio V, Meadu V, Eka Dinata A, Agus F, Hairiah K, Mbile P, Sonwa DJ and Weise S. 2007b. *Opportunities for Avoided Deforestation with Sustainable Benefits: An interim report of the ASB partnership for the Tropical Forest Margins*. Nairobi, Kenya. ASB Partnership for the Tropical Forest Margins. 42  
<http://www.worldagroforestry.org/sea/Publications/searchpub.asp?publishid=1784>
- Swallow, B., Noordwijk, M. van. 2008. Restoring the functions of watersheds: agroforestry systems that are intermediate between natural forests and intensive foodcrop agriculture can restore most if not all watershed functions attributed to natural forests. *ASB Policy Briefs 09*. Nairobi: ASB Partnerships for the Tropical Forest Margins, 4p. Intranet Full Text:  
<http://intranet/downloads/publications/PDFs/BR08143>. PDF Website:  
[http://www.asb.cgiar.org/publications/view.asp?Pub\\_ID=1003](http://www.asb.cgiar.org/publications/view.asp?Pub_ID=1003)
- Swallow, B. M., M. F. Kallesoe, U. A. Iftikhar, M. Van Noordwijk, C. Bracer, S. J. Scherr, K. V. Raju, S. V. Poats, A. Kumar Duraiappah, B. O. Ochieng, H. Mallee and R. Rumley. 2009. *Compensation and Rewards for Environmental Services in the Developing World: Framing Pan-Tropical Analysis and Comparison*. *Ecology and Society* 14 (2): 26. [online] URL: <http://www.ecologyandsociety.org/vol14/iss2/art26/>
- Tomich T.P., D.E. Thomas, and M. van Noordwijk. 2004. Environmental services and land use change in Southeast Asia: from recognition to regulation or reward? *Agriculture, Ecosystems and Environment* 104: 229-244.

- Tomich, T.P., Timmer, D.W., Velarde, S.J., Alegre, J., Areskoug, V., Cash, D.W., Cattaneo, A., Cornelius, J., Ericksen, P., Joshi, L., Kasyoki, J., Legg, C., Locatelli, M., Murdiyarso, D., Palm, C., Porro, R., Perazzo, A.R., Salazar-Vega, A., van Noordwijk, M., Weise, S., and White, D.. 2007. Integrative science in practice: process perspectives from ASB, the Partnership for the Tropical Forest Margins. *Agriculture Ecosystems and Environment*, 9: 269-286
- van Dijk, A.I.J.M., van Noordwijk, M., Calder, I.R., Bruijnzeel, L.A., Schellekens, Chappell, J.N.A., 2008. Forest-flood relation still tenuous – comment on ‘Global evidence that deforestation amplifies flood risk and severity in the developing world’ by C.J.A. Bradshaw, N.S. Sodi, K. S-H. Peh and B.W. Brook. *Global Change Biology*  
<http://www3.interscience.wiley.com/journal/119881750/issue>
- van Noordwijk M., T.P. Tomich, and B. Verbist. 2001. Negotiation Support Models for Integrated Natural Resource Management in Tropical Forest Margins. *Conservation Ecology* 5(2). URL: <http://www.consecol.org/vol5/iss2/art21>.
- van Noordwijk, M., Chandler, F. and Tomich, T.P., 2004a. An introduction to the conceptual basis of RUPES: rewarding upland poor for the environmental services they provide. ICRAF-Southeast Asia, Bogor. 41 pp
- van Noordwijk, M., J. Poulsen, and P. Ericksen. 2004b. Filters, flows and fallacies: Quantifying off-site effects of land use change. *Agriculture, Ecosystems and Environment*, 104: 19-34.
- van Noordwijk, M. 2005. RUPES typology of environmental service worthy of reward. RUPES working paper, ICRAF-Southeast Asia, Bogor. 53 pp.
- van Noordwijk, M., Agus, F., Verbist, B., Hairiah, K. and Tomich, T.P. 2007. Managing Watershed Services in Ecoagriculture Landscapes. In: Sara J. Scherr and Jeffrey A. McNeely (eds.). *Farming with Nature: The Science and Practice of Ecoagriculture*. Island Press, Washington DC. pp 191 - 212.
- van Noordwijk, M., Leimona, B., Emerton, L., Tomich, T.P., Velarde, S., Kallesoe, M., Sekher, M. and Swallow, B., 2007. Criteria and indicators for ecosystem service reward and compensation mechanisms: realistic, voluntary, conditional and pro-poor. Working Paper 37. Nairobi: World Agroforestry Centre.
- van Noordwijk, M., Leimona, B., Hoang, M.H., Villamor, G.B. and Yatich, T., 2008a. Payments for environmental services. *ETFRN NEWS* 49, 95-100
- van Noordwijk M, Leimona B, Villamor GB and Galudra G. 2008b. Dealing with myth-perceptions: how to reduce communication and perception gaps before Rewards for Environmental Services negotiations can start?. Bogor, Indonesia. World Agroforestry Centre - ICRAF, SEA Regional Office.  
<http://www.worldagroforestry.org/sea/Publications/searchpub.asp?publishid=1923>
- van Noordwijk, M., Purnomo, H., Peskett, L. and Setiono, B., 2008c. Reducing emissions from deforestation and forest degradation (REDD) in Indonesia: options and challenges for fair and efficient payment distribution mechanisms. ICRAF working paper 81. Working Paper nr 81. World Agroforestry Centre

- van Noordwijk, M., Roshetko, J.M., Murniati, Angeles, M.D., Suyanto, Fay C. and Tomich, T.P., 2008d. Farmer Tree Planting Barriers to Sustainable Forest Management. . In: Denyse J. Snelder and Rodel D. Lasco (Eds.) *Smallholder Tree Growing for Rural Development and Environmental Services: Lessons from Asia*. *Advances in Agroforestry Volume 5*, Springer, Berlin. pp 427-449
- van Noordwijk, M., Suyamto, D.A., Lusiana, B., Ekadinata, A. and Hairiah, K., 2008e. Facilitating agroforestation of landscapes for sustainable benefits: tradeoffs between carbon stocks and local development benefits in Indonesia according to the FALLOW model. *Agriculture Ecosystems and Environment* 126: 98-112.
- van Noordwijk M, Villamor GB, Leimona B and Hoang MH. 2008f. Criteria and Indicators for Ecosystem Reward and Compensation Mechanisms: Realistic, Voluntary, Conditional and Pro-Poor. pp 372-390. In: Gebbie L, Glendinning A, Lefroy-Braun R and Victor M, eds. *Sustainable Sloping Lands and Watershed Management Conference Linking research to strengthen upland policies and practices*, 12-15 Dec 2006. Lao PDR, Laos. National Agriculture and Forestry Research Institute
- Verchot, L.V., Van Noordwijk, M., Kandji, S., Tomich, T.P., Ong, C.K., Albrecht, A., Mackensen, J., Bantilan, C., Anupama, K.V. and Cheryl Palm, C.A., 2007. Climate change: linking adaptation and mitigation through agroforestry. *Mitig Adapt Strat Glob Change* 12: 901-918
- Verchot LV, Swallow BM and van Noordwijk M. 2008. Reducing emissions from landscape-wide land use change in developing countries. <http://www.worldagroforestry.org/sea/Publications/searchpub.asp?publishid=2057>
- von Benda-Beckmann, K. 1981. "Forum Shopping and Shopping Forums: Dispute Processing in Minangkabau Village." *Journal of Legal Pluralism* 19: 117-159
- Wackernagel M, Rees W-E., 1997. Perceptual and structural barriers to investing in natural capital. Economics from an ecological footprint perspective. *Ecological Economics* 20: 3-24
- Wunder, S. 2005. Payments for environmental services: some nuts and bolts. CIFOR Occasional Paper 42. Center for International Forestry Research, Bogor, Indonesia.
- Wunder, S. 2006. Are direct payments for environmental services spelling doom for sustainable forest management in the tropics? *Ecology and Society* 11(2): 23. [online] URL: <http://www.ecologyandsociety.org/vol11/iss2/art23/>
- Wunder, S., 2008. Payments for environmental services and the poor: concepts and preliminary evidence. *Environment and Development Economics* 13: 279-297
- Wunder, S. and Albán, M., 2008. Decentralized payments for environmental services: The cases of Pimampiro and PROFAFOR in Ecuador. *Ecological Economics* 65, 685-698

## WORKING PAPERS IN THIS SERIES

### 2005

1. Agroforestry in the drylands of eastern Africa: a call to action
2. Biodiversity conservation through agroforestry: managing tree species diversity within a network of community-based, nongovernmental, governmental and research organizations in western Kenya.
3. Invasion of *Prosopis juliflora* and local livelihoods: Case study from the Lake Baringo area of Kenya
4. Leadership for change in farmers organizations: Training report: Ridar Hotel, Kampala, 29th March to 2nd April 2005.
5. Domestication des espèces agroforestières au Sahel : situation actuelle et perspectives
6. Relevé des données de biodiversité ligneuse: Manuel du projet biodiversité des parcs agroforestiers au Sahel
7. Improved land management in the Lake Victoria Basin: TransVic Project's draft report.
8. Livelihood capital, strategies and outcomes in the Taita hills of Kenya
9. Les espèces ligneuses et leurs usages: Les préférences des paysans dans le Cercle de Ségou, au Mali
10. La biodiversité des espèces ligneuses: Diversité arborée et unités de gestion du terroir dans le Cercle de Ségou, au Mali

### 2006

11. Bird diversity and land use on the slopes of Mt. Kilimanjaro and the adjacent plains, Tanzania
12. Water, women and local social organization in the Western Kenya Highlands
13. Highlights of ongoing research of the World Agroforestry Centre in Indonesia
14. Prospects of adoption of tree-based systems in a rural landscape and its likely impacts on carbon stocks and farmers' welfare: The FALLOW Model Application in Muara Sungkai, Lampung, Sumatra, in a 'Clean Development Mechanism' context
15. Equipping integrated natural resource managers for healthy agroforestry landscapes.
16. Are they competing or compensating on farm? Status of indigenous and exotic tree species in a wide range of agro-ecological zones of Eastern and Central Kenya, surrounding Mt. Kenya.
17. Agro-biodiversity and CGIAR tree and forest science: approaches and examples from Sumatra.
18. Improving land management in eastern and southern Africa: A review of policies.
19. Farm and household economic study of Kecamatan Nanggung, Kabupaten Bogor, Indonesia: A socio-economic base line study of agroforestry innovations and livelihood enhancement.
20. Lessons from eastern Africa's unsustainable charcoal business.
21. Evolution of RELMA's approaches to land management: Lessons from two decades of research and development in eastern and southern Africa
22. Participatory watershed management: Lessons from RELMA's work with farmers in eastern Africa.
23. Strengthening farmers' organizations: The experience of RELMA and ULAMP.
24. Promoting rainwater harvesting in eastern and southern Africa.

25. The role of livestock in integrated land management.
26. Status of carbon sequestration projects in Africa: Potential benefits and challenges to scaling up.
27. Social and Environmental Trade-Offs in Tree Species Selection: A Methodology for Identifying Niche Incompatibilities in Agroforestry [Appears as AHI Working Paper no. 9]
28. Managing tradeoffs in agroforestry: From conflict to collaboration in natural resource management. [Appears as AHI Working Paper no. 10]
29. Essai d'analyse de la prise en compte des systemes agroforestiers pa les legislations forestieres au Sahel: Cas du Burkina Faso, du Mali, du Niger et du Senegal.
30. Etat de la recherche agroforestière au Rwanda etude bibliographique, période 1987-2003

## **2007**

31. Science and technological innovations for improving soil fertility and management in Africa: A report for NEPAD's Science and Technology Forum.
32. Compensation and rewards for environmental services.
33. Latin American regional workshop report compensation.
34. Asia regional workshop on compensation ecosystem services.
35. Report of African regional workshop on compensation ecosystem services.
36. Exploring the inter-linkages among and between compensation and rewards for ecosystem services CRES and human well-being
37. Criteria and indicators for environmental service compensation and reward mechanisms: realistic, voluntary, conditional and pro-poor
38. The conditions for effective mechanisms of compensation and rewards for environmental services.
39. Organization and governance for fostering Pro-Poor Compensation for Environmental Services.
40. How important are different types of compensation and reward mechanisms shaping poverty and ecosystem services across Africa, Asia & Latin America over the Next two decades?
41. Risk mitigation in contract farming: The case of poultry, cotton, woodfuel and cereals in East Africa.
42. The RELMA savings and credit experiences: Sowing the seed of sustainability
43. Yatich J., Policy and institutional context for NRM in Kenya: Challenges and opportunities for Landcare.
44. Nina-Nina Adoung Nasional di So! Field test of rapid land tenure assessment (RATA) in the Batang Toru Watershed, North Sumatera.
45. Is Hutan Tanaman Rakyat a new paradigm in community based tree planting in Indonesia?
46. Socio-Economic aspects of brackish water aquaculture (Tambak) production in Nanggroe Aceh Darrusalam.
47. Farmer livelihoods in the humid forest and moist savannah zones of Cameroon.
48. Domestication, genre et vulnérabilité : Participation des femmes, des Jeunes et des catégories les plus pauvres à la domestication des arbres agroforestiers au Cameroun.
49. Land tenure and management in the districts around Mt Elgon: An assessment presented to the Mt Elgon ecosystem conservation programme.

50. The production and marketing of leaf meal from fodder shrubs in Tanga, Tanzania: A pro-poor enterprise for improving livestock productivity.
51. Buyers Perspective on Environmental Services (ES) and Commoditization as an approach to liberate ES markets in the Philippines.
52. Towards Towards community-driven conservation in southwest China: Reconciling state and local perceptions.
53. Biofuels in China: An Analysis of the Opportunities and Challenges of *Jatropha curcas* in Southwest China.
54. *Jatropha curcas* biodiesel production in Kenya: Economics and potential value chain development for smallholder farmers
55. Livelihoods and Forest Resources in Aceh and Nias for a Sustainable Forest Resource Management and Economic Progress.
56. Agroforestry on the interface of Orangutan Conservation and Sustainable Livelihoods in Batang Toru, North Sumatra.

## 2008

57. Assessing Hydrological Situation of Kapuas Hulu Basin, Kapuas Hulu Regency, West Kalimantan.
58. Assessing the Hydrological Situation of Talau Watershed, Belu Regency, East Nusa Tenggara.
59. Kajian Kondisi Hidrologis DAS Talau, Kabupaten Belu, Nusa Tenggara Timur.
60. Kajian Kondisi Hidrologis DAS Kapuas Hulu, Kabupaten Kapuas Hulu, Kalimantan Barat.
61. Lessons learned from community capacity building activities to support agroforest as sustainable economic alternatives in Batang Toru orang utan habitat conservation program (Martini, Endri et al.)
62. Mainstreaming Climate Change in the Philippines.
63. A Conjoint Analysis of Farmer Preferences for Community Forestry Contracts in the Sumber Jaya Watershed, Indonesia.
64. The Highlands: A shower water tower in a changing climate and changing Asia.
65. Eco-Certification: Can It Deliver Conservation and Development in the Tropics?
66. Designing ecological and biodiversity sampling strategies. Towards mainstreaming climate change in grassland management.
67. Participatory Poverty and Livelihood Assessment Report, Kalahan, Nueva Vizcaya, the Philippines
68. An Assessment of the Potential for Carbon Finance in Rangelands
69. ECA Trade-offs Among Ecosystem Services in the Lake Victoria Basin.
70. Le business plan d'une petite entreprise rurale de production et de commercialisation des plants des arbres locaux. Cas de quatre pépinières rurales au Cameroun.
71. Les unités de transformation des produits forestiers non ligneux alimentaires au Cameroun. Diagnostic technique et stratégie de développement Honoré Tabuna et Ingratia Kayitavu.
72. Les exportateurs camerounais de safou (*Dacryodes edulis*) sur le marché sous régional et international. Profil, fonctionnement et stratégies de développement.
73. Impact of the Southeast Asian Network for Agroforestry Education (SEANAFE) on agroforestry education capacity.
74. Setting landscape conservation targets and promoting them through compatible land use in the Philippines.



75. Review of methods for researching multistrata systems.
76. Study on economical viability of *Jatropha curcas* L. plantations in Northern Tanzania Assessing farmers' prospects via cost-benefit analysis
77. Cooperation in Agroforestry between Ministry of Forestry of Indonesia and International Center for Research in Agroforestry
78. "China's bioenergy future. an analysis through the Lens if Yunnan Province
79. Land tenure and agricultural productivity in Africa: A comparative analysis of the economics literature and recent policy strategies and reforms
80. Boundary organizations, objects and agents: linking knowledge with action in agroforestry watersheds
81. Reducing emissions from deforestation and forest degradation (REDD) in Indonesia: options and challenges for fair and efficient payment distribution mechanisms

## **2009**

82. Mainstreaming Climate Change into Agricultural Education: Challenges and Perspectives.
83. Challenging Conventional mindsets and disconnects in Conservation: the emerging role of eco-agriculture in Kenya's Landscape Mosaics.
84. Lesson learned RATA garut dan bengkurat: suatu upaya membedah kebijakan pelepasan kawasan hutan dan redistribusi tanah bekas kawasan hutan.
85. The emergence of forest land redistribution in Indonesia.
86. Commercial opportunities for fruit in Malawi.
87. Status of fruit production processing and marketing in Malawi.
88. Fraud in tree science.
89. Trees on farm: analysis of global extent and geographical patterns of agroforestry
90. The springs of Nyando: water, social organization and livelihoods in Western Kenya.
91. Building capacity toward region-wide curriculum and teaching materials development in agroforestry education in Southeast Asia.
92. Overview of Biomass Energy Technology in Rural Yunnan.
93. A Pro-Growth Pathway for Reducing Net GHG Emissions in China
94. Analysis of local livelihoods from past to present in the central Kalimantan Ex-Mega Rice Project area
95. Constraints and options to enhancing production of high quality feeds in dairy production in Kenya, Uganda and Rwanda
96. Agroforestry education in the Philippines: status report from the Southeast Asian Network for Agroforestry Education (SEANAFE)

## **2010**

97. Economic viability of *Jatropha curcas* L. plantations in Northern Tanzania- assessing farmers' prospects via cost-benefit analysis.
98. Hot spot of emission and confusion: land tenure insecurity, contested policies and competing claims in the central Kalimantan Ex-Mega Rice Project area
99. Agroforestry competences and human resources needs in the Philippines



The World Agroforestry Centre is an autonomous, non-profit research organization whose vision is a rural transformation in the developing world where smallholder households strategically increase their use of trees in agricultural landscapes to improve their food security, nutrition, income, health, shelter, energy resources and environmental sustainability. The Centre generates science-base knowledge about the diverse role that trees play in agricultural landscapes, and uses its research to advance policies and practices that benefit the poor and the environment.



United Nations Avenue, Gigiri - PO Box 30677 - 00100 Nairobi, Kenya  
Tel: +254 20 7224000 or via USA +1 650 833 6645  
Fax: +254 20 7224001 or via USA +1 650 833 6646  
Southeast Asia Regional Programme - Sindang Barang, Bogor 16680  
PO Box161 Bogor 16001, Indonesia  
Tel: +62 251 625 415 - Fax: +62 251 625 416  
[www.worldagroforestry.org](http://www.worldagroforestry.org)