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### **Payments for Forest Ecosystem Services: Global and Local Assessments of Costs and Benefits**

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# Summary

For centuries, human activities have resulted in severe damages and losses of the world's forests and their provision of ecosystem services. As a majority of our world's population are dependent on the utilization of forest resources, sustainable forest management helps to ensure not only the continuing functionality of these precious natural ecosystems but also human welfare and well-being. So far, a variety of policy instruments has been implemented to halt forest loss, ranging from legislative, enabling, to economic measures. This study focuses on Payment for Ecosystem Services (PES), an emerging economic instrument in the forestry sector. Throughout the research, PES is framed as a market based mechanism where (i) a clearly defined ecosystem service is transacted between buyers and sellers, and (ii) payment is conditional upon the fact that services are adequately delivered. The main objective is to examine to what extent PES can be considered a cost-effective and co-beneficial to forest management, from both environmental and socio-economic perspectives. Studying the cost-effectiveness and co-benefits of PES is shown to be challenging as it is very difficult to empirically demonstrate and quantify these properties in practice, owing to a number of uncertainties and the context-dependent nature of the PES schemes.

To answer the main research question, I first conduct two comprehensive, global meta-analyses on the costs of avoided deforestation (Chapter 2) in general and transaction costs of forestry carbon projects (Chapter 3) in particular. The results from Chapter 2 quantitatively confirm that in developing countries, the magnitude of avoided deforestation costs (US\$ per tCO<sub>2</sub>) depends significantly on a mixture of both study design and context factors. Amongst those are the method used to calculate costs, the rate used to discount costs over time, carbon density, alternative land uses, and studied location. Moreover, it is observed that transaction costs and co-benefits of avoided deforestation are one of the least studied issues that are typically unknown and not quantified.

The determinants of transaction costs are essential to understanding how costs vary across different institutional and organizational settings. In Chapter 3, I build up an analytical framework for assessing transaction costs of forestry carbon projects. Four main groups of transaction cost's driving factors are identified as the characteristics of (i) the transaction, (ii) transactor, (iii) institutional design, and (iv) project in general. When applied to the regression analysis of selected projects, the results demonstrate significant relationship between the transaction costs (US\$ per tCO<sub>2</sub>) and the three first groups. Amongst those, "market type" (CDM versus non CDM) as a representative for institutional design proves to strongly influence the magnitude of transaction costs. This is explained as a result of the inherent difference in project administrative regulation and governing mechanisms between the two market types.

In a next step, I zoom in on the local application of PES by examining two representative cases in Vietnam. Chapter 4 applies and tests the developed conceptual framework in Chapter 3 on a more local perspective where I measure and compare TC borne by two PFES coordinating organizations with different institutional designs. Data on transaction costs related to payment transfers and conditionality compliance are collected using a combination of in-depth interviews with local PFES scheme coordinators, site visits, and secondary data analysis. The two PFES schemes show substantial differences in transaction costs despite the fact that they emerged from the same legal-institutional framework. The cost variations are explained as due to differences in (i) underlying institutional design characteristics, in particular the forest land ownership, (ii) the number of participants which reflects transactor characteristics and (iii) the payment frequency as an important transaction design characteristic.

The topic of co-benefits is studied in Chapter 5 where I quantify the impacts of the PFES scheme in Lam Dong province on forest ecosystems, household livelihoods, and income levels. The study reveals that between the pre-PES period and the period since PES was introduced in the study area, a statistically significant increase in average percentage tree-cover was observed. The absolute and relative changes in income also proved to be significantly higher for participating households than non-participating households. Equally important, it is showed that whilst controlling for other relevant socio-economic trends and characteristics, changes in income levels are driven significantly by the number of years during which families participated in the PES scheme.

The evidences attained from this research bring about several recommendations. First, to narrow the knowledge gap of PFES more research on the transaction costs and co-benefits are very much needed. To date, there has been little research that simultaneously quantifies both the socio-economic and environmental consequences of PES. Second, institutional design features such as market type and land ownership are proven to considerably influence both the total and transaction costs. Policy makers are therefore advised to pay more attention to the role of institutional design when considering PES as an option for forest governance. Finally, results from the case studies conducted in Vietnam help confirm that PES can bring out double dividend by improving local forest cover and participant's livelihoods at the same time. To achieve co-benefits, a certain amount of transaction costs is incurred, mainly as a result of compliance checking.