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Why Payment for Ecosystem Services is a Cost-Effective Strategy for Climate Change Adaptation and Mitigation?

By: CHOU Phanith, Faculty of Development Studies, Royal University of Phnom Penh

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SOVANN Chansopheaktra, Department of Environment, Royal University of Phnom Penh

Roles of Payment for Ecosystem Services in Climate Change Adaptation and Climate Change Mitigation

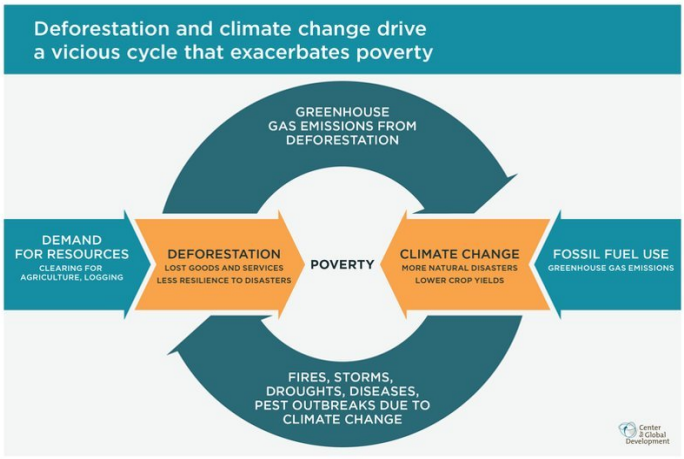
Global climate change increases the risk of climate-related disasters such as flood, drought, storm, wildfire, and extreme temperature, etc. Between 1998 to 2017 climate-related disasters and geophysical disasters killed 1.3 million people and left 4.4 billion injured, homeless, displaced, or in need of emergency assistance (CRED, 2018a), and caused US$ 2,245 billion or 77% of the total on economic losses. The increasing frequency and intensity of climate-related disasters affect various sectors including forest ecosystem services through exacerbating the degradation and destruction of ecosystem services (Munang et al., 2013).

However, ecosystem services play a fundamental role in disaster risk reduction by ensuring food security, providing decent livelihoods, mitigating natural hazards, controlling erosion, purifying water, supporting pollination, supporting soil formation, supporting nutrient cycling, and enhancing cultural services (FAO, 2016; Munang et al., 2013; Sutherland et al., 2016). Therefore, the contribution of ecosystem services to the well-being of people are extraordinarily vast and far-reaching (FAO, 2016).

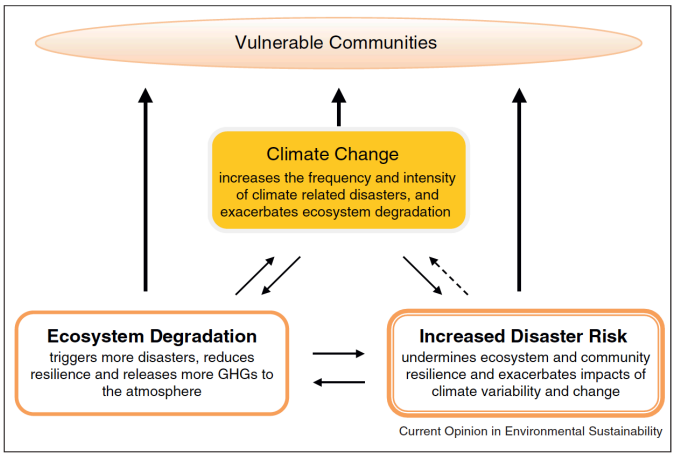
KEY MESSAGES TO POLICY MAKERS

- Payment for Ecosystem Services is the Cost-Effective Strategy for Climate Change Adaptation and Mitigation.
- Maintaining ecosystem services supports local livelihoods, improves forest functions, and has a long-term climate mitigation benefit through carbon sequestration.
- Minimizing the disturbance to ecosystem services saves tremendous economic loss from climate change impacts.
- Paying for ecosystem services attracts more financial support from many sources (REDD+, Official Development Assistance (ODA) for Sustainable Forest Management, Non-Timber Forest Products (NTFPs), Ecotourism, and Domestic Payment for Ecosystem Services).

The ecosystem and climate change adaptation and mitigation are intertwined. The climate-induced ecosystem degradation triggers more disasters including more frequencies and intensities of heavy rains, droughts, extreme temperature, and storms (CRED, 2018a; Munang et al., 2013), that drives a vicious cycle exacerbating the poverty (Seymour, 2017). In return, the poverty of local people aggravates ecosystem degradation. Chou (2018b) claimed that when climate-related disasters occurred in the forest of the community in Phnom Prich Wildlife Sanctuary, Mondulkiri, local people extracted the forest resources intensively as a measure to cope with those problems in short-term. Hence, the combination of highly active forest resources extraction and climate change induced ecosystem degradation surely lead to a mass-deforestation; as a result, it significantly reduces the forest capacity on carbon sequestration, the most important for climate change mitigation.



Source: Seymour, F. (2017). Forests and Poverty: Barking Up the Wrong Trees?



Source: Munang et al. (2013). The role of ecosystem services in climate change adaptation and disaster risk reduction.

Photo 1. Vulnerability from Ecosystem Degradation

Importance of the Study

Cambodia has the largest area of pristine tropical forests in mainland Southeast Asia, providing invaluable various ecosystem services, but the forests are alarmingly under tremendous pressure (FAO, 2016; Watkins et al., 2016). Millions of people in Cambodia depend directly on the forest ecosystem for their basic food, water, energy, and cash income generation (Watkins et al., 2016). Cambodia forest also plays a crucial role in regulating the water and soil cycles, protecting rural communities from the storm and floods, providing recreation services, and maintaining indigenous culture (Watkins et al., 2016).

After the civil war, Cambodia has made considerable efforts to conserve the forest ecosystem, resulting in an approximate 41% of the country landmass (7.5 million hectares) designated as protected areas by 2017 according to the Cambodian Ministry of Environment (Chou, 2018a). Nevertheless, the forest in Cambodia is still under threat from the deforestation driven by large-scale infrastructure, timber production, illegal logging, mining projects, land grabbing, agricultural land development, and other development activities (Cock, 2016; FA, 2009; Milne and Mahanty, 2015). At the same time of rapid deforestation, Cambodia is among the top most vulnerable countries to the impact of climate change. The Cambodian National Adaptation Programme of Action to Climate Change (NAPA) identifies that agriculture, forestry, and fisheries are the most vulnerable sectors from climate change impact in Cambodia (MoE, 2006).

The current climate change leads to forest degradation, which triggers more disasters and increases vulnerability to poverty (Munang et al., 2013). The economic losses from this climate change impact destructively to infrastructure, death, agricultural production, shelter, and biodiversity losses, etc.). Cambodia Climate Change Alliance reported that climate change would reduce absolute Cambodia GDP by 2.5% in 2030, and 9.8% in 2050. So, there is an entry question that is going to pay for this economic loss from the climate change impact which caused by weakening ecosystem services from deforestation? Or another question is that if we cannot avoid paying for economic losses from climate change why not do we pay for ensuring ecosystem services?

This policy brief aims to provide the scientific reasons that payment for ecosystem services is a cost-effective measure to prevent us from any climate-related disasters. This study selects Mondulkiri province for the case study because it is the largest remaining relatively undisturbed landscape in mainland Southeast Asia, the most critical site for biodiversity conservation in Cambodia, and the location of great importance in social, economic, and cultural (Chou, 2018c; Watkins et al., 2016).

Mondulkiri Province

Mondulkiri province is in the heart of the trans-boundary Eastern Plains Landscape (EPL) protected area complex. The landscape of Mondulkiri is mostly mountainous and hilly area with the average elevation of about 800 meters above the sea level (MoT, 2015). Mondulkiri has different climates compared to other provinces in Cambodia. The average temperature is 20 degree Celsius with the average rainfall of about 1,800 mm/year. The total area of this province is 14,288 km^2, which is the second largest province in Cambodia, and it is the second lowest population in the country. This province is dominant by ethnic minorities, which account for around 80% of the total population while Khmer ethnic is about 20% (NCDD, 2010).

Forest in Mondulkiri comprises of deciduous forest, semi-evergreen forest, and evergreen forest, mosaicking diversity of habitats, ranging from evergreen hills to open dry forest and savannas that home to many endangered species such as Asian elephants, wild cats, wild cattle, and vultures. Now, the rich biodiversity of Mondulkiri forests is being threatened by many (conventional) inappropriate economic development activities such as mining, agro-industry expansion, population growth, infrastructure development, and logging (WWF, 2017). Since those projects rarely include the external costs (i.e. cost of restoring ecosystem), the net economic benefits (monetary and non-monetary) are generally negative when projects end.

Alternatively, **we hypothesize that maintaining a healthy forest ecosystem generating higher cost-effectiveness.** One of the undeniable reasons is that the forest creates ecosystem services, which produce valuable benefits to society, to the local economy, and **to mitigate climate change through carbon sequestration.**

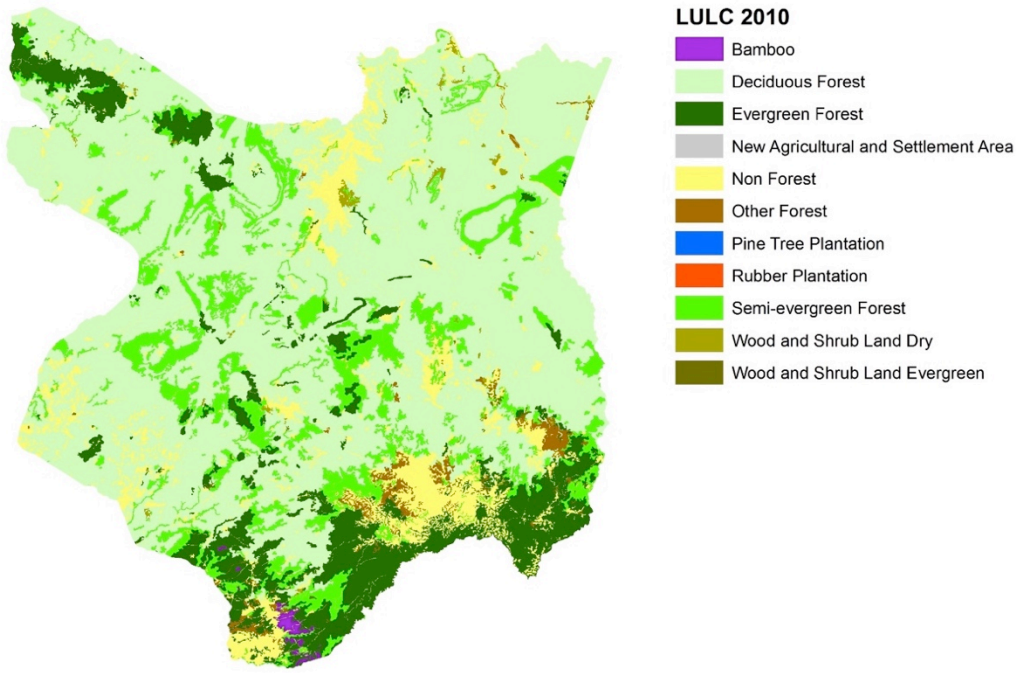


Photo 2. Forest Cover 2010 of Mondulkiri
Source: Watkins et al. (2016).

Photo 3. A Glance at Saen Monorom City, Mondulkiri, 2015

Photo by: Phanith Chou (2015)

Maintaining Ecosystem Services is an Effective Existing Strategy for Climate Change Adaptation and Long-term Climate Change Mitigation

Mondulkiri forest provides at least six key ecosystem services such as Non-Timber Forest Products (NTFPs), Carbon Stock, Water Yield, Habitat Quality, Nutrient Retention, and Sediment Retention. Chou (2017) & Watkins et al. (2016) found that **NTFPs** are abundant over the landscape of Mondulkiri landscape. Each NTFP has different characteristics of habitat and stocks. For example, bamboo, fuelwood, and Prich leaves (*Melientha suavis* Pierre) are very abundant while the commercial products such as liquid resin, solid resin, wild honey, and orchids are located in further distance, mostly in semi-evergreen forests. Chou (2018b) found that NTFPs prevent 66% households which collected NTFPs from falling into poverty. NTFPs also play a vital role in responding to climate-related disasters, especially drought.

The **carbon stock** in Mondulkiri is high and it serves an important function for regulating the climate and the areas which the highest amount of carbon stock are located in protected areas such as Keo Seima, Phnom Prich, Srepok, Lomphat, Snuol, and Phnom Nam Lear. The natural forests of this province also regulate the **water cycle** by absorbing and storing water in tree roots. This annual water yield supplies water for daily use of local people and wildlife. The landscape of Mondulkiri is considered as **suitable habitats** for the flagship species including

Asian Elephant, Leopard, Jungle Cat, Banteng, Gaur, Sambar Deer, Eld's Deer, Red Muntjac, Yellow-cheeked Crested Gibbon, Giant Ibis, Vultures, Siames Crocodile, etc.

These biodiversity play crucial role to balance the ecological functions and food chain for not only wildlife but also to humankind. Sediment and nutrient play role in ensuring soil fertility and makes the land suitable for growing crops. It helps local communities to reduce the impact of **drought and extreme** weather which degrade the soil fertility. The good roots and leaf litter system in Mondulkiri landscape reinforces the **good quality of soil and protect erosive effects of wind, rain, gravity and flowing water**. Therefore, it is undeniable that if humans do not disturb the forests, forests will always bring utmost goods and services to all humankind and biodiversity to adapt themselves from any climate-related disasters together with climate change mitigation through carbon sequestration.

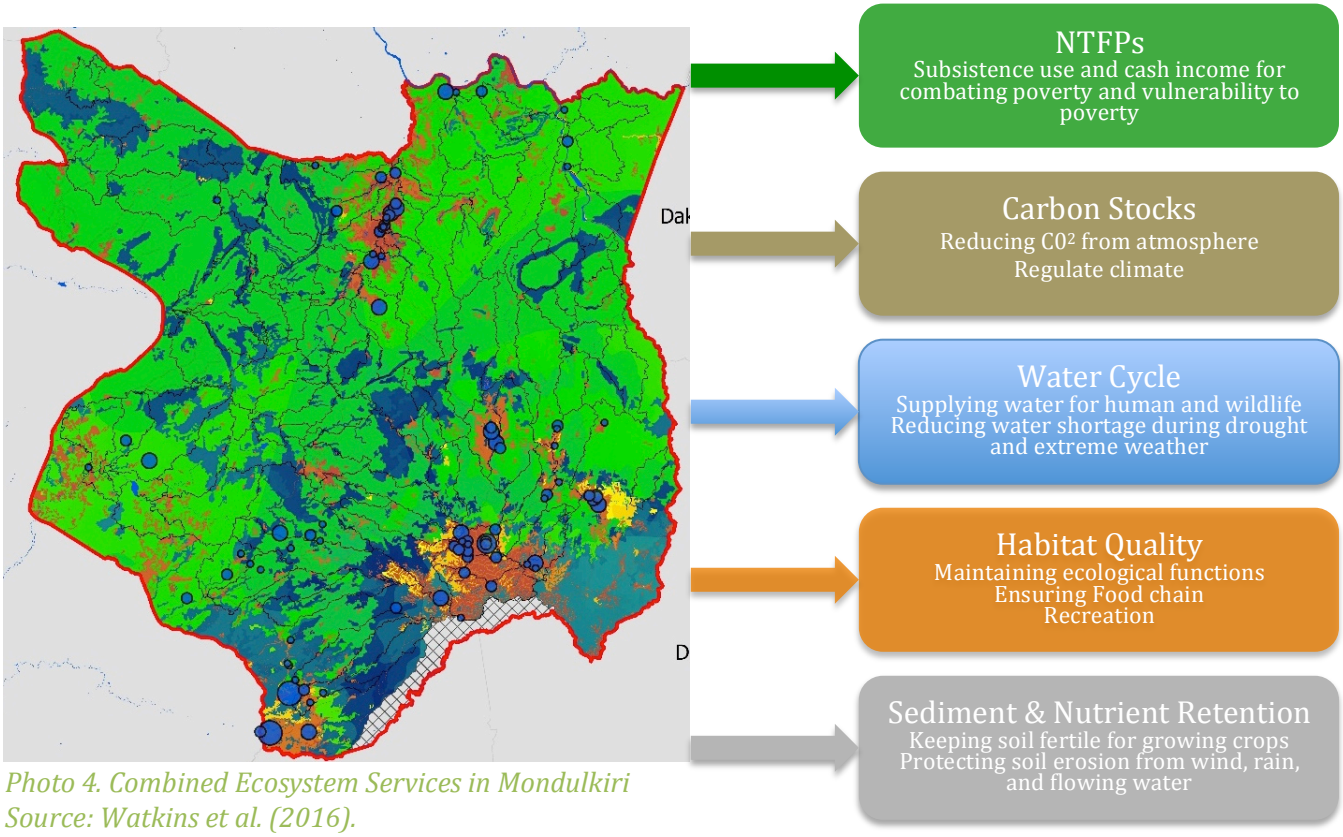


Photo 4. Combined Ecosystem Services in Mondulkiri
Source: Watkins et al. (2016).

Minimization the Human Disturbance to Ecosystem Services Saves Tremendous Economic Losses from Climate Change Impact

Economic losses from climate-related disasters are huge. In 2017, 335 natural disasters affected over 95.6 million people and costing a total of US$335 billion worldwide. Indeed, climate change will reduce Cambodia's GDP by 9.8 percent in 2050. Climate change will be the main cause of GDP loss which accounts for 57 percent of the economic loss and damage (UNDP-Cambodia, 2018). However, there is a claim that if we minimize the human disturbance to the forest ecosystem services, Cambodia can avoid to some extent of economic loss from climate change impacts. Watkins et al. (2016) applied InVEST model to predict the economic loss in case the current situation of deforestation or ecosystem services disturbance has still going on until 2030.

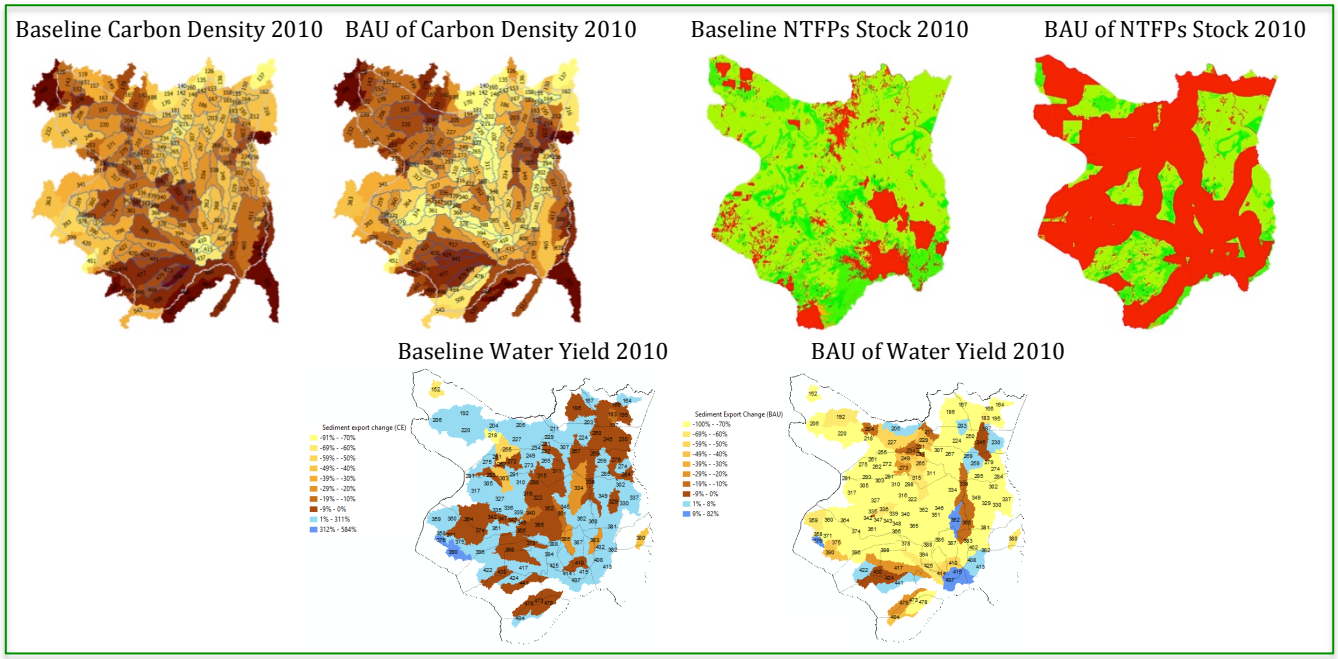


Photo 5. Economic Losses from Loss of Ecosystem Services (Carbon Stock, NTFPs, Water Yield) between baseline 2010 – BAU Scenario 2030

Source: Watkins et al. (2016).

Under business as usual scenario (BAU) comparing to baseline result of 2010, if local communities lose the forest containing primary ecosystem services which they depend on, it is highly likely that rural economic loss would be tremendous and causing high vulnerable to poverty. For illustration, the value of removal of CO_2 from the atmosphere is predicted about US$ 387 million between 2010 to 2030 in Mondulkiri. The current value of resin, bamboo, and honey is estimated to be almost US$26 million per year in Mondulkiri, but this amount is predicted to drop to US$4.5 million in 2030 under BAU scenario. The value of Water yield would be lost about US$ 7 million per year. If we predict the combined value of ecosystem services, the economic value of ecosystem services likely to decrease dramatically under BAU scenario, which is greater than US$ 1 billion up to 2030. These results clearly show that if we can minimize the human disturbance to ecosystem services, we can save very high compensation costs or economic losses from any consequences causing by climate change impact.

Paying for Ecosystem Services Attracts More Financial Agreement from Various Sources to Deal with Climate-Related Disasters

Payment of ecosystem services is the key concept for a sustainable financial instrument to enhance ecosystem services in order to deal with any climate change impact and to mitigate the long-term climate change. Climate-related disasters cause many consequences such as killing human lives, destroying crop production, increasing water shortage, destruction infrastructure, and disturbing ecological functions, etc. In 2017, 4.2 billion people worldwide were potentially exposed by natural disasters with economic costs about US$

334 billion (CRED, 2018b). Why people and state do not pay for ensuring ecosystem services which is the most natural effective strategy to avoid the huge costs of climate-related disasters? Nevertheless, there are entry questions about who should pay for ecosystem services? How much they should pay? And how they can pay? There are numbers of payment scheme such as:

- **Payment directly to nature**: Local people contribute voluntarily to protect forest conservation in Phnom Prich Wildlife Sanctuary. It is not a formal market model of PES mentioned by (Wunder, 2005), but it is a form of local economic incentives creating by indigenous knowledge/perception. Chou (2018a) found that when local communities extract NTFPs in Phnom Prich Wildlife Sanctuary, Mondulkiri province, Cambodia, local people have incentives to participate in forest conservation activities such as not collect the critical part of species, join in forest protection, contribute finance for forest protection, and contribute household labor for reforestation. When estimating to economic value, these voluntary actions equal to US$0.95/ha or US$95/km^2 in Phnom Prich Wildlife Sanctuary. In average, this kind of incentives is around US$212,690 per year in PPWS. Therefore, local communities satisfy to pay for nature, and they will sustain their livelihood in return.
- **In-Kind payment for ecosystem services:** A local community self-organized PES deals to pay for watershed services in Honduras. Ecological Development Fund based in United States of America provides payment to authority and local communities in Pico Bonito, Honduras to conserve 19 major watersheds. As a result, forest restoration and watershed conservation must be done, so the whole area can avoid the problem of erosion and flood through the drainage system providing by watershed (Varga, 2009).
- **Carbon market-based PES schemes:** Suijiang forestry farm, a Chinese company, establishes the deals with local communities and farmers to pant the forests. After received payment from carbon credit through clean development mechanism (CDM), the company signed the contract with local communities and farmers by paying for farmers' labor costs to ensure their short-term income, and the long-term benefit is carbon sequestration (Varga, 2009).
- **Market-based incentives for PES:** State enterprise of Vietnam provides financial incentives in forest conservation to farmers in Lam Dong and Son La provinces. The state enterprise offers cash incentives to farmers for planting the trees about 5 million hectares. Later on, the government identified publicly owned electric and water utilities (ex: electricity of Vietnam and the Sai Gon water company) as the services buyers and local farmers are the service providers. In results, those private companies and tourism business must contribute a small portion of their revenue into a centrally managed fund before compensating directly to local farmers. For illustration, a hydropower company pays 20VND/kWh of commercial electricity. Clean water production business pays 40NVD/m^3 while tourism company contributes 1% of their annual gross revenue (Suhardiman et al., 2013). **This payment scheme enhances not only short-term livelihood improvement but also long-term climate mitigation** through forest conservation and reforestation program.

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Authors: CHOU Phanith & SOVANN Chansopheaktra

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Contact Us:

1. Dr. VA Dany, Head of Department of Environmental Science, Royal University of Phnom Penh

Email: danyenvironment@gmail.com

2. Dr. Chou Phanith, Lecturer-Researcher of Department of Community Development, Faculty of Development Studies, Royal University of Phnom Penh

Email: c.phanith@gmail.com

3. Mr. Sovann Chan Sopheaktra, Lecturer-Researcher of Department of Environmental Science, Royal University of Phnom Penh

Email: chansopheaktra@gmail.com

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