Non-Timber Forest Products and their Role in Ecosystem and Community Resilience

A Cost Benefit Analysis of NTFPs

Summary

The Ecosystem based Adaptation (EbA) project is geared towards combating the impacts of climate change. Operating in 17 Village Districts Committees of Kaski, Parbat and Syangja District that include 9 core VDCs of the Panchase Protection Forest (PPF) and 8 adjoining VDCs, the EbA programme selected the area due to its vulnerability to climate change impacts. The major climate change hazards as landslides and soil erosion are predicted in the Panchase region with erratic rainfall pattern as resulted by changing climatic condition.

Non-Timber Forest Products (NTFPs) as Amriso (Broom Grass) and Timur are being planted in the region area. NTFPs plantations have proven to be the most effective methods of retaining the soil, thereby controlling the erosion and the landslides. They can be planted and managed in the abandoned agriculture fields—where previously, maize used to be sown—as well as in the Chure hills to reduce soil erosion. It is relatively easier for the farmers to plant and manage the species. Traditionally, people in Panchase have been collecting different forest products for fuel wood, food, construction materials, medicine and traditional rites. After the plantation of NTFPs as Amriso and Timur, the locals have also been enabled to generate commercial returns by harvesting and selling them.

The Cost Benefit Analysis (CBA) shows the cultivation of NTFPs to be highly profitable. The contribution of NTFPs to the income generation was highest in the case of poor families (9.89%), followed by middle income families (3.34%) and the least for the higher income families (1.34%). The household survey conducted for the present study revealed that 100% of the population is directly or indirectly dependent on NTFPs. House-hold response indicates diversity in both the types and uses of products collected. On top of the economic benefit, the EbA intervention also focuses on the use of NTFPs to retain the soil, so as to control the future climate induced hazards as soil erosion, landslide and flashflood.

The present study which was carried out to determine the role of NTFPs towards poverty alleviation and sustainable forest management in local communities, surrounding Panchase Protection Forest, indicates a substantial benefit of Amriso and Timur for local community as viable option in terms of economic benefit at household level as well as their significant contribution to the ecosystem.

Introduction

NTFPs, as Amriso, Cherry, Timur including medicinal plants are non-woods, alternative and secondary forest products that can be used as ecologically friendly method to prevent natural disasters as landslide and flooding. Therefore, they are useful natural commodities that do not require extra care and seasonal harvesting. NTFPs in particular, highlight those forest products, which have high economic potentials to the local people and communities, but have been ignored in the wake of forest management priorities.

However, in recent decades, interest and awareness in NTFPs as alternatives or supplements to forest management practices have soared up. In some forest types, under the conducive political and social conditions, forests have been and can be managed to upsurge NTFPs' diversity and, consequently, to promote biodiversity as well as the economic diversity.

In the context of Nepal, where majority of the people rely on the ecosystem based goods and services—either free of cost or at normal price—it is of pressing requirement that they adapt through the sustainable use and conservation of ecosystem in the present scenario of climate change. Ecosystem based Adaptation (EbA) is geared towards doing the same. This approach treats natural resources like NTFPs as complementary to or as a substitute for infrastructure measures. Thus, the improvement in the functioning of these ecosystems would generate better and higher quality of ecosystem services for all the stakeholders, not just at local level, but also at the national and international levels. These additional benefits although not counted by the private decision makers, had to be taken into consideration by the society or the government sector. Economic analysis or Cost Benefit Analysis (CBA) of the adaptation measures considers both the private and external benefits, emanating from these EbA interventions so as to enhance the ecosystem services to help people adapt to the imminent impacts of climate change.

CBA is an economic tool to help make better decision. Different ecosystems of a landscape such as Panchase, provide provisioning, regulating, cultural and supporting services. These services are quantified and valued to estimate the benefits from the landscape. Various investments can be made to adapt to the changing climate scenario and to increase the benefits from these ecosystem services (Talberth, 2015). CBA attempts to estimate the cost of these investments and then compares it with the outcome benefits as seen in the enhanced ecosystem services. If the benefits exceed the cost, it would make an economic sense to invest further in other areas in the future. Thus, it helps in making efficient policies including the ones on adaption (Aplizar et al, 2013).

Economic analysis or CBA offers alternative solutions to decision makers, and assists them to make robust decisions when it comes to implementing projects to address climate change. It is also a means to devise various incentive mechanisms, including reduction of perverse incentives. Case studies of Amriso and Timur cultivation in Panchase show that both of these interventions can provide better economic returns, and are also more efficient than the (BAU) scenarios. The research also shows that the provision of quality seedlings and seeds by the government would provide more incentives to the farmers to plant these species.

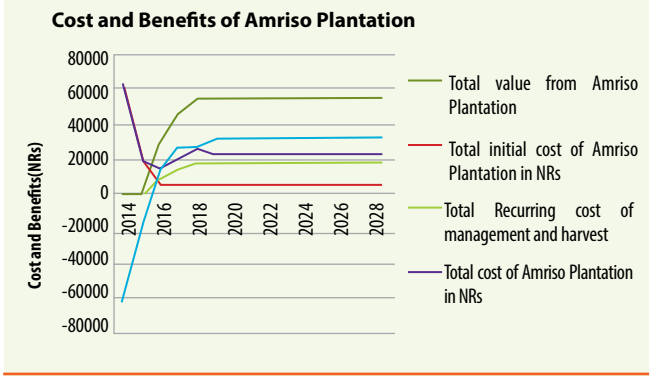
Economic Analysis of Ecosystem Based Adaptation Options

A. Economic Analysis of Amriso Plantation in Chitre, Parbat

Ecological characteristics of Amriso (Broom Grass)

Amriso, or Broom Grass *(Thysanolaena maxima)* or Tiger Grass is a popular non-timber forest products (NTFPs), grown as a cash-crop in Nepal. The inflorescences of the plant are harvested to make sweeping brooms. The brooms made out of Amriso are more durable than those made from other plants such as *Cocos nucifera* and *Phragmites* species. The leaves of the plant provide good fodder, and the stems are used as cooking-fuel. It has mat-like roots that bind the soil firmly, preventing soil erosion. Its cultivation can promote the sustainable use of the abandoned agricultural and the degraded lands. When planted, the Amriso stabilizes slopes and prevents landslides. It also helps reduce the growth of invasive plant species like *Lantana camara* (Bhatta et al, 2015, Bhuchar 2001).

COSTS AND BENEFITS OF AMRISO PLANTATION IN CHITRE, PARBAT



Cost Benefit Analysis (CBA)

Cost Benefit Analysis under Business as Usual Scenario

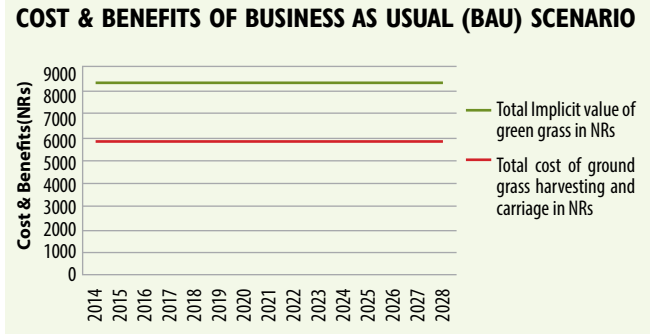
The CBA is done for the EbA scenario. The economic life of the Amriso plantation is estimated to be 15 years. Hence, the same period of economic life has been assumed for the grassland management. The EbA project is paying a rental fee of NRs[1] 14,000 per hectare of grassland for Amriso plantation. However, since the land is a fixed factor of production, our analysis does not include the cost of the land.

> "The work that we are doing is not a one day or two day thing. It's long-term...We are convinced that we will be able to get the message out that having an Amriso plantation in barren land can give a lot of profit. I am looking forward to people investing time and effort in planting Amriso and other plants in barren and abandoned land. We are hoping that all these areas will be covered in Amriso one day."
>
> Sabina AC, President,
> Panchase Women's Network.

[1] 1NRs (Nepali Rupees). NRs 100 is equivalent to one US$

If we assume that there would not be a rental fee on the land, the BAU of grassland management would generate a Net Present Value (NPV) of NRs 76,668 per hectare, or a Benefit-Cost Ratio (BCR) of 1.43. For the purpose of sensitivity analysis, a simple economic calculation of the BAU under the assumption that an annual rental fee of NRs 14,000 per hectare is charged for the land was taken into the account. It would lead to negative or an annual loss of NRs 3,528 or a negative NPV of NRs 29,816 per hectare. The BCR would be 0.9, which also indicates negative returns.

COSTS AND BENEFITS OF DEGRADED GRASSLAND MANAGEMENT IN CHITRE, PARBAT



Costs and benefits of Degraded Grassland Management in Chitre, Parbat

EbA Scenario: Amriso Plantation in Chitre, Parbat District

In 2014, Amriso was planted in 0.25 hectares[2] (or 5 Ropani) of privately owned degraded grassland in Chitre of Parbat district. The area faces the northern aspect. Seeds of rhizomes, collected from the nearby area were sown in the area. The present rate of survival of these rhizomes is 60 percent. At least, 500 more rhizomes had to be planted again in the rainy season of 2015 in the same land. A group of only women, comprising of twenty members, was created to manage the Amriso. They were trained on Amriso plantation and management.

The total cost of the training was NRs 28,700 for 2 days. Rhizome cost NRs 4 per piece. The total cost of pitting was NRs 15,000. The transportation cost of the Rhizome was NRs 2,300, and the weeding cost was NRs 12,000. A daily wage rate of NRs 500 per day prevails in the area. Once the Amriso start to yield brooms (after 2 years in this case), the inflorescence also called as panicles (broom) is extracted

[2] One hectare is equivalent to about 20 Ropani (ropani) in Nepali area measurement.

Group Collection Center at Tanahu/ (Photo: Dr. Keshav Kanel)

COST BENEFIT ANALYSIS OF AMRISO PLANTATION UNDER EBA SCENARIO

Present Value of Benefit	NRs 1,187,448
Present Value of Costs	NRs 800,224
Net Present Value (NPV)	NRs 387,224
Benefit Cost Ratio (BCR)	1.48
Internal Rate of Return (IRR)	26%

A discount rate of 10 percent and the life span of 15 years.

(Photo: EbA Project)

from the stem. The inflorescences are tightly bundled up to make brooms. Each broom is sold at a net price of NRs 40 (deducting the cost of bundling) in the villages and nearby small market.

The leaves of the Amriso are fed to livestock. It is a prized fodder since the green leaves are available even during the dry season when other green fodders are in short supply. The implicit price of the leaves is about NRs 4 per Kg. The green leaves are not traded in the market. Similarly, the stems of the Amriso are used at household level, and not traded in the market. They are dried and used domestically as fuel for cooking food. Furthermore, they are implicitly valued at NRs 4/Kg. Both the prices (value) of the Amriso leaves and the stems were calculated based on "barter trade"[3] . A maximum of 75 kg of dried brooms can be obtained from one Ropani of Amriso plantation. Being an effective biological means of conserving soil and reducing soil erosion, it is also planted along the road-side to protect the land against erosion (Bhatta et al 2015; Bhuchar 2001).

> "I am confident that Amriso plantation in abandoned agricultural-lands in our village will be a popular enterprise amongst the women of Chitre in coming days. The EbA intervention has shed light on its potential in restoring the degraded lands while also providing fuel wood and fodder. It can also be an alternative option to generate income since the local and regional market has huge demand of the sweeping brooms."
>
> Ms Sushila Devi Gurung,
> Member Secretary, Panchase Women Network."

[3] Since these products are not bought or sold through cash, we ask them how much they would pay per Kg of the product in terms of maize or millet. Since maize or millet is transacted in the market, we would get the value of these products (Leaves and stem) by converting the millets and or maize paid to get these products into cash.

Economic Analysis of Amriso Plantations (NRs per Ha)

There are two types of costs associated with Amriso plantation as suggested in Aplizar, et al. (2013). They are: initial or investment cost, and recurring cost. The initial cost comprises of (a) Land preparation and weeding cost, (b) Cost of rhizome as planting material, and (c) Two-day training cost to 20 women-only-group members. Similarly, the recurring cost comprises of (a) extracting panicles from the stem, (b) harvesting and hauling of grass and stems from the site, and (c) annual burning of the site.

The other benefits which accrue to society also known as external benefits are in terms of the reduced soil erosion risks at the planted site and reduced sedimentation downstream due to conserved soil on the site. The former benefit occurs at the upstream, and the latter in the downstream. Soil erosion is estimated at 10.62 tons/ha/year under the BAU scenario (degraded grassland management) and 5.54 tons/ha/year under the EbA or the Amriso plantation scenarios (Regmi et al, undated; Tiwari et al 2008). So, there is a net reduction of 5.08 tons/ha/year of erosion from the Amriso plantation.

Sensitivity Analysis for Amriso

Scenario 1: Inclusion of rental fee

A sensitivity analysis was also carried out to see how the investment would perform if we change some important parameters of the analysis. For example, if we assume that we need to pay an annual rental fee of NRs 3,500 (for a quarter of a hectare), then the NPV would still be quite higher or NRs 277,392, but lower than the base case. Under this assumption, BCR would fall to 1.3, and the IRR would also fall to 21 percent but would still be higher than the base case.

Scenario 2: Decline in the yield of panicle

Another sensitivity analysis of Amriso plantation was carried out by assuming that the production of panicle (broom grass inflorescence) would decline by 15 percent in comparison to the base case. This reduction in Amriso production by 15 percent would still generate more benefits than the initial investment cost. Under this assumption, the NPV would be NRs 231,132. Similarly, BCR would still be 1.29 and the IRR would be 21 percent.

B. ECONOMIC ANALYSIS OF TIMUR PLANTATION IN RAMJA

Ecological characteristics of Timur

Timur, or Bamboo-Leaved Prickly Ash is also commonly known as Nepalese pepper. It is an indigenous plant that produces seeds of medicinal value, and supports in retaining soil along the bund of sloping agriculture land (Bari). Its unique features—its ability to grow in less fertile soil with very less disease and pest infestation; its availability in forests and the surrounding agricultural lands without much adverse effects in agricultural productivity; its usage as a terrace holder for crop land; and long experience of the rural women and poor in its seed collection—makes the *timur* a suitable plant species for adaptation and livelihood improvement of the economically weak communities.

Cost Benefit Analysis

Cost and Benefit Analysis under Business as Usual Scenario

Alternative of Timur plantation in the field is to cultivate maize as usual. The gross annual income from Timur would be NRs 53,688 per year per hectare. However, the cost of cultivating maize would be NRs 45,861 per year per hectare. So, the net benefit per year would be NRs 7,827 per year per hectare. At a discount rate of 10 percent, the present cost value (for two decades) would be NRs 390,441, and the present benefit value (for two decades) would be NRs 457,076. Thus, the total NPV of the BAU scenario (maize cultivation) would be NRs 66,636 per hectare. The benefit cost ratio of this BAU case amounts to 1.2.

EbA Scenario: Timur Plantation in Chitre, Parbat District

EbA scenario attempts to optimize the benefits of ecosystems services under the ongoing climate change context. This case study deals with the EbA Scenario of Timur cultivation in fallow and previously maize cultivated farm land in Panchase area. It also illustrates the returns from maize cultivation as BAU scenario. Compared to BAU of maize cultivation, Timur plantation uses natural environment to generate multiple ecosystem services as mentioned above.

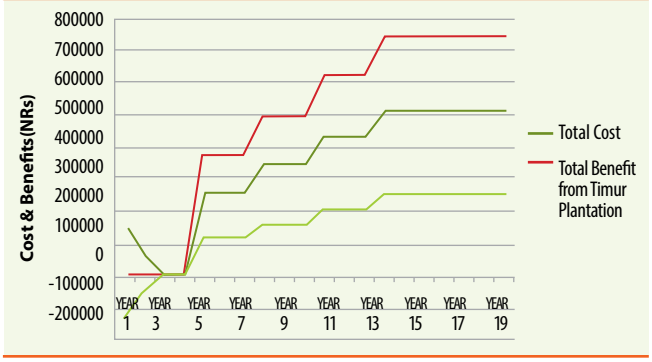
Timur, usually blooms from April to May, and produces constant fruit yields over the years (ANSAB, 2011). Seedlings of Timur are planted at a spacing of 3m by 3m during July/August. 1,100 seedlings are planted in one hectare of farm area. They start bearing fruit from the fifth year. Initially the yield per tree is 1.5 Kg of dried fruit, and then increases up to 3 Kg per tree over time. The dried seeds are sold at NRs 250 per Kg.

The total investment cost is NRs 139,900 in the first year, and NRs 57,450 in the second year. The cost of fruit collection varies depending upon the amount of fruits produced in due course of time. It is estimated that a farmer can collect 3 Kg of Timur seeds per day, valued at an opportunity cost of NRs 500 per day. Some cost would also be incurred in drying the fruits.

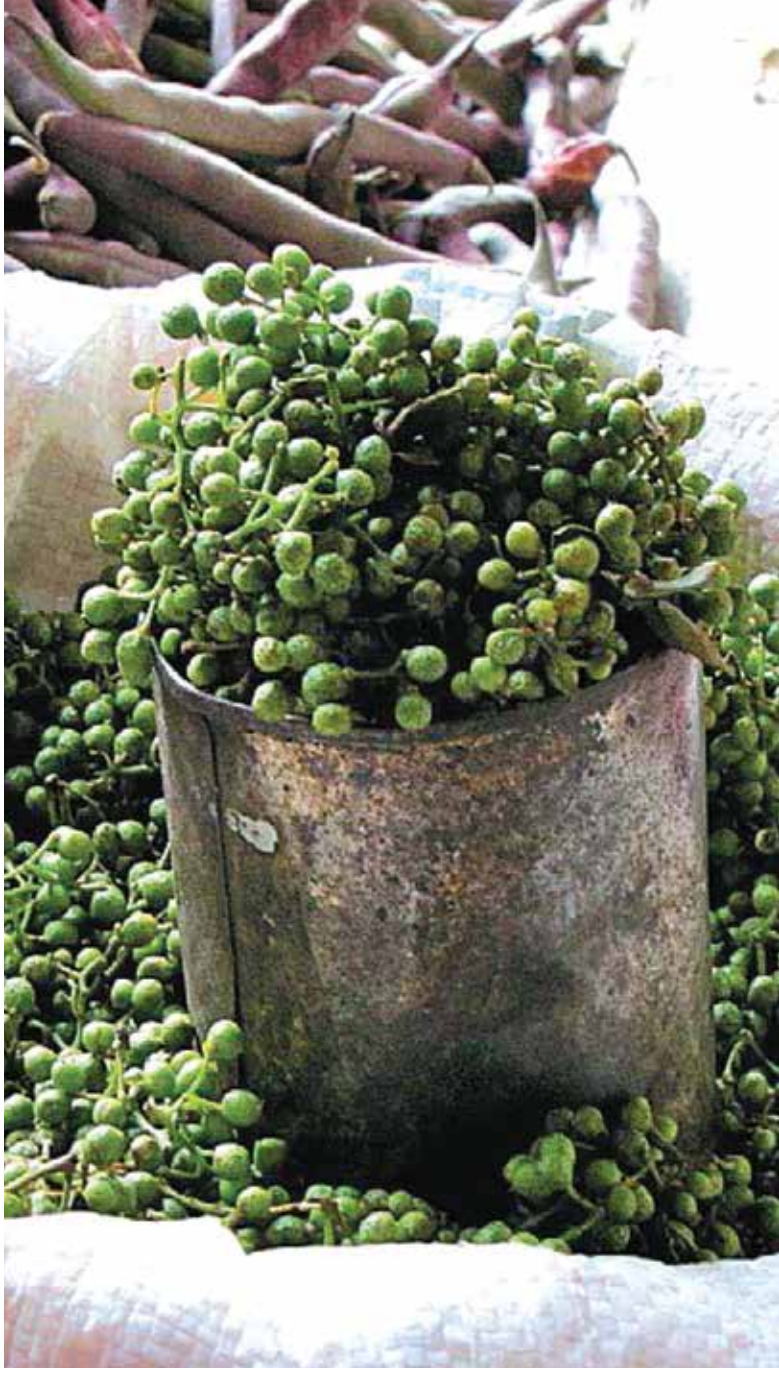
Cost Benefit Analysis of Timur Plantation under EbA Scenario

An economic analysis of EbA scenario (Timur plantation) in one hectare of land for a production period of two-decade was carried out in a spread sheet. Therefore, the economic life of Timur is considered as 20 years. The NPV of the entire production (intercropping with maize) at a discount rate of 10 percent amounted to NRs 769,434 per hectare. A breakdown of total benefit (NPV) shows that the private benefit from Timur plantation) of NRs 762,839, and an external benefits (soil conservation and reduced sediment load in hydro power dam of NRs 6,595 accrues from the plantation. In other words, about 99 percent of the total NPV is tapped by the Timur farmers as private benefit.

Cost and Benefit of Timur Plantation in Ramja



A comparison of the BAU and the EbA scenarios of Timur plantation on the farm land of Panchase shows that Timur planation provides significantly higher benefits than from the maize cultivation. For example, the NPV from maize cultivation is NRs 457,076 per hectare. However, the NPV from Timur plantation is NRs 769,434 per hectare. So, Timur plantation provides an additional benefits of NRs 312,358 or 68 percent more per hectare.



Policy Implications

Amriso plantation is an excellent EbA measure to improve the productivity of the land, to reduce soil erosion, and to increase/diversify the income of the farmers in the hill of Nepal. So far, the Leasehold Forestry program under the Department of Forests has helped the farmers to plant more than 3,000 hectares of degraded public land to restore its ecological integrity and to expand income generation to the economically weak farmers. Given the high cash income from the plantation and its management, farmers of the area can be motivated to plant and manage the Amriso in these agricultural fields. This is one of the most successful programs in Nepal.

The cost of Amriso plantation for both the farmers and the government (subsidy in terms of providing rhizome, training etc.) is insignificant compared to the ecological solution to deal with climate change and the opportunity for income generation from the panicle. It would be quickly adopted by the marginalized farmers and the total cost to the government would also be very minimal. So, more budgets should be allocated to the program by the government. The CBA would be a tool to convince the Ministry of Finance and the Ministry of Forests and Soil Conservation to expand the program in the hills and the Chure area.

Even though the benefits from Timur plantation far exceeds that of maize cultivation, farmers have not yet extensively planted this crop because they still think that 20 years is too long to get the total benefits. Moreover, the farmers say that the prickles are too sharp to collect the seeds from the tree. The technique of producing seedlings in a nursery was also not well developed in the villages. Until now, most of the farmers had to depend on wild seedlings naturally grown from the dropping of seeds by the birds. So, it will take a while before the majority of the farmers adopt its cultivation at a commercial scale. As the price of the seed is increasing faster than the inflation, the farmers may have higher incentives to grow the trees over time. Even then, the government could provide extensive support and financial incentives to the farmers in the initial period so that they may widely adopt Timur plantation on their farm as an adaptation strategy.

Conclusion

NTFPs as seen above are low cost interventions that act like soil fillers to combat soil erosion. With their medicinal values and economic potentials, NTFPs have been popular amongst the local people, especially those who reside in land areas that are prone to landslides and soil erosion. Without much ado about nurturing the plants of NTFPs, people in the communities have been more accepting to plant such trees for battling and countering the effects of climate change, and to gain quicker economic returns in degraded and abandoned grassland of Panchase area.

EbA interventions have raised social awareness—through pragmatic approach of NTFPs plantation—amongst the locals that these products should be used not only for their commercial values, but also as the bioengineering means for reducing the risks related with soil erosion and landslides.

As a result of the intervention, two of the NTFPs, Amriso and Timur have become more popular in the EbA project site.

Amriso plantation, as an EbA scenario, generates a Net Present Value (NPV) of NRs 387,000/hectare within a period of one-and-half decade. Its Internal Rate of Return (IRR) is 1.48 percent and Benefit/Cost Ratio (BCR) is 1.48. In comparison, the degraded grassland management as BAU scenario generates NPV worth only NRs 76,600/ha or a BCR of 1.43. If the cost of the land is included, degraded land management would yield a negative return.

Likewise, Timur, a medium size tree, yields seeds from its fifth year. It is becoming popular to plant the species at the bunds of agriculture field so as to produce seed for commerce/trade and to conserve soil and water in the field. CBA of Timur plantation shows that its cultivation is highly profitable. One hectare of farm land generates about NRs 770,000 (as NPV) over a period of two decades with a return of 34 percent. Alternatively, maize cultivation on the same piece of land generates a NPV of only NRs 66,600 over the same period of time.

The interventions of EbA have been piloted in selected areas of Panchase. The study findings have shown that multiple benefits of planting Amriso and Timur in degraded or barren land. Thus, it is also evident that the ecosystem solutions to climate change impacts are available locally which highlights the need for intermixing with scientific knowledge and climate modeling for Nepal towards such feasible solutions in many such vulnerable mountain ecosystems in Nepal.

Recommendation

Climate adaptation is an ongoing process. Hence, EbA is set apart from Business as Usual in terms of conservation and ecosystem management. The intervention of EbA in Panchase region goes beyond planting NTFPs in public lands, which were degraded over the course of time. The initiative raises awareness amongst the locals about the results of climate change and displays the methods of adapting to the imminent threats brought by the climate change.

Because of the steep geographical structure of the region, Panchase is highly prone to landslide and erosion. Marred further by the out-migration of the local youth populace, more private lands have been left untilled, inviting further degradation of the soil. With the intervention of EbA with regards to planting easily manageable NTFPs that retain the soil has demonstrated to the local stakeholders to take ownership of their area to combat the serious threats on ecosystem.

Presently, Amriso and Timur are being cultivated in both the private and public lands of Panchase region. With the introduction and intervention of EbA project, the lands have now been nurtured and cultivated again by growing these NTFPs.

From this study, there are clear opportunities to mitigate the climate change effect on the following sequences of interventions in the area on a priority basis:

- Expansion of NTFPs as Amriso and Timur on degraded and abandoned lands and capitalizing their role on livelihood.
- Prioritization of plantation of the species based on their multiple and co-benefits to the ecosystem.
- Pressing need to comprehend climate change scenario and its impact in the region and plan ecosystems solutions to address it

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This report is prepared on the basis of the "Cost-Benefit Analysis of EbA interventions: Case Studies from Panchase Project Area. Cost Benefit Analysis Report."

Citation:
GoN/EbA/UNDP (2015). Cost-Benefit of EbA Interventions: Case Studies from Panchase Project Area. Cost Benefit Analysis Report. Prepared by Dr. Keshav Raj Kanel for the Ecosystem based Adaption Project in Mountain Ecosystems in Nepal Project. Government of Nepal, United Nations Environment Programme, United Nations Development Programme, International Union For Conservation of Nature, and the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety.

Published By: Government of Nepal (GoN)/United Nations Development Programme (UNDP)

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Supported by:
Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
based on a decision of the German Bundestag

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