Carbon Sequestration through Climate Investment in Forests and Rangelands (CS-FOR) in Kyrgyzstan

Economic and Financial Analysis

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# **Introduction**

1. The goal of the Carbon Sequestration through Climate Investments in Forests and Pastures (CS-FOR) is to contribute to the development of a low carbon-emission and climate-resilient economy. The core intervention area of the project will comprise the four districts of Ak-Talaa, Toguz-Toro, Suzak and Uzgen, among the most vulnerable to the combined effects of direct and indirect impacts of climate change. The project will intervene in key hot spots of target areas with adapted forest and pasture investments aimed to clearly transform management of pasture and forest resources at the national and local levels to ecosystem-based sustainable NRM. The integrated approach used to facilitate the investment decisions will be inclusive to ensure participation and cohesion of the various stakeholders involved at local level, and will mainstream the need to enhance communities’ climate change adaptation and responsiveness. While CS-FOR will focus on the selected target areas (see chapter 1), the interventions and the knowledge generated through the evidence-based approach will allow the country to scale-up the approach to additional priority districts, cycle (also depending on availability of financing), and will have a parallel country-wide and demand-driven outreach, in order to stimulate the economic incentives and ensure long term impact beyond the project’s investment.
2. **Direct beneficiaries** of the project include about 450,000 citizens in the core intervention area in the regions of Jalal-Abad, Osh and Naryn, who will benefit from the significant increase of forest coverage and rangeland rehabilitation in hotspots with high risks of hazards, as well as the agribusinesses and their raw material suppliers participating in the supported value chains.
   1. **Institutions at local level**, namely the stakeholders involved in the Community Landscape Management Groups (CLMGs) including State Forest Entreprises (Leskhozes), National Parks, self-government bodies (Municipalities and their institutions, such as ayil okmutu and aiyl kenesh), the Pasture Users’ Unions, other natural resources users groups and all relevant stakeholders.
   2. **Institutions at national level**, including the State Agency for Environmental Protection and Forestry (SAEPF), the Ministry of Agriculture, Food Industry and Melioration (MAFIM), the Ministry of Emergency Situations (MES), the State Agency for Local Self Government and Interethnic Relations (SALSGIR), the Climate Finance Center (CFC), other relevant ministries, research and educational institutions, non-governmental organizations (NGOs) and others.
3. The proposed project promotes an innovative approach to leveraging investment in ecosystem-based NRM through a set of instruments which take into account both economic incentives and environmental services. The project will support investment in afforestation/reforestation, forest enrichment and improved management, and pasture rehabilitation. The project will leverage the private sector’s investments in ecosystem-based NRM by creating an enabling institutional environment for ‘Climate-sensitive Value Chains’ that will provide economic incentives to the required diversification and enhanced efficiency, productivity and competitiveness of existing economic activities in the highly degraded target areas. Innovative technologies and monitoring tools (including geospatial referencing and analysis) will be used to ensure an informed decision-making process and planning, as well as for objective assessments of the project’s contributions to climate change mitigation and adaptation, and for knowledge sharing. Such tools will be designed in a way that helps the country and all stakeholders to progressively move towards evidence-based policy dialogue and institutionalization of public support.
4. The project’s investments and activities will be executed through three components, in addition to Project Management:
   1. Component 1. Evidence-based strengthening of NRM governance
   2. Component 2. Green Investments for Forest and Pasture Rehabilitation
   3. Component 3. Climate-sensitive Value Chains Development
5. **Investment Delivery approach**. The project will support carbon emission reduction and enhance carbon storage (carbon sinks) through various channels: the implementation of the Integrated NRM and climate-resilience plans (INRMCRP), including investment in afforestation, reforestation and forest restoration; preservation of pastures and prevention of further degradation; the potential progressive reduction of the number of livestock, representing a reduction in the carbon emissions; and the adoption of climate-sensitive technologies through competitive grants. The implementation of INRMCRPs and the positive results obtained by the technologies introduced in the agrifood sector will be amongst the main drivers for replication beyond the project. The country will thus shift from a carbon insensitive agrifood sector to a low-carbon emission economy.
6. Traditional financial models are a useful but not sufficient tool for measuring the Project’s objective of mobilizing investments to accelerate the adoption of climate smart technologies that are conducive to carbon sequestration besides creating economic development and employment opportunities. The models presented are for demonstration purposes only and to be used as building blocks for the analysis. The analysis presents typical Afforestation / reforestation models household/farm and enterprise models that then compose the representative agricultural production and processing value chains.

# **Project Benefits**

1. In the core intervention districts, the CS-FOR will target the population living in the four intervention districts for an approximate population of about 520,000 individuals. Additionally, the project will involve various national institutions, 3 regional administrations, 4 districts, 50 municipalities that include 49 pasture user unions (PUU) and the civil society. Under the IRNMCRP the project will contribute to ensuring capturing about 19.8 million tons of CO2 equivalent via reforestation-afforestation of 6,000 ha of severely damaged forests, the rehabilitation of about 644,000 hectares of degraded pastures, and the improved management of about 56,349 ha of forests. It will also contribute to increase the resilience levels for about 70% of the population in the area. The estimated cost per ton of CO2eq (total investment cost/expected lifetime emission reductions) is around US$ 2.5 per tonne (or US$1.5 per tonne considering only the GCF grant). Sustainability and replicability of project activities will be ensured by the newly established sustainable NRM governance at the community level and by the establishment of an improved legal and regulatory environment.
2. As an additional and significant benefit, the interventions of the project will help to reduce risk and losses due to disasters – from both geo-physical and meteorological hazards. The ecosystem-based approach to forestry and pasture management is a cost-effective and locally sustainable way to diversify livelihoods, while also protecting poverty-reduction progress from recurring (and increasing from climate change) risk to high temperatures, drought, wildfire, and landslides. Reducing risk to these hazards is also in line with Kyrgyzstan’s commitment in their National Disaster Risk Reduction Strategy and the commitments to the Sendai Framework for Action, while reducing risk of wildfire (a top contributor to CO2 emissions) will protect communities, their land, and contribute to the national and global agenda (Paris Agreement) to limit global warming.

# Financial Analysis

1. The analysis focuses on a number of indicative economic activities identified during the project design and that would be potentially supported by the CS-FOR. Following the Project structure, particularly Component 2 and Component 3, two blocks with illustrative models were prepared to demonstrate the financial viability of potential investments:
   1. **Grant-financed activites: Green investments for forest and rangeland rehabilitation (Component 2):** 
      1. Afforestation, reforestation, forest enrichment
      2. Pasture restoration
   2. **Loan-financed activities: Climate-sensitive value chains (Component 3):**
      1. Fruit / nut orchard
      2. Nursery
      3. Conservation agriculture for cereals
      4. Greenhouse
      5. Beekeeping
      6. Broiler
      7. Turkey
      8. Cold storage
      9. Solar dryer
      10. Vacuum dryer
2. The **investment in forestry**, including afforestation / reforestation and forest restoration in the target area through the INRMCRPs present expectedly poor financial results (except for walnut plantations). This is associated to the low pace of growth in the local conditions of the adapted tree species selected as most suitable for the investment (see Chapter 4 and its Appendix for more details).
3. **Investment in improved rangeland** present better results, with positive financial returns, and with higher resistance in with-project scenario to climate stresses. Both categories of investment present substantial results under the economic analysis, which takes into account the valuation of carbon sequestration and the ecosystem benefits. In order to ensure financial viability of these investments, the project will provide significant level of concessionality.
4. **Investment in Climate-sensitive Value chains.** Concerning the investment under component 3, mostly focusing on improved competitiveness of the agricultural sector with associated increased employment and livelihoods diversification opportunities, all value chain models show substantially positive financial benefits and rate of return. These results are derived from the increased access to the required financing (loans) – which will be made available by the CS-FOR co-financing, coupled with training, demonstrations and advisory services, provided by the project.
5. Investments in Climate-sensitive value chains will be primarily driven concessional loans funded by the Russian-Kyrgyz Development Fund (RKDF), provided at 10% interest rate in Kyrgyz som (half of the prevailing market interest rate) since there is lack of access to affordable funding for medium scale economic actors. RKDF has a strong development mandate and is interested in channeling funds in the agriculture sector – one of the priority sectors – and to entrepreneurs in rural areas. The technical assistance under component 3 and the market incentives generated by the loans will progressively increase the access to higher segments of the market and increase overall access to financial products.
6. Within the CS-FOR project, climate investments for carbon sequestration through forest and rangeland rehabilitation (Component 2) will be implemented with highly concessional terms (on average, 80% of the costs will be covered by the GCF grant). On the other hand, investments into climate-sensitive value chains (Component 3) will be financed through loans from RKDF and supported by Project technical assistance (the project will deploy technical assistance for an amount equivalent to 15%-20% of the cost of the investments).

# **Key Assumptions**

1. The parameters for the models are based on information gathered during the design: interviews with farmers and entrepreneurs, information from the donor agencies operating in Kyrgyzstan and mission estimates. In particular, information on labor and input requirements for various operations, capital costs, prevailing wages, yields, farm gate and market prices of commodities, input and farm-to-market transport costs were collected. Conservative assumptions were made both for inputs and outputs, and take account of possible risks.
2. **Prices.** Prices for commodities/inputs reflect annual average farm-gate prices and those actually paid/received by the farmer/entrepreneur, and imply potential risks. A list of prices used in the analysis can be found in the spreadsheet “Prices” of the Integrated Financial Model document.
3. **Interest.** CS-FOR loans will be provided at an interest rate of 10% in a local currency (and 5% in USD) as general rule of the Russian-Kyrgyz Development Fund (RKDF) funded credit lines. the 10% interest rate was used in the analys to model the financial viability of the agricultural loans within the Climate-sensitive value chains component.
4. **Lending Terms.** The length of the loans is five years. Loans are expected to be repaid in equal instalments over a five-year period. The loans were assumed to have a one-year grace period. Interest on the entire amount outstanding would be paid during the grace period.
5. **Adoption rate**. Aggregated benefit cash flows are calculated taking into account 80% of adoption rate[[1]](#footnote-1). This represents conservative benefits projections assuming that at least 80% of Project investments will succeed.
6. **Models Characteristics.** All models aim to identify incremental costs and revenues related to the introduction of new technologies or practices and associated to the investments carried out on the first year. However, due to the absence of some activities in the Project core area without project (WOP) values for some models (e.g., processing) are set at nul. In most cases, the result of the investment translates into additional demand from primary producers and new permanent jobs: investments into climate-sensitive value chains may generate more tha 3 300 full-time equivalent jobs at full capacity (Table 12).
7. **The impact of climate pattern**. Based on the findings described in Chapter 1 of the Feasibility study and reported in the project ATLAS (various sources), the main climate change related stressors to agriculture comprise generalized temperature and water stress recurrence. The consequences of these stressors are applied on both, the WOP and with project (WP) streams of incremental costs and benefits, for all models (except for greenhouse and agrifood processing models[[2]](#footnote-2)).
8. The impact of climate pattern for pasture improvement was built based on considerations of the Third National Communication of the Kyrgyz Republic which concludes that “on the whole there is a slight increase in the yield of hayfields and pastures of all types”, but there is another stronger factor which mostly and adversely impacts the yield – the load on pastures. Both factors are taken into account for the analysis of the model for pasture rehabilitation.
9. For such models as afforestation / reforestation, forest enrichment, intensive poultry and beekeeping, the impact pattern was applied based on the assumption of having 20% decline in incremental benefits due to drought and late frosts impacts (once in every 4 years)
10. For models of fruit / nut orchards, nursery and conservation agriculture where climate resilient technologies (drip irrigation and no-till) are utilised, only 5% decline in WP benefits due to drought and late frosts impacts (once in every 4 years) is projected.
11. Comaprative yields under Without and With project scenarios (including climate change influenced yields) are presented in Table 1.

Table 1. Comparative yields of selected agricultural crops/products under Without and With project scenarios at maturity[[3]](#footnote-3)

| **Crop / Product** | **Unit** | **WoP yield** | **WP yield** | **Yield (WOP) under high climatic stresses years** | **Yield (WP) under high climatic stresses years** |
| --- | --- | --- | --- | --- | --- |
| Wheat | *t/ha* | 2.1 | 2.7 | 1.7 | 2.6 |
| Corn | *t/ha* | 6.0 | 7.8 | 4.8 | 7.5 |
| Alfalfa | *t/ha* | 2.5 | 3.3 | 2.0 | 3.1 |
| Barley | *t/ha* | 1.8 | 2.4 | 1.5 | 2.3 |
| Honey | *kg/bee-family* | 24.0 | 28.0 | 20.0 | 22.4 |
| Meat sold for grazing livestock | *kg/LU/year* | 15.8 | 22.2 | 13.5 | 21.1 |
| Milk production for grazing livestock | *l/LU/day* | 5.3 | 6.0 | 4.5 | 5.7 |
| Cucumber (open field WOP vs greenhouse WP) | *t/ha* | 40.0 | 150.0 | 20.0 | 150.0 |
| Tomato (open field WOP vs greenhouse WP) | *t/ha* | 40.0 | 120.0 | 20.0 | 40.0 |
| Nursery | *‘000 seedling/100m2* | 1.0 | 2.5 | 0.8 | 2.4 |
| Orchards[[4]](#footnote-4) | | | | | |
| Apple | *t/ha* | 10.0 | 14.5 | 8.0 | 13.7 |
| Apricot | *t/ha* | 7.0 | 12.8 | 5.0 | 12.2 |
| Cherry | *t/ha* | 4.5 | 6.0 | 3.3 | 5.7 |
| Almond | *t/ha* | 0.5 | 1.9 | 0.4 | 1.8 |
| Pistachio | *t/ha* | 0.3 | 0.9 | 0.1 | 0.9 |
| Walnut | *t/ha* | 1.0 | 4.8 | 0.7 | 4.5 |

1. The technologies supported by the project are more suitable to the climate change context and produce higher benefits in the local context despite they have a higher cost.
2. **Gradual increases in** **capacity utilization** are applied to greenhouse, broiler and turkey management and agrifood processing models starting from first years of operation.
3. **Financial Discount Rate.** The Financial Discount Rate of 8% is used in this analysis to assess the viability and robustness of investments. The Discount Rate is used as complementary selection criterion to consider viability for the project’s all investments with an IRR above the opportunity cost of capital, i.e. 8%[[5]](#footnote-5).
4. **Analysis period**. All models were analyzed in two time horizons: 10 years to show the financial prospects under market conditions, and 20 years, which coincides with the capitalization period of the investment for carbon sequestration. At aggregated level, the costs and benefits streams are presented for 10- and 20-year periods, while results of individual models are presented for a 10-year period. More details on production and financial parameters for the models are found in the Integrated Financial Model spreadsheet linked at the end of this chapter.
5. **Results of the Analysis.** The period of analysis is 10 and 20 years to account for the phasing and gestation period of the proposed interventions. Given the above benefit and cost streams, the FIRR is -1.9% for 10 years and is estimated at 20.3% for 20 years. The net present value (NPV) of the project’s net benefit stream, discounted at 8%, is US$ -12.5 million for 10 years and US$ 55.4 million for 20 years. Detailed calculations of aggregated financial IRR and NPV are presented in the “Summary” spreadsheet of the Integrated Financial Model.

**Sensitivity analysis on financial performance**

1. **Climate change impacts on economic activities.** All models take into account the effect of climate change in their baseline scenario and adjust the costs and benefits streams according to the expected effect of climate change under baseline conditions (i.e., from the Third Communication to UNFCCC (reference to Chapter 1 of the Feasibility Study). The EFA sensitivity analysis (more details are available in spreadsheet “Sensitivity” of the Integrated Financial Model) assessed the effect of variations in benefits and costs in the realisation of benefits. In this analysis costs and benefits variations are considered due to climate change impacts which may affect the overall performance of the models, summarized in two channels:
   1. **Decreasing yields / productivity**: capturing the impact of more intense droughts on yields of fruit and nut trees, pasture productivity and crop production
   2. **Increasing costs**: including the need for replanting seedlings due to the influence of higher frequency of temperature and rainfall related stresses (or droughts), or the effect of landslides and mudslides on forests and rangeland infrastructures.
2. The detailed results are presented below in Table 2. An increase in total project costs by 60% and a fall in total project benefits by 40% would reduce the base IRR to 8.1% and 7.0% respectively for the 20-year period . In the case of 40% decline in aggregated benefits, NPV is estimated at US$ -3.5 million.

Table 2: Financial parameters in different scenarios due to climate change impacts

| **Scenario** | **IRR (%)** | **NPV (million US$)** | **IRR (%)** | **NPV (million US$)** |
| --- | --- | --- | --- | --- |
|  | **10-year period** | | **20-year period** | |
| Base scenario | -1,9% | -12,5 | 20,3% | 55,4 |
| Increase of costs due climate change impacts by 60% | NA | -51,7 | 8,1% | 0,3 |
| Decrease of benefits due climate change impacts by 40% | NA | -33,6 | 7,0% | -3,5 |

**Impacts of macroeconomic developments on economic activities**

1. In addition to climate change impacts, the analysis considered the possible effects of macroeconomic developments (e.g. high inflation, grow of capital cost, ad-hoc trade barriers) to the Project results. The effects of change in such parameters as a discount rate, interest rate (for RKDF loans) and adoption rate are presented below:

Table 3: Financial parameters in different scenarios due to change of macroeconomic situation

| **Scenario** |  | **IRR (%)** | **NPV  (million US$)** | **IRR (%)** | **NPV  (million US$)** |
| --- | --- | --- | --- | --- | --- |
|  |  | **10-year period** | | **20-year period** | |
| DISCOUNT RATE | | | | | |
| Base case | 8% | -1,9% | -12,5 | 20,3% | 55,4 |
|  | 12% | -1,9% | -13,9 | 20,3% | 25,6 |
| INTEREST RATE (RKDF LOANS) | | | | | |
| Base case | 10% | -1,9% | -12,5 | 20,3% | 55,4 |
|  | 15% | -2,9% | -14,1 | 19,7% | 53,9 |
|  | 20% | -3,9% | -15,7 | 19,1% | 52,3 |
| ADOPTION RATE | | | | | |
| Base case | 80% | -1,9% | -12,5 | 20,3% | 55,4 |
|  | 70% | -8,2% | -19,1 | 16,7% | 37,0 |
|  | 50% | NA | -32,3 | 8,1% | 0,2 |

1. CS-FOR 20-year results are sensitive to the further reduction in adoption rate of benefits and increase in the dsicount rate: 50% adoption rate reduces base IRR to 8.1% and NPV to US$ 0.2 million, while 12% discount rate provides NPV of US$ 25.6 million. Increase in the interest rate of RKDF loans to from 10% to 20% slightly reduces base IRR to 19.1% and NPV US$ 52.3 million.
2. Finally, the impact of **institutional and organizational aspects** may negatively affect the Project results through delay in implementation of activities, e.g., 2-year delay results in IRR of 12.2% and NPV of US$ 22.1 million for 1 20-year horizon (Table 4).

Table 4: Financial parameters in different scenarios due to delay in project activities

| **Scenario** | **IRR (%)** | **NPV (million US$)** | **IRR (%)** | **NPV (million US$)** |
| --- | --- | --- | --- | --- |
|  | **10-year period** | | **20-year period** | |
| Base scenario | -1,9% | -12,5 | 20,3% | 55,4 |
| 1 year delay | -14,2% | -27,3 | 15,7% | 38,1 |
| 2 year delay | NA | -40,2 | 12,2% | 22,1 |

# **Summary of Models Overview**

1. A detailed description of models is provided within the sections below.
2. **Summary.** The main result of the financial analysis provides: (i) mixed financial results for forestry-pasture investments (e.g., negative NPV for spruce forestry operations associated with long-term benefits and positive NPV with walnut related activities); (ii) a significant increase in gross and net returns from the most of climate-sensitive value chain models compared with and without-project situation illustrating the worthiness of the investments.
3. 10-year financial IRR and NPV for aggregated cash flows of Component 2 (forests and rangelands) investment are -20.9% and US$ -13.3 million respectively, while financial IRR and NPV achieve 8.8% and US$ 1.3 million USD in 20 years. This underlines weak attractiveness of forest and pasture interventions from a pivate sector view.
4. The indicative models show a positive impact on employment. Hired labour details for each of the models are described below. Favourable cash flows from the possible programme financed investments indicated that the improvements in incomes at the farm/ enterprise levels would be sufficient to ensure uptake of the proposed activities. Also, a beneficiary’s contribution is likely to translate into a high degree of economic attractiveness. Detailed business proposals would be required for each value chain investment in the “Jobs” spreadsheet of the Integrated Financial Model document.

# **Integrated forestry – pasture rehabilitation**

1. Component 2 constitutes the bulk of investment for carbon sequestration via investment in restoration and improvement of forests and pastures in the target area through the INRMCRP developed based on ecosystem and climate-smart agriculture approaches.
2. Pastures and forests, as keystones of the supply chain, should be managed responsibly in compliance with environmental, social, and economically sustainable good practices and with a specific attention to climate change impacts, thus making sure that local communities’ needs, rights and responsibilities are well factored in the ecosystem management equation of target areas to ensure improved natural resource management.
3. Allegedly, current prevailing practices of reforestation/afforestation, and the restoration of pasture and forest ecosystems have not been leading to the desired result. Overexploitation of forests is due to illegal felling and fuel-wood harvesting, and of pastures on both forest and municipal land is due to the unsustainable number of livestock heads, poor incentive schemes leading to inappropriate management practices, and insufficient capacity of the leskhozes (forest institutions) to secure survival of planted species, control resources, and to effectively involve communities in the process. For example, some species (pistachio and almond) are eaten up by cattle, and some trampled (walnut). In this regard, there is an urgent need to revise the approach to management of natural resources as well as in shifting from an economy of pure exploitation - with high dependency from natural stocks and low level of climate resilience - to a greener one resulting from sustainable management of available resources (natural, financial and human) supported by processes of productivity enhancement via increased quality and efficiency. It is therefore necessary to involve private sector and local communities in this process to stimulate approaches and management/control practices so to shift incentives from pure exploitation of the commons to sustainable management of community’s resources.

## Forestry

1. The proposed investments aim at ensuring carbon sequestration by collaborative and more effective afforestation/reforestation on degraded forest areas. The investment are also beneficial to mitigate forest conversion and degradation, and to start replenishing the forest cover. The investment will impact on ecosystems and produce benefits in the form of alternative sources of income to reduce the over-dependence on livestock and its related heavy toll on natural balance of sustainable landscapes.
2. The INRMCRP will include investments in following activities: (i) afforestation/reforestation and (ii) forest enrichment.
3. **Afforestation/Reforestation.** The models include investment in prevailing and adapted and tree species, including spruce, juniper, poplar, walnut, pistachio and other forests (mixed). The implementation will require interaction between leskhoz, private sector and local communities in the process of creating new approaches and management/control practices to shift incentives from pure exploitation of the commons to sustainable management of community’s resources based on the INRMCRP. Based on the current tenure of pasture and forests, leskhozes will concentrate on supervision and monitoring duties, leaving the forest-related economic functions to communities and private sector.
4. The Project will support the identification of opportunities for forest investment according to three prevalent models that take into account the altitude, dominant tree species, forest legal status, custodianship and the main partners, as follows. The investment models will include: **(a)** Leskhoz investments in high-altitude spruce and juniper forests; **(b)** collaborative forest management through long-term leasing of walnut and pistachio forests on state forest fund (SFF) lands from leskhozes; **(c)** individuals investing in tree-planting on municipal under-developed state land fund (SLF) lands, with long-term leases tendered from aiyl okmotus (AO) (poplar and mixed broadleaved trees).
5. Based on the participatory INRMCRP planning, areas for forestry activities will be identified where private sector and local communities will be willing to invest. In this case, the Project will provide co-financing (up to 65% of total costs) – this is justified by the fact that these species are not as productive as commercial orchards and the main benefit is the carbon sequestration potential. On the other side, the Project will cover up to 90% of total costs of investment in areas with low attractiveness for the private sector, but with high vulnerability to the impacts of climate change. The investment will be phased as illustrated in Table 5.

Table 5. Afforestation / reforestation / Forest Enrichment phased investment

| TOTAL TARGET | **Area, ha** | **Y1** | **Y2** | **Y3** | **Y4** | **Y5** | **Y6** | **Y7** | **Y8** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Forest resources: Afforestation/Reforestation** |  |  | 5% | 20% | 25% | 25% | 25% |  |  |
| Spruce | **650** | - | 33 | 130 | 163 | 163 | 163 | - | - |
| Juniper | **400** | - | 20 | 80 | 100 | 100 | 100 | - | - |
| Poplar | **190** | - | 10 | 38 | 48 | 48 | 48 | - | - |
| Walnut | **1,000** | - | 50 | 200 | 250 | 250 | 250 | - | - |
| Pistachio | **200** | - | 10 | 40 | 50 | 50 | 50 | - | - |
| Mixed forests | **770** | - | 39 | 154 | 193 | 193 | 193 | - | - |
| **TOTAL** | **3,210** | **-** | **161** | **642** | **803** | **803** | **803** | **-** | **-** |
| **Forest resources: Forest enrichment** |  |  |  |  |  |  |  |  |  |
| Spruce | **1,400** | - | 70 | 280 | 350 | 350 | 350 | - | - |
| Juniper | **230** | - | 12 | 46 | 58 | 58 | 58 | - | - |
| Walnut | **1,370** | - | 69 | 274 | 343 | 343 | 343 | - | - |
| **TOTAL** | **3,000** | **-** | **150** | **600** | **750** | **750** | **750** | **-** | **-** |
| **TOTAL FORESTRY** | **6,210** | **-** | **311** | **1,242** | **1,553** | **1,553** | **1,553** | **-** | **-** |

1. The involvement of private sector and local communities in forestry activities will be ensured through the above incentives and linking their co-financing with both types of lands. Key financial and social results of forestry activities are presented in the Table 6.

Table 6. Summary of financial results for forestry activities for 10-year period.

|  | **Adoption area** | **Investments per ha** | **Total investment** | **GCF** | **Beneficiaries** | **IRR** | **NPV** | **Number of beneficiaries** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Unit* | *ha* | *US$/ha* | *Million US$* | *Million US$* | *Million US$* | *%* | *US$/ha* | *Households* |
| **Forest resources: Afforestation/Reforestation** | | | | | | | | |
| Walnut | 1 000 | 2 603 | 2,6 | 1,7 | 0,9 | 19% | 900 | 1000 |
| Pistachio | 200 | 2 214 | 0,4 | 0,3 | 0,2 | 1% | -254 | 200 |
| Mixed forests | 770 | 1 502 | 1,2 | 1,0 | 0,1 | -12% | -121 | 0 |
| Poplar | 190 | 2 421 | 0,5 | 0,4 | 0,0 | -19% | -162 | 0 |
| Spruce | 650 | 2 262 | 1,5 | 1,3 | 0,1 | -46% | -213 | 0 |
| Juniper | 400 | 3 170 | 1,3 | 1,1 | 0,1 | NA | -301 | 0 |
| **Total** | **3 210** |  | **7,4** | **5,9** | **1,5** |  |  | **1 200** |
| **Forest resources: Forest enrichment** | | | | | | | | |
| Walnut | 1 370 | 682 | 0,9 | 0,6 | 0,3 | 21% | 304 | 1370 |
| Juniper | 230 | 1 010 | 0,2 | 0,2 | 0,0 | NA | -92 | 0 |
| Spruce | 1 400 | 1 098 | 1,5 | 1,4 | 0,2 | NA | -99 | 0 |
| **Total** | **3 000** |  | **2,7** | **2,2** | **0,5** |  |  | **1 370** |
| **TOTAL FORESTRY** | **6 210** |  | **10,1** | **8,1** | **2,0** |  |  | **2 570** |

1. About 3,000 ha of deforested or severely degraded forest lands inside and outside existing SFF lands is planned to be afforested/reforested and 3,000 ha of degraded forests are projected to be restored (enriched) with the total investment needs estimated at US$10.1 million. In this analysis the investment costs include all total costs incl. labor, seedlings, and fencing, which is removable and reusable every 5 years.
2. Given the pressure of livestock and climate change impacts on forests, the focus will be on ensuring high survival rate of planned interventions through channelling investments to (i) fencing plantations to secure survival of planted seedlings and seeds; (ii) use of climate resilient and locally adapted tree species; (iii) shift towards producing and planting larger amounts of closed-root seedlings; (iv) regular weeding and soil loosening, and on poor soils adding organic fertilizer/mulch; and (v) limited and efficient irrigation without incremental investments or increase in the water use per hectare above the current practices (without Project).
3. **The impact of climate pattern** due to droughts (once in every a 4-year period) has been applied for the streams of benefits of all forestry models. In addition, we have calculated the potential increase in costs due to drought impacts. For example, if the drought hits in the first year 161 ha forest plantations, in year two the incremental cost of seedling replanting is estimated at US$85,100 (Table 7 below shows the different additional costs related to the impact of droughts or high temperatures with low rainfall stresses during critical years of plantation).

Table 7. Additional cost due to drought / climate stresses on A/R area

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **US$** |  | **Y2** | **Y3** | **Y4** | **Y5** | **Y6** | **Y7** | **Y8** |
| If a drought occurs in the A/R area in one of these years (USD): | **Y2** | 0,00 | **85 056** |  |  |  |  |  |
| **Y3** | 0,00 |  | **348 729** |  |  |  |  |
| **Y4** | 0,00 |  |  | **459 301** |  |  |  |
| **Y5** | 0,00 |  |  |  | **467 807** |  |  |
| **Y6** | 0,00 |  |  |  |  | **467 807** |  |
| **Y7** | 0,00 |  |  |  |  |  | 42 528 |
| **Total cost** | **1,871,227** |  | 85 056 | 348 729 | 459 301 | 467 807 | 467 807 | 42 528 |

1. The opportunity cost of grazing was incorporated into financial models as the WOP scenario since forestry activities are planned to be implemented mostly on degraded SFF lands currently used for grazing.
2. Negative IRR and NPV for spruce, juniper and mixed forests are explained by long rotations of these species (80-120 years) and existing moratorium for harvesting high value species like juniper and walnut. Similarly, assuming the rotation period of poplar at 20 years, financial results are negative. Benefits from walnut and pistachio are associated exclusively to their nuts without timber and fuelwood harvesting. In overall, financial results for forestry activites are poor justifying the high level of concessionality.
3. Given the existing practices of leasing relatively small-scale forest plots to each household and Project inclusiveness, the number of beneficiaries based on 1-ha lease plots is estimated at 2,570 households. The Project will further analyze and design its interventions into forestry operations taking into account interests and scale of the private sector and local community’s interventions in forestry. Best practices both from international and local experiences will be utilized to design relevant PPP approaches with analysis of risks and opportunities.

## Rangeland management

1. The livestock/pasture ecosystem is trapped in a vicious cycle of productivity collapse: overgrazing and degradation cause lower levels of available forage, which reduces animal productivity, causing households to own more animals to compensate for productivity declines, which in turn increases grazing pressure and leads to more degradation. The pasture degradation process is connected to a net loss of carbon stored in plants and soil. Only a drastic change in grazing management practices can reverse the degradation trend and increase carbon sequestration.
2. Degraded pastures present a rapid rehabilitation under improved grazing management due to the promotion of integrated ecosystem management of local pastures on both SLF and SFF lands. The main investment comprise:
   1. **promotion of rotational grazing (pasture rotation)** as the first and most importantactivity for achieving higher pasture production, and therefore greater carbon sequestration
   2. **planting of trees as shelterbelt** on municipal pastures and Leskhoz land (for the generation of ecosystem services at landscape level) to provide shade and reduce wind velocity, which improve both livestock and forage production, and contribute overall to resilience and climate change adaptation
   3. **broadcasting seed of desirable perennial plants** that can accelerate pasture Improvement; supporting the establishment of seed-multiplication fields in Rayons, manage seed harvest and cleaning, and testing methods of broadcasting seed with or without light cultivation
   4. **inter-breeding with better-performing livestock breeds** that can increase production per animal and allow smaller herds to achieve equivalent household livestock production (fewer livestock will ease the grazing pressure on pastures); culling and sale of low-productive or barren cows.
3. Application of the above practices will allow to achieve following benefits: (i) a greater amount of standing vegetation, increasing Carbon stocks and protecting the soil surface, (ii) ground cover by vegetation increases rainwater infiltration and reduces erosion, (iii) a shift in species composition of the vegetation towards greater plant diversity, including palatable perennial species, (iv) more forage of better quality available for grazing, (v) higher grazing capacity, (vi) bigger animals, including a faster growth rate of young calves, foals, lambs and kids, (vii) higher milk yield, up to 100% increase in peak milk production and 20% in average, (viii) healthier animals ascribed in part to better nutrition, (ix) internal parasite loads drop, partly due to long rest periods interrupting stages of the life cycle of internal parasites outside the host, (x) more cows conceive and deliver a calf every year, (xi) a rising population of productive cows due to higher birth rate and lower mortality, (xii) higher income for village households.
4. For the analysis, household and pasture user union (PUU) models were designed:
5. **Household livestock production model**. The modeldescribes the interrelationships between households (livestock owners) and Pasture Committee (a governing body of PUU) from the household perspective. In the analysis an average household keeps 4 livestock units (2 cattle, 1 horse and 5 sheep). It is projected that by investing in improved breeds and providing financial contribution to the PUU for rehabilitation of pastures, household will gain benefits in terms of increased meat and milk productivity due to improved pasture conditions from year two of the pasture investments. In addition, improved pastures will be more resilient to climate change impacts and thus contribute less to decrease in meat and milk productivity due to, for example, droughts.
6. The expected annual NPV of net benefits in financial terms is expected at US$ 33 per household. This amount of benefits will not make households richer but most importantly may provide incentives to improved pasture and livestock management.
7. **PUU model**. The PUU model aggregates benefits and costs ofthehousehold model and additionally introduces a set of following investments: (i) excavator for road infrastructure improvement, (ii) bridges, (iii) waterpoints, (iv) equipment and medicine for veterinary clinics, (v) shade shelters, (vi) wind breaks, (vii) seed increase production field, (viii) a set of additional equipment to PUU and (ix) technical support for integrated and improved pasture management. In addition, the PUU model incorporates co-management of leskhoz grazing areas in accordance with recently adopted Regulation No. 192 approved on April 10, 2018 titled ''Regulation on use and control of SFF lands”. The total investment per PUU is estimated at US$107 thousand, 75% of which would be financed by the Project and 25% co-financed by PUU members (households).
8. Livestock productivity gains and associated benefits from rehabilitated pastures – indicated in Table 8 – were proposed based on previous experiences of livestock development projects in the country (e.g., the IFAD-funded “Livestock and Market Development Project” or the more recent “Access to Markets Programme”) and experts’ opinions. In addition to that, livestock benefits in terms of meat and milk productivity has been linked to the impact of climate pattern (temperature and water stress recurrence) on pasture productivity under WOP and WP scenarios.

Table 8. Benefits under WOP and WP scenarios

|  |  |  |  |
| --- | --- | --- | --- |
| **Technical parameters** | **Unit** | **WOP** | **WP** |
| Share of meat to sell | % | 20% | 25% |
| Meat productivity gain in pastures | % | 5% | 15% |
| Share of milk to sell | % | 30% | 35% |
| Milk productivity gain in pastures | % | 5% | 20% |

1. In order to evaluate the possibility of decreasing livestock unit number in the Project core area which is one of the key threats for pasture rehabilitation, following three scenarios have been tested:

Table 9. Change of livestock unit number and share of bulls and cows from Year 1 to Year 20

|  |  |  |
| --- | --- | --- |
| **Scenarios** | **WOP** | **WP** |
| Scenario 1 – no herd control | Livestock herd number increases by 10% (8.3 thousand livestock units (LU)), share of bulls and cows is equal to 50% each within cattle herd | Constant livestock herd number (7.5 thousand LU) and increasing share of cows from 50% to 70% within cattle herd |
| Scenario 2 – herd control | Livestock herd number increases by 10% (8.3 thousand LU), share of bulls and cows is equal to 50% each within cattle herd | Decreasing livestock herd number by 10% (6.8 thousand LU) and increasing share of cows from 50% to 70% within cattle herd |
| Scenario 3 – smart herd control | Livestock herd number increases by 10% (8.3 thousand LU), share of bulls and cows is equal to 50% each within cattle herd | Decreasing livestock herd number by 20% (6.0 thousand LU) and increasing share of cows from 50% to 70% within cattle herd |

1. Within a 10-year period, three scenarios show positive and almost similar financial results implying the financial feasibility of decreasing livestock herd number (Table 10), thus reducing pressure on pasture.

Table 10. Financial results of pasture restoration activities for 10-year period

|  |  |  |
| --- | --- | --- |
| **Scenarios** | **IRR (%)** | **NPV (thousand US$)** |
| Scenario 1 | 46.3% | 227.3 |
| Scenario 2 | 45.8% | 214.7 |
| Scenario 3 | 48.3% | 216.6 |

1. The potential number of beneficiaries from pasture rehabilitation investments is expected to reach all 105,000 households who live in the Project core area and are involved in livestock grazing on rangeland in SLF and SFF.

# **Climate-sensitive Value Chain Models**

1. The Component 3 will support the development of the selected value chains’ participants towards higher efficiency and competitiveness of the marketed product. The main selection criteria for the value chains will include low carbon footprint, market potential, financial viability and raw material sourcing area within the core project area (current or planned). Examples, inter alia, include tree nuts (walnuts, almonds, pistachio), dried fruits (dried apricot, dried plum), and fruit orchards (cherries, apples).
2. By implementing innovative climate-smart agricultural practices, value addition must be achieved using resource-efficient technologies such as solar dryers, drip irrigation, solar pumps, no-till technique, etc. The Project will also support livestock operations that aim to reduce pressure on pastures and improve their health (e.g., apiculture, rational feeding practices). Necessary investment and technical assistance to ensure compliant slaughter of animals will be supported by other ongoing projects in the domain including the recently approved IFAD-funded “Access to Markets Project”.
3. The role of Climate-sensitive value chain investments is to strengthen the sustainability of the investment in carbon sequestration carried out for forest and pasture rehabilitation by creating economic opportunities with limited risk, in order to decrease pressure on and degradation of natural resources in the project intervention areas, thus contributing also to the enhanced resilience. More specifically, investments will focus on decreasing the pressure on pastures by promoting income diversification and more productive livestock generating higher returns. Small and medium enterprises supported by the technical assistance will have access to the credit lines of Russian-Kyrgyz Development Fund (RKDF). The loans will be provided at 5% p.a. in USD and at 10% in local currency, for a term of about 3-5 years, to existing enterprises representing eligible value chains. The financial IRR for aggregated Climate-sensitive value chain investments for 20 years is estimated at 28.1% exceeding the expected rate of return of RKDF loans (10%). The financial results for 10 years are as follows: NPV is estimated at US$ 0.7 million, while IRR is 9.0%.
4. In order to reduce forest and pasture degradation and to change the behavior of keeping an alarming number of unproductive animals as a source of cash income for safety net, communities need a parallel path towards increased efficiency and productivity of the livestock production system along with a progressive continuous creation of alternative (to livestock) income opportunities able to offer at least the same incentives for economic return (e.g., orchards and high value non-timber forest products). This shift will not only reduce the pressure on resources (increased carbon sink and enhanced ecosystem benefits) but also reduce emissions (as more productive animals raised using good practices emit less).
5. These models shall be regarded as a potential set of project investments and this set can be flexiblly adapted within the project implementation.
6. In a 10-year horizon all Climate-sensitive value chain models provide positive financial results (IRR ranges from 21% to 39%) – in the range of similar economic activities and investment operations in the region, implying the financial attractiveness for investments. The summary of the possible production / processing models representative of the Climate-sensitive value chain component activities is presented in Table 11. The table summarizes the hypothetical cases of individual enterprises, but may not represent the final portfolio of investment.
7. **Fruit and nut orchards.** For the purposeof the analysis, an area of about 3,100 ha of fruit and nut orchards was considered as potential investment with project support, for a total amount estimated at US$ 11.2 million. In this analysis the investment cost includes seedlings, fencing and drip irrigation. The opportunity cost of grazing was incorporated into financial models since low productive lands can be used that are currently used for grazing. The rotation period of fruit and nut orchards is well above 10 years, i.e. the analyzed period. Despite the short period of analysis, fruit / nut orchards models show very positive results: IRR ranges from 22% to 39%. The number of beneficiaries based on 1-ha was estimated at 3100 households assuming small scale (1-ha) orchards.
8. Investments in **nursery** establishment aim at producing high quality seedlings in the Project core area both for commercial and restoration purposes. The investment package will mainly include young seedlings, drip irrigation, fence and fertilizers. It is planned to support 100 business cases with the establishment of relatively small-scale nurseries (100 m2). IRR at 28% signals about financial attractiveness of such business under the condition of access to markets. 100 beneficiaries are expected to benefit from these activities.
9. **Solar and vacuum dryers** are aimed at processing of fruits and nuts which production will be strongly supported under component 2 (as investment in Afforestation/reforestation, forest enrichment of nut trees) and component 3 (as commercial investment). While solar dryers are oriented towards small-sale households, vacuum dryers (or electric dryers) will be utilized by at least medium-scale entrepreneurs. The investments include dryer facilities, technological equipment and technical assistance. Models show attractive financial results. Solar dryer investments will target 100 beneficiaries, while vacuum dryer investments would focus on at least 10 entrepreneurs with 265 small-scale suppliers.
10. **Cold Storage** model builds on the interrelationships between above non-timber forest products (NTFP) and other producers and end consumers. The financial viability of the model will be ensured with the access to markets and shops in big cities through their own distribution chain. The total investment of the Cold storage facility would be around US$64.0 thousand, including in a Cold storage facility construction, technological and laboratory equipment purchase and technical assistance. This would allow the enterprise to annually store 80 tons of agriculture products. The financial modelling with conservative assumptions shows that cold storage is financially attractive (IRR of 35%). 10 cold storage facilities plan to source from 2 260 small-scale suppliers annually.
11. **Conservation agriculture.** The Project may facilitate crop production using the conservation agriculture practices (no-till, crop rotation, soil cover) which reduce operational costs (incl. fuel consumption) and strengthen the crop resilience to drought impacts which were applied for WOP and WP scenarios. To enhance the promotion of conservation agriculture practices, technical assistance and access to finance will be ensured. The tentative set of investments includes tractor, hydropneumatic subsoiler, direct seeder and technical assistance for a total amount of US$60.8 thousand. Financial results are positive with IRR at 23%. The number of potential adopters is estimated at 400. Each of these adopters is assumed to manage at least 10-ha agricultural land.
12. **Two** **greenhouse** **models for vegetable production** have been analysed (1000 m2 and 300 m2), mostly for adoption in Uzgen and Suzak districts. The investment package will mainly include greenhouse construction, energy efficient heater and drip irrigation equipment. Greenhouse itself is regarded as climate resilient technology. The IRR for 300 m2 greenhouse (28%) is higher than for 1000 m2 greenhouse (21%) due to use of family labor (0 value in the financial analysis). The number of beneficiaries is expected to achieve 70 households or entrepreneurs.
13. **Beekeeping, broiler and turkey raising** models show economic incentives to the required diversification from a predominantly ruminant composition, and enhanced efficiency, productivity and competitiveness of existing economic activities in order to reduce livestock pressure on pastures by providing alternative sources of income generation for local households and entrepreneurs. Investments with such activities are associated with facility construction, equipment, purchase of animals and technical assistance. All models show high IRRs ranging from 23% to 36%. The total number of direct beneficiaries is accounted for 220 households/entrepreneurs.

Table 11. Summary of financial results for Climate-sensitive value chain investments for 10-year period.

|  | **Adoption** | **Investments per unit of adoption** | **Total investments** | **Loan (RKDF)** | **Beneficiaries** | **TA (GCF)** | **IRR** | **NPV** | **Number of entrepreneurs** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Unit* | *Area, ha* | *US$/ha* | *‘000 US$* | *‘000 US$* | *‘000 US$* | *‘000 US$* | *%* | *US$/ha* | *Entrepreneurs* |
| Fruit and nut orchards |  |  |  |  |  |  |  |  |  |
| Apple | 300 | 6 462 | 1 939 | 1 318 | 291 | 330 | 39% | 21 403 | 300 |
| Cherry | 100 | 6 462 | 646 | 439 | 97 | 110 | 34% | 14 140 | 100 |
| Apricot | 100 | 6 119 | 612 | 416 | 92 | 104 | 34% | 12 839 | 100 |
| Walnut | 2 000 | 3 352 | 6 703 | 4 558 | 1 005 | 1 140 | 32% | 11 150 | 2 000 |
| Almond | 300 | 2 337 | 701 | 477 | 105 | 119 | 25% | 5 812 | 300 |
| Pistachio | 300 | 1 918 | 575 | 391 | 86 | 98 | 22% | 5 844 | 300 |
| *Unit* | *# of business* | *USD/business* | *“000 US$* | *‘000 US$* | *‘000US$* | *‘000 US$* | *%* | *US$/business* | *Entrepreneurs* |
| Beekeeping (60 bee-families) | 20 | 17 485 | 350 | 238 | 59 | 52 | 36% | 6 100 | 20 |
| Cold storage facility | 10 | 64 040 | 640 | 435 | 109 | 96 | 35% | 39 279 | 10 |
| Vacuum dryer | 5 | 85 077 | 851 | 579 | 145 | 128 | 30% | 36 818 | 10 |
| Greenhouse (300 m2) | 50 | 14 673 | 714 | 485 | 121 | 107 | 28% | 4 184 | 50 |
| Nursery | 100 | 655 | 65 | 45 | 11 | 10 | 28% | 898 | 100 |
| Turkey | 50 | 5 603 | 299 | 203 | 51 | 45 | 24% | 935 | 50 |
| Conservation agriculture | 30 | 60 757 | 1 823 | 1 239 | 310 | 273 | 23% | 26 903 | 300 |
| Beekeeping (30 bee-families) | 50 | 9 750 | 488 | 332 | 83 | 73 | 23% | 2 166 | 50 |
| Broiler | 100 | 20 410 | 1 790 | 1 217 | 304 | 268 | 23% | 1 784 | 100 |
| Greenhouse (1000 m2) | 20 | 44 558 | 866 | 589 | 147 | 130 | 21% | 8 146 | 20 |
| Solar dryer | 100 | 2 234 | 223 | 152 | 38 | 34 | 21% | 408 | 100 |
| **TOTAL SUSTAINABLE CHAINS** |  |  | **19 286** | **13 114** | **3 279** | **2 893** |  |  | **3 910** |

# **Economic Analysis**

1. The CS-FOR is based on the economic analysis of development projects, i.e. to aggregate benefits from specific models of households taking up pre-defined packages of interventions as compared to project costs.
2. Considering that presented models as representative, it is estimated that in terms of hardware investments (credit and grants) the Project would reach all 105,000 rural households in the core area through pasture rehabilitation activities; 9,200 beneficiaries, including 2,800 small-scale suppliers, will also benefit from green investments in forestry and value chain activities. In terms of labor it is expected that Project investments in Climate-sensitive value chains will generate more than 3,300 full-time equivalent jobs at full capacity of the provided investments (Table 12).

Table 12. Full-time jobs created at full capacity (number of incremental jobs\*)

|  |  |  |  |
| --- | --- | --- | --- |
| **Activities** | **Jobs per ha** | **Adoption area, ha** | **Total jobs** |
| **Fruit/Nut orchards** | | | |
| Apple | 1,1 | 300 | 340 |
| Apricot | 0,8 | 100 | 85 |
| Cherry | 0,9 | 100 | 88 |
| Almond | 0,6 | 300 | 194 |
| Pistachio | 0,6 | 300 | 172 |
| Walnut | 1,1 | 2 000 | 2159 |
| **Activities** | **Jobs per case** | **Adoption, case** | **Total jobs** |
| Honey (60 bee-families) | 1,0 | 20 | 20 |
| Honey (30 bee-families) | 0,4 | 50 | 21 |
| Greenhouse (1000 m2) | 1,0 | 20 | 20 |
| Greenhouse (300 m2) | 0,5 | 50 | 25 |
| Nursery | 0,2 | 100 | 17 |
| Broiler | 0,9 | 100 | 92 |
| Turkey | 0,7 | 50 | 33 |
| Solar dryer | 0,3 | 100 | 25 |
| Vacuum dryer | 2,7 | 10 | 27 |
| Cold storage facility | 3,0 | 10 | 30 |
| **TOTAL** |  |  | **3 346** |

\* full time equivalent hired labour

1. The economic discount rate of 4.75% based on the current refinancing rate of the National Bank of the Kyrgyz Republic is used in this analysis.
2. The shadow exchange rate (SER) has been calculated at 1 USD = 73.4 KGS. Overall conversion factors for inputs and outputs vary between 0.70 and 1.19. An average conversion factor of 0.89 has been applied when converting financial prices into economic prices. The derivation and a summary of economic prices are presented in the conversion factor (“CF”) spreadsheet of the Integrated Financial Model.
3. **Benefit Stream.** The analysis attempts to identify quantifiable benefits that relate directly to the activities undertaken following implementation of the components, or that can be attributed to the project’s implementation.
4. The illustrative models described above have been used for the calculation of the overall benefit stream on the basis of economic prices.
5. In calculating the overall benefits from the models, the following was taken into account:
6. Incremental net benefit was calculated for all models.
7. Impacts of climate change have been incorporated to the calculation of benefit stream of relevant models.
8. Gradual capacity utilization was applied for greenhouse, broiler, turkey and processing models
9. An 75%-80% success rate was applied to the pasture rehabilitation model and 90% survival rate for afforestation and reforestation activities.
10. The benefits are calculated for the period of 20 years.
11. No financing flows have been undertaken in the calculations as they are either already reflected in the Project costs (the CS-FOR financing and beneficiary’s contribution for the investment costs) or represent transfer payments (taxes).
12. **Cost Stream.** The incremental costs in economic prices have been calculated by the removal of price contingencies and taxes/duties. There are recurrent costs (i.e. operational costs) after the CS-FOR completion. The Project costs not directly associated with investments have been added to the cost stream.
13. **Valuation of CO2 equivalent sequestration potential.** Under the Integrated NRM and climate-resilience plans the project will contribute to ensuring capturing about 19.8 million tonnes of CO2 equivalent via reforestation-afforestation of 6,000 ha of severely damaged forests, the rehabilitation of about 644,000 hectares of degraded pastures, and the improved management of about 56,000 ha of forests. More details are available in the Carbon Accounting Section of the Feasibility Study. The analysis considered the shadow price of US$ 40/tCO2 as the social value of carbon (as estimated by the World Bank, 2017).[[6]](#footnote-6)
14. **Economic benefit from ecosystem services.** The incremental economic benefits for the project are from the improvement and restoration of ecosystem services in the rehabilitated forest and pasture areas with the Project support. These ecosystem services represent public goods, which are not captured by markets or by the Gross Domestic Product (GDP) and do not monetarily contribute to farmers.[[7]](#footnote-7)
15. A regional report prepared by The Economics of Land Degradation (ELD)[[8]](#footnote-8) Initiative to value land degradation looked beyond the market value for crops; the ELD also looked at ecosystem services benefits including from carbon storage and sequestration to nutrient provision and cycling. The country case study looked at three pilot sites with summer pastures, based on high levels of land degradation together with local dependence on land and land-based ecosystems for subsistence and income. Of the three study sites, the one geographically closest to the CS-FOR target areas is Kyzyl Ungur municipality, which is located in the south. Kyzyl Ungur municipality is characterized by a mix of forest and pastures, in silvo-pastoral systems which serve as the primary source of income, particularly the walnut forests. Out of the indicated ecosystem services in the study, the only relevant ones for our analysis are non-timber products and drinking water (Table 13) since the other services such as pasture and forest carbon storage and sequestration, fodder, walnuts were already integrated in financial and economic analysis. For other ecosystem services like erosion control, pollination, water flow regulation and habitat provision, no economic values were found in the country. Therefore, they were not considered in the economic analysis.

Table 13. Monetary values for ecosystem services (US$/ha/year)

|  |  |
| --- | --- |
| **Ecosystem Service** | **Value** |
| Non-timber products | 6.5 |
| Drinking water | 0.3 |
| Total (US$/ha/year) | 6.8 |

1. **Results of the Analysis.** The period of analysis is 10 and 20 years to account for the phasing and gestation period of the proposed interventions. Given the above benefit and cost streams, the base case economic rate of return (ERR) is estimated at 68.0% and 71.3% for 10 and 20 years respectively. The base case net present value of the project’s net benefit stream in economic terms, discounted at 4.75%, is US$ 113.5 million for 10 years and US$ 353.7 million for 20 years.
2. **Sensitivity Analysis.** Sensitivity analysis assessed the effect of variations in benefits and costs. The analysis is undertaken to show the potential climate change impacts on revenues and costs. An example is that costs increase due to higher climate related stresses, for example additional replanting costs in reforestation and afforestation activities due to temperature and water stresses. In terms of benefits, late frosts and droughts adversely impact the yield of fruit and nut trees, while pasture productivity and crop yields may suffer from frequent droughts. This combined with low adoption of climate smart practices and technologies may have adverse impacts on Project’s interventions (Table 14).
3. For a 20-year period, a fall in total project benefits by 30% and an increase in total project costs by the same proportion would reduce the base economic NPV to US$ 170.7 million and US$ 291.5 million respectively.. Economic IRR and NPV will decline to 32.8% and US$ 41.2 million due to 30% fall in benefits, 30% increase in costs will reduce base IRR and NPV to 35.4% and US$ 73.2 million and within a 10-year period. Detailed calculations of aggregated economic IRR and NPV are presented in the “Summary” spreadsheet of the Integrated Economic Model.

Table 14: Sensitivity Analysis to costs and benefits changes due to climate change impacts

| **Scenario** | **Economic IRR (%)** | **Economic NPV  (million US$)** | **Economic IRR (%)** | **Economic NPV  (million US$)** |
| --- | --- | --- | --- | --- |
|  | **10-year period** | | **20-year period** | |
| Base scenario | 68,0% | 113,5 | 71,3% | 353,7 |
| Increase of costs due climate change impacts by 20% | 54,5% | 100,1 | 59,2% | 333,0 |
| Increase of costs due climate change impacts by 30% | 35,4% | 73,2 | 43,2% | 291,5 |
| Decrease of benefits due climate change impacts by 20% | 51,7% | 77,4 | 56,8% | 262,2 |
| Decrease of benefits due climate change impacts by 30% | 32,8% | 41,2 | 41,2% | 170,7 |

1. In addition, sensitivity analysis was conducted for the price of CO2, sequestration potential of pasture soils in terms of CO2eq value per ha and pasture area (Table 15). The fluctuations in capacity of pasture soils to sequester carbon shall be regarded as a function to possible climate change impacts, particularly temperature and water stresses.

Table 15: Economic parameters in different scenarios due to change in CO2eq price and carbon sequestration potential by rangeland

| **Scenario** |  | **IRR (%)** | **Economic NPV  (million US$)** | **IRR (%)** | **Economic NPV  (million US$)** |
| --- | --- | --- | --- | --- | --- |
|  |  | **10-year period** | | **20-year period** | |
| Carbon sequestration in rangeland , tCO2eq | | | | | |
| Base case | 1,25 | 68,0% | 113,5 | 71,3% | 353,7 |
|  | 0,3 | 27,1% | 34,7 | 37,8% | 180,4 |
|  | 0,8 | 49,7% | 76,1 | 55,4% | 271,4 |
| CO2 price, USD/tCO2 | | | | | |
| Base case | 40 | 68,0% | 113,5 | 71,3% | 353,7 |
|  | 20 | 42,1% | 61,5 | 49,1% | 238,4 |
|  | 80 | 112,4% | 217,6 | 113,3% | 584,3 |
| Ha of rehabiltated rangelands with potential to sequestr carbon, thousand ha | | | | | |
| Base case | 644 | 68,0% | 113,5 | 71,3% | 353,7 |
|  | 500 | 56,8% | 90,3 | 61,4% | 302,6 |
|  | 300 | 40,3% | 58,2 | 47,7% | 231,9 |

1. For a 10-year horizon, an extreme fall in carbon sequestration potential by rangelands to 0.3 tCO2e/ha provides economic IRR of 27.1% and economic NPV of US$ 34.7 million, while decline of CO2 price to US$ 20 leads to economic NPV of US$ 61.5 million. In a case if only 500 thousand ha is rehabilitated, i.e. is able to sequester carbon, economic IRR will decline to 56.8% and and NPV reduces to US$ 90.3 million.
2. For a 20-year period, an extreme fall in carbon sequestration value to 0.3 tCO2e/ha leads to the reduciton of economic IRR to 37.8% and NPV to US$ 180.4 million. Increase in CO2 price from US$ 40 to US$ 80 per ton almost doubles IRR, while the net present value of economic benefits almost reaches US$ 600 million. Only 300 thousand ha of rehabilitated pastures will bring down economic IRR and NPV to 47.7% and US$ 231.9 million respectively.
3. In addition to climate change impacts, the analysis considered the possible effects of macroeconomic developments to the Project economic results. The effects of change in such parameters as a discount rate, interest rate (for RKDF loans) and adoption rate are presented below:

Table 16: Financial parameters in different scenarios due to change of macroeconomic situation

| **Scenario** |  | **Economic IRR (%)** | **Economic NPV  (million US$)** | **Economic IRR (%)** | **Economic NPV  (million US$)** |
| --- | --- | --- | --- | --- | --- |
|  |  | **10-year period** | | **20-year period** | |
| DISCOUNT RATE | | | | | |
| Base case | 4,8% | 68,0% | 113,5 | 71,3% | 353,7 |
|  | 10% | 68,0% | 74,4 | 71,3% | 189,7 |
| INTEREST RATE (RKDF LOANS) | | | | | |
| Base case | 10% | 68,0% | 113,5 | 71,3% | 353,7 |
|  | 20% | 64,1% | 110,5 | 67,8% | 350,7 |
| ADOPTION RATE | | | | | |
| Base case | 80% | 68,0% | 113,5 | 71,3% | 353,7 |
|  | 70% | 58,0% | 90,9 | 62,3% | 296,5 |
|  | 50% | 35,4% | 45,7 | 43,2% | 182,2 |

1. CS-FOR 20-year results are sensitive to the further reduction in adoption rate of benefits and increase in the dsicount rate: 50% adoption rate and 10% discount rate decrease economic NPV to US$ 182.2 million and US$ 189.7 million respectively. Increase in the interest rate of RKDF loans to 20% reduces base economic NPV to US$ 350.7 million. 10-year results change similarly.
2. Finally, the impact of **institutional and organizational aspects** may negatively affect the Project results through delay in implementation of activities, e.g., 2-year delay results in economic IRR of 21.8% and NPV of US$ 37.8 million for 10-year period (Table 17).

Table 17: Financial parameters in different scenarios due to delay in project activities

| **Scenario** | **IRR (%)** | **NPV (million US$)** | **IRR (%)** | **NPV (million US$)** |
| --- | --- | --- | --- | --- |
|  | **10-year period** | | **20-year period** | |
| Base scenario | 68,0% | 113,5 | 71,3% | 353,7 |
| 1 year delay | 39,2% | 74,2 | 47,4% | 311,0 |
| 2 year delay | 21,8% | 37,8 | 36,0% | 270,3 |

1. CS-FOR will provide substantially high and positive economic net incremental revenues starting from Year 4. Compared to the WOP scenario, it is able to accelerate revenues by 2 times and almost triple revenues starting from Year 5 (Chart 1).

Chart 1. CS-FOR economic revenues

|  |  |
| --- | --- |
|  |  |

# **Economic and financial analysis spreadsheet**

|  |
| --- |
| [Hyperlink to financial analysis spreadsheet – 19 June 2018](https://www.dropbox.com/s/pd28mko1cpykq51/CS-FOR_Integrated%20Financial%20Model.xlsx?dl=0) |

|  |
| --- |
| [Hyperlink to economic analysis spreadsheet – 19 June 2018](https://www.dropbox.com/s/yqfrr991klsl2ea/CS-FOR_Integrated%20Economic%20Model.xlsx?dl=0) |

# **Appendix - Value of forest and pasture-related ecosystem services in Kyrgyzstan**

Mitigation and adaptation to climate change are CS-FOR benefits, to be achieved through ecosystem-based transformation, including through nature-based solutions. In particular, Component 2 targets biophysical aspects of ecosystem enhancement/melioration through investment in restoration and improvement of forests and pastures. Regenerating forests increases vegetative cover and biodiversity, and reduces land degradation; improving pastures also increases vegetative cover and slows down the process of land degradation. These actions contribute to enhancing/stabilizing ecosystem services and their functions, which in turn increases the resilience of ecosystems to the impacts of climate change. In addition to carbon sequestration and carbon storage benefits, and primary production functions (such as food and fibre), other ecosystem services that benefit from rehabilitation/restoration of degraded forest and pasture lands include soil fertility, water flow regulation and habitat and forage provision for animals including bees.

The monetary costs of the degradation of ecosystem services is high and is not accounted for in farmers’ perceptions of “value”, which can affect management choices; in agroforestry for example, it was found that a major challenge impeding agroforestry adoption in Kyrgyzstan was farmers’ perception that engaging in agroforestry would “lead to the loss of valuable arable land and deprive the farmers of other subsistence agricultural opportunities” (Djanibekov *et al.*, 2016[[9]](#footnote-9)). Insufficient fodder production in the mountainous areas of Kyrgyzstan and Tajikistan resulted in grazing in forests, contributing to forest degradation; between 2001 and 2009, the monetary value of deforestation was estimated at about 0.32 billion USD (*Ibid.*[[10]](#footnote-10)).

A study undertaken in 2016 in Central Asia estimated that for the period between 2001-2009, the annual cost of land degradation in the region due to land use and cover change was USD 5.85 billion - most of which was due primarily to rangeland degradation (USD 4.6 billion), then desertification (USD 0.8 billion), deforestation (USD 0.3 billion), and finally, abandonment of croplands (USD 0.1 billion) (Mirzabaev *et al.*, 2016[[11]](#footnote-11)).

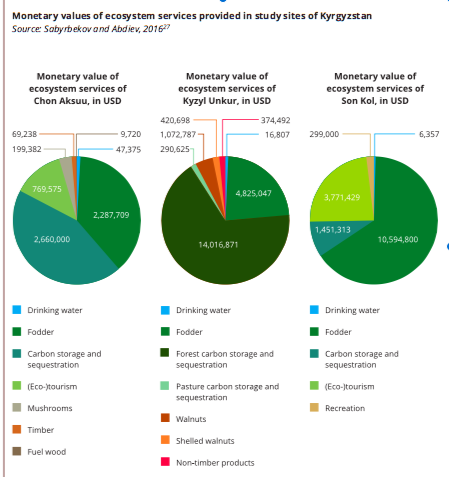
Specifically for Kyrgyzstan, for the period between 2001-2009, costs of land degradation through land use and cover change only (i.e. without costs of land degradation from lower soil and land productivity within the same land use), were estimated at USD 0.55 billion (annual cost of land degradation); USD 822 (annual cost of land degradation per capita); USD 5 billion (GDP in 2009); and 11% (as share of 2009 GDP). Cost of action *versus* inaction were also calculated, in USD billion: 4 (annual total economic value for cost of land degradation (2009); 2 (annual provisional cost of land degradation); 6 (cost of action (6 years)); 6 (cost of action (30 years)); 22 (cost of inaction (6 years); and 29 (cost of inaction (30 years)) (*Ibid.*) [[12]](#footnote-12).

A regional report[[13]](#footnote-13) prepared by The Economics of Land Degradation (ELD) Initiative to value land degradation looked beyond the market value for crops (normally the metric used as an indicator for land value); the ELD also looked at ecosystem services benefits including from carbon storage and sequestration to nutrient provision and cycling. Country case studies provided supporting information for the Central Asia Regional Report, including for Kyrgyzstan[[14]](#footnote-14). This is the first study that assessed the value of pasture ecosystems with cost-benefit analysis. The country case study looked at three pilot sites with summer pastures, based on high levels of land degradation together with local dependence on land and land-based ecosystems for subsistence and income. The pilot sites were: Chon Aksuu watershed, Kyzyl Unkur municipality and Son Kol Lake highland pastures. Cost-benefit analyses were performed on three scenarios: baseline, and two alternatives: i) higher pasture yields through improved pasture management, with favourable weather, and ii) moderate pasture yields through improved pasture management alongside unfavourable weather, both scenarios inclusive of carbon storage and sequestration.

Yields in the baseline scenario decrease by 2.5%/yr. Conversely, in the first alternative, yields increased by 5%/yr, and in the second alternative yields increased by 2.5%/yr. Of the three study sites, the one geographically closest to the CS-FOR target areas is Kyzyl Unkur municipality, whichis located in the south. Kyzyl Unkur municipality is characterized by a mix of forest and pastures, in silvo-pastoral systems which serve as the primary source of income, particularly the walnut forests.

In the first scenario, the cost-benefit analysis shows a net present value of USD 4.1 million at a 10% discount rate. In the second scenario, the cost benefit analysis shows a net present value of USD 1.6 million at a 10% discount rate. The introduction of tourism could see up to USD 1.1 million after 10 years – however, tourism in the pilot area is lacking, due to poor access to potential sites.

Below is a screen shot taken from the ELD Central Asia Regional Report, based on the Kyrgyzstan case study, illustrating the monetary values of ecosystem services for the three pilot sites (including, amongst others, carbon storage and sequestration; water flow regulation and habitat provision are not included).



Very recently, the Intergovernmental Platform on Ecosystem Services and Biodiversity made public the summary for policy makers of the regional assessment report on biodiversity and ecosystem services for Europe and Central Asia[[15]](#footnote-15) (including Western, Central and Eastern Europe, and the five Central Asian countries). The full report is currently not available will be, shortly. The summary policy makers states that: “In Europe and Central Asia, which has an area of 31 million square kilometres, the regulation of freshwater quality has a median value of $1,965 per hectare per year. Other important regulating services include habitat maintenance ($765 per hectare per year); the regulation of climate ($464 per hectare per year); and the regulation of air quality ($289 per hectare per year).

In 2016, IPBES also released the Summary for policymakers of the assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services on pollinators, pollination and food production[[16]](#footnote-16). In this summary, it was stated that : Given that pollinator-dependent crops rely on animal pollination to varying degrees, it is estimated that 5-8 per cent of current global crop production, with an annual market value of $235 billion-$577 billion (in 2015, United States dollars[[17]](#footnote-17)) worldwide, is directly attributable to animal pollination”.

While not specifically mentioning Kyrgyzstan, in 2007, the publication *Climate change and terrestrial carbon sequestration in* Central *Asia*[[18]](#footnote-18) found that “Aggregate losses to the national economies across the Aral Sea Basin caused by high groundwater level and secondary salinization are estimated at USD 1750 millions annually, approximately equal to 32% of the market value of potential agricultural crop produce”.

# **Appendix – Market assessments of selected value chains**

**Estimated margins along the beef value chain**

Case of Naryn Province, mixed production system (6 months – intensive feeding, 3 – grazing).

Prices based on industry data (April 2018).

Table 10 - Daily feeding needs of one head of cattle from the age of 1 to 20 months (LW 520 kg)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Feed | Daily need, kg | Duration in days | Total needs, kg | Price, KGS/kg | Sub-totals, KGS |
| Milk | 2 | 60 | 120 | 16,0 | 1.920 |
| Fodder lime | 0,0401 | 540 | 22 | 50,0 | 1.083 |
| Salt | 0,06 | 540 | 32 | 8,0 | 259 |
| Grass meal/chopped hay | 1 | 60 | 540 | 10,0 | 5.400 |
| Grazing on pastures, DM intake | 3 | 240 | 720 | 0,3 | 216 |
| Wild grasses hay, DM | 1,5 | 300 | 450 | 32,0 | 14.400 |
| Grains | 4 | 150 | 600 | 10,0 | 6.000 |
| Number of days |  | 600 |  |  | 29.278 |

Table 11 – Production costs of growing one head of cattle (LW 520 kg)

|  |  |  |  |
| --- | --- | --- | --- |
| Costing item | Qty | Price, KGS/unit | Sub-totals, KGS |
| Feeding | 1 |  | 29.278 |
| Vet services, vaccinations | 8 | 50 | 400 |
| Health control, lab tests | 2 | 20 | 40 |
| Drugs (anti-acaricide treatment of pastures), times | 1 | 300 | 300 |
| Transport of animal, trip | 1 | 600 | 600 |
| Labour[[19]](#footnote-19), months | *6* | 4.832 | 28.992 |
| **Total:** |  |  | **59.610** |

Some farmers reach up to 65-70 thousand KGS of production costs.

Table 12 – Beef procurement prices

|  |  |  |
| --- | --- | --- |
| Buyer | Price, KGS/kg LW | Price, KGS/kg |
| Middleman (animal trader) | 115 | 250 |
| Slaughterhouse (corporate business) | 120 | 260 |

Source: real prices as of 20 April 2018.

Table 13 – Estimated gross margin of farmer

|  |  |
| --- | --- |
| COP of farmer, 1 head of cattle | 59.610 |
| LW of marketed cattle | 520 |
| COP of farmer, KGS/1 kg (LW) | 114,6 |
| Average trader price, KGS/1 kg LW | 115 |
| Gross margin of farmer, KGS/1 kg LW | 0,4 |
| Gross margin of farmer, KGS/head | 190 |

Table 14 – Distribution of the margin along the chain (1 carcass of 540 kg LW, dressing coef. 46%, meat output 240 kg of beef)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Cost of Prod. | Trader | Primary processor | Retail |
| Price, KGS/kg | 248 | 250 | 260 | 290 |
| Margin, KGS/kg | 2 | 10 | 30 |  |

Therefore, while farmers profit is close to zero (190 KGS per head with 60 thousand KGS of production costs), animal traders’ profit is 2400 KGS/carcass.

**Current area under orchards and greenhouses in the project area**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Province** | **District** | **Fruit orchards** | | | **Greenhouses, ha** |
| Osh |  | Specialization | Total, ha | Drip irrigation, ha |
| Jalal-Abad | Suzak |  | 430 | 320 (74%) | 20 |
| Jalal-Abad | Toguz-Toro | Apple | 25 | 25 (100%) | 0 |
|  | Uzgen |  | 180 | 160 (89%) | 20 |
| Naryn | Ak-Taala | Apple, plum, cherry, black current | 203 | 135 (67%) | 1 |

Source: district branches of MAFIM

**Assessment of lost market opportunities for nuts and dried fruits on nearby markets**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Market outlet | Wholesale price, Kyrgyzstan, US$/kg | Export quantity, kg | Wholesale price, destination country, US$/kg | Opportunity cost, US$ |
| Uzbekistan |  |  |  |  |
| Walnut, in shell | 0,5 | 550.000 | 2,8 | 1.265.000 |
| Dried fruits, in bulk | 3,5 | 2.700.000 | 12 | 22.950.000 |
| Tajikistan |  |  |  |  |
| Walnut, in shell | 0,6 | 20.000 | 2,8 | 44.000 |
| Dried fruits, in bulk | 1,4 | 16.000.000 | 12 | 169.600.000 |
| Total: |  |  |  | 193.859.000 |

Source: interviews at Massy and Batkent markets, [Gateway](http://rus.gateway.kg/) information portal, RDF study and WB forestry project data.

**Economic effect of direct sales of animals to slaughterhouse**

Nation-wise, the need for holding paddocks has been assessed as follows: Naryn – 4 districts (Ak-Taala – 1); Talas – 2; Suzak – 1; Uzgen – 1; and Issyk-Kul – 2. Toguz-Toro has insufficient stock of animals. Initial investment cost is about 100.000 USD and some 10 ha of nearby pastures and land are required for feed provision and organisation of paddock. Meat processors (slaughterhouses) will be interested in taking loans to accompany such investment provided the project is able to build the capacity at community level, in particular with regards to local administration and support to mediator network development.

The proposed scheme consists in aggregation of live animals at the commune level with the organized procurement directly by a slaughterhouse. Animals are aggregated and kept in a holding paddock of approximate capacity of 500 heads of sheep and serve to justify logistical costs for processors (large quantities), flatten supply seasonality (year-round supply of animals) and ensure all biosecurity protocols are complied with.

The project will foster direct linkages and relations of trust between herders and processors with four main objectives:

1. Increased animal offtake at community level;
2. Improved animal productivity driven by quality-based pricing and relations of trust;
3. Increased of herders’ margins by eliminating the risks of “losses” due to mistreatment by traders (e.g. reduced weight or fattiness category);
4. Increased income of local authorities thanks to locally collected income tax from formal business transactions.

*Table 15 – Estimated economic effect of sales of cattle (II fattiness category)*

|  |  |  |
| --- | --- | --- |
|  | WOP | WP |
| Estimated LW, kg | 430 | 440 |
| Average procurement price, KGS/kg LW | 115 | 120 |
| Revenue from sales of cattle | 49.450 | 52.800 |

As shown above, traders usually “reduce” the weight of live animals by at least 10 kg. With current prices, this is about 1150 KGS of “lost” income. If adding incremental revenue from direct sales (WP), farmer’s gross revenue goes up to 4.500 KGS per head.

Assumed, one community sells a batch of 10,000 kg (about 50 heads) and mediator’s fee is of 3 KGS/kg, local administration will leverage an incremental income of 3.000 KGS (10 percent tax on profit for legal entities).

1. Aggregated benefits are reduced by 20%, while aggregated costs are the same. [↑](#footnote-ref-1)
2. It is assumed that performance of these models can be affected by climate change impacts at a very limited scale since the activities are perfomed in closed environments. [↑](#footnote-ref-2)
3. Source: WOP values are based on existing data and experts’ opinions; WP values are estimated by authors based on experts’ opinions and local experiences. [↑](#footnote-ref-3)
4. (i) Only for reference, as the model does not envisage improved practice, but the establishment of orchards on unproductive land; (ii) for WOP scenarios yields of fruit rees are based on household harvests, while yields of nut trees are based on wild harvests in forests. [↑](#footnote-ref-4)
5. Weigthed average rate of deposits of individuals in local currency in the beginning of 2018 (Source: National Bank of the Kyrgyz Republic) [↑](#footnote-ref-5)
6. World Bank, 2017. Guidance note on shadow price of carbon in economic analysis. [↑](#footnote-ref-6)
7. See Appendix to this Chapter: Value of forest and pasture-related ecosystem services in Kyrgyzstan. [↑](#footnote-ref-7)
8. Sabyrbekov, R., & Abdiev, A. (2016). Economics of Land Degradation (ELD) Initiative: Kyrgyzstan Case Study. Evaluating ecosystem services of highland pastures. Report for the ELD Initiative from the Consultative International Group on Agricultural Research (CGIAR): Amman, Jordan [↑](#footnote-ref-8)
9. Djanibekov, U.; Villamor, G.; Dzhakypbekova, K.; Chamberlain, J.; Xu, J. Adoption of Sustainable Land Uses in Post-Soviet Central Asia: The Case for Agroforestry. Sustainability 2016, 8(10), <http://www.mdpi.com/2071-1050/8/10/1030>. [↑](#footnote-ref-9)
10. Ibid. [↑](#footnote-ref-10)
11. Mirzabaev, A., Goedecke, J., Dubovyk, O., Djanibekov, U., Quang, B.L., & Aw-Hassan, A. (2016). Economics of land degradation in Central Asia. In Nkonya, E. et al (Eds), Economics of Land Degradation and improvement – a global assessment for sustainable development. <https://link.springer.com/content/pdf/10.1007%2F978-3-319-19168-3_10.pdf> [↑](#footnote-ref-11)
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16. IPBES (2016): Summary for policymakers of the assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services on pollinators, pollination and food production. S.G. Potts, V. L. Imperatriz-Fonseca, H. T. Ngo, J. C. Biesmeijer, T. D. Breeze, L. V. Dicks, L. A. Garibaldi, R. Hill, J. Settele, A. J. Vanbergen, M. A. Aizen, S. A. Cunningham, C. Eardley, B. M. Freitas, N. Gallai, P. G. Kevan, A. Kovács-Hostyánszki, P. K. Kwapong, J. Li, X. Li, D. J. Martins, G. Nates-Parra, J. S. Pettis, R. Rader, and B. F. Viana (eds.). Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany. 36 pages. [↑](#footnote-ref-16)
17. Value adjusted to 2015 United States dollars taking into account inflation only. [↑](#footnote-ref-17)
18. R, Lal; M. Suleimenov; B.A. Stewart; D.O Hansen; P. Doraiswamy. 2007. Climate change and terrestrial carbon sequestration in Central Asia. Taylor & Francis Group, London, UK [↑](#footnote-ref-18)
19. Based on minimum salary scale (4,832 KGS/month) [↑](#footnote-ref-19)