BUSINESS MODEL
ON COMMERCIAL SAXAUL PLANTATIONS

ANALYSIS OF THE SAXAUL WOOD MARKET IN THE ARAL SEA REGION

Regional Project
"Ecologically Oriented Regional Development in the Aral Sea Region"

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A STUDY TO ANALYZE THE SAXAUL WOOD MARKET IN THE ARAL SEA REGION AND TO DEVELOP A BUSINESS MODEL ON COMMERCIAL SAXAUL PLANTATIONS IN KAZAKHSTAN

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On behalf of
German Federal Ministry for Economic Cooperation and Development (BMZ)

Kazakhstan, 2021

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1. INTRODUCTION

This study on the development of a business model for the creation of commercial saxaul plantations was carried out within the framework of the Regional Project for Environmentally Oriented Development of the Aral Sea Region (ECO ARAL). The aim of the study is to assess the market for saxaul timber in the Aral Sea region (in the Kyzylorda and Mangistau regions) and the potential for the development of commercial plantations in the region, as well as to develop a business model for developing commercial saxaul plantations.

The key premise of this study is the assumption that the saxaul plantations will fulfill the demand for saxaul wood and reduce the burden on state forestry and prevent illegal logging of saxaul in national forests. One of the key objectives of the study is to conduct an assessment of the economic feasibility of creating commercial saxaul plantations in the conditions of the Kyzylorda and Mangistau regions, assess the attractiveness of investments in such plantations for farmers, and develop a business model for creating such plantations.

The development of saxaul plantations could have an important role for the development of the Aral Sea region both from a social, economic and environmental point of view. Most of the rural population of the Aral Sea region makes their living from irrigated agriculture. However, in conditions of an increasing shortage of water resources, degradation and salinization of soil resources, the consequences of climate change, irrigated agriculture in these regions becomes difficult. The development of saxaul plantations might potentially provide employment and and additional income for population of these regions. In addition, the development of commercial saxaul plantations can contribute to the fight against desertification and soil salinization, as well as climate change mitigation by GHG sequestration.

2. CONCLUSIONS AND RECOMMENDATIONS

The existing ban on saxaul felling has been in effect since 2004, when the moratorium was first introduced. As of January 1, 2018, according to the State Enterprise "Kazakh Forest Management Enterprise" in 1st of January 2018 the total stock of saxaul forest was 14.9 cubic meters, including ripening saxaul of 3.97 million cubic meters, ripped and overripped - 7.08 million cubic meters.

A sufficient condition implementation of the project of the development of saxaul plantation and legal trade of saxaul wood is to give a permission to cut saxaul on the sites of the state forest fund. Permission could be given by the Order of the Chairman of the Committee for Forestry and Wildlife of the Ministry of Ecology, Geology and Natural Resources.

The annual demand for saxaul wood in Kazakhstan is estimated at 37 thousand tons, including 1.3 thousand tons in the Mangistau region, and 1.6 tons in Kyzylorda region. For the continuous production of such a volume of saxaul wood on plantations from 1.6 to 6.5 thousand hectares of land for plantations will be required in Mangystau region (depending on the quality of the soil), and from 2 to 8 thousand hectares in Kyzylorda region.

Currently the state forest fund has accumulated about 7 million cubic meters of saxaul timber suitable for felling. However due to the ban is not being cut. In future a one-time release this mass of wood can create significant pressure on the wood market, and could affect the economic efficiency of the planned project to establish saxaul plantations through a possible reduction in product prices.

In this case, the organization of the second redistribution for the production of charcoal from saxaul can significantly increase the added value of products and make the product export-oriented.

The developed economic models show that the cultivation of saxaul in plantations in order to obtain wood is not economically feasible.

The cultivation of saxaul plantations can be economically viable only as an carbon offset project, when farmers receive the carbon credits on sequestered CO2 and if the plantations are located on fertile lands of the 1st and 2nd class of forest suitability. At carbon unit price of 45 euros per ton of CO2eq, the 100 ha saxaul plantation shows the following financial results:

- Simple payback period is reduced to 5 years;
- The discounted payback period is 6 years;
- Internal rate of return will be at 30.4%;
- The present value of the project for 62 years will amount to 37.8 million tenge.

In the case of placing plantations on lands of the 3rd group of forest suitability, economically viable saxaul plantation carbon offset project starts from 300 ha. A positive cash flow from selling of carbon units will start from 3-4 years of the life of the project.

Placing plantations on plots of the 3rd group of forest suitability is a rather risky undertaking, depending on uncontrolled natural and climatic risk.

3. OVERVIEW OF THE SAXAUL TIMBER MARKET IN KYZYLORDA AND MANGISTAU OBLASTS

volumes of saxaul timber consumption (domestic and import volumes) and potential demand for saxaul timber

A ban on cutting saxaul forests in state forests has been in place in Kazakhstan since 2004, and restriction on the sale of saxaul timber products has been effective since 2017. In this regard, currently there is no legal market for saxaul timber and its products in Kazakhstan. According to the Committee for Forestry and Wildlife of the Ministry of Ecology, Geology and Natural Resources [1], in 2020, 296 cases of illegal logging were recorded in the territories of the state forest fund, the estimated damage amounted to 72.5 million tenge for 5.6 thousand cubic meters of timber.

There is a high demand for saxaul wood from the restaurant business, as well as from the population, in order to use it in cooking on charcoal / wood-fired dishes.

In addition, there is a demand from the rural population in remote areas for space heating in winter. Given the relatively higher cost of saxaul wood in comparison with other fuel sources (coal, gas), and the growing gasification of the rural regions, in the long term the demand for saxaul wood products for heating purposes is estimated to be insignificant.

Due to the lack of statistics on the volume and consumption of saxaul wood, assessment of the potential saxaul market in Kyzylorda and Mangistau regions can be carried out indirectly.

Currently, according to the State Revenue Committee of the Ministry of Finance of the Republic of Kazakhstan, about 11 thousand tons of charcoal is imported into Kazakhstan on average for the period from 2012 to 2019. (other periods are not typical). The assumption is that imported charcoal is used for the same purposes as potential products from saxaul wood. The table shows the calculations of the potential demand for saxaul wood, subject to import substitution of charcoal.

Table 1 - Assessment of the potential size of the saxaul market in the Kyzylorda and Mangistau regions based on the substitution of charcoal imports

AVERAGE ANNUAL INDICATORS FOR THE PERIOD 2012-2019	THE REPUBLIC OF KAZAKHSTAN	KYZYLORDINSKAYA	MANGYSTAU
IMPORT OF CHARCOAL TO THE REPUBLIC OF KAZAKHSTAN, TONS	10,870		
CALORIFIC VALUE OF 1 KG OF CHARCOAL, KCAL	6,510		
CALORIFIC VALUE OF 1 KG SAXAUL, KCAL	3,100		
CONVERSION FACTOR OF CHARCOAL EQUIVALENT TO SAXAUL	2.1		
ESTIMATION OF THE MARKET CAPACITY OF SAXAUL REPLACED BY CHARCOAL, TONS	22,846		
ESTIMATION OF ILLEGAL TRADE IN SAXAUL, TONS	15,000		
POPULATION, THOUSAND PEOPLE	17,537	756	614
EVALUATION OF THE SAXAUL MARKET, TONS	37,846	1,631	1,326

Source: data of CNI MF RK, BNS ASPD RK, own calculations

A rough estimate of the wood / charcoal demand from restaurants and cafeterias for the production of charcoal-fired meat products was also carried out. Table 2 presents an assessment of the demand for saxaul of public catering enterprises for the production of barbecue products.

Table 2 - Assessment of the potential size of the saxaul market in Kyzylorda and Mangystau regions based on the need for restaurant business enterprises for charcoal from saxaul

INDICATOR	THE REPUBLIC OF KAZAKHSTAN	KYZYLORDINSKAYA	MANGYSTAU
THE DEMAND FOR SAXAUL OF PUBLIC CATERING ENTERPRISES PER CAPITA OF THE URBAN POPULATION *, KG / PERSON	2.07	2.07	2.07
URBAN POPULATION, THOUSAND PEOPLE	11151	364.9	287.7
THE NEED FOR SAXAUL IN URBAN AREAS, TONS	23,050	754	595

Source: data of BNS ASPiR RK, 2GIS, own calculations
** The calculation of the demand for saxaul of public catering enterprises in terms of per capita urban population is presented in Appendix 6.*

The indicated estimate of saxaul consumption for cooking does not take into account the possible consumption for heating.

Thus, the annual consumption of saxaul in the Mangistau region is estimated on about 1.3 thousand tons per year, in Kyzylorda - about 1.6 thousand tons. For the continuous production of such a volume of saxaul wood on plantations under it would require 6.5 thousand ha of plantations in Mangystau region and 8.0 thousand ha of plantation in Kyzylorda region on the land of the 3rd group of forest suitability with a productivity of 9 tons of wood per ha for 47 years cycle [2]. On lands of the 1st and 2nd groups of forest suitability with a productivity of plantations 4 times more than the 3rd group, the required area would be 1.6 thousand hectares in the Mangistau region, and 2.0 thousand hectares in the Kyzylorda region.

The existing ban on saxaul felling has been in effect since 2004, when the moratorium was first introduced [3]. As of January 1, 2018, according to the State Enterprise "Kazakh Forest Management Enterprise" [4] in 1st of January 2018 the total stock of saxaul forest was 14.9 cubic meters, including ripening saxaul of 3.97 million cubic meters, ripped and overripped - 7.08 million cubic meters.

Currently the state forest fund has accumulated about 7 million cubic meters of saxaul timber suitable for felling. However due to the ban is not being cut. In future a one-time release this mass of wood can create significant pressure on the wood market and could affect the economic efficiency of the planned project to establish saxaul plantations through a possible reduction in product prices.

4. DEVELOPMENT OF A BUSINESS MODEL FOR THE OPERATION OF COMMERCIAL SAXAUL PLANTATIONS (~ 100 HA)

Two business models of commercial saxaul plantations have been developed, depending on the types of soil on which the plantations are located, which significantly distinguishes their productivity and economic parameters.

The soils on which saxaul grows, depending on the level of groundwater (hereinafter GWL) and the presence of a dense carbonate horizon in the profile, are divided into the following groups of forest suitability:

1 group of soils. Sandy, sandy loam, loamy with maximum salinity in 0-2 m thicker soil up to 0.6% of the dense residue with groundwater occurrence up to 8 m. This group includes: gray-brown, residual meadow sandy loamy soils, takyr-like solonchak, light loamy on buried meadow-gray-brown soils, light solonchak light loamy gray soils. GWL up to 6 m, light texture, non-saline or slightly saline without dense horizons in the profile, as well as with GWL up to 3 m, but with salinization of individual horizons 0-2 m thicker up to 1% in terms of dense residue, including sulfates up to 0 ,9 %.

2 group of soils. Loamy with salinity in 0-2 m thicker soil up to 1.5% and a groundwater level up to 8 m residual meadow sandy loam on the plains, takyr loamy brown semidesert weakly differentiated cohesive and sandy loamy on undulating reliefs, brown semidesert incompletely developed cohesive sandy on hilly and undulating sands.

3 group of soils. The groundwater level is more than 6 m, light and medium texture, with salinization of individual horizons in 0-2 m thickness up to 0.5% for a dense residue, a thick carbonate horizon, locally destroyed in places of settlements (colonies) of a large sand lance, takyrs with a thickness of the upper a dense horizon up to 1 m. as well as soils with a groundwater level up to 3 m and salinization of individual horizons in 0-2 m thick from 1.5 to 3.0% for a dense residue, including sulfates - up to 2%. This group includes: takyr-like solonchak soils on buried meadow-gray loamy soils, brown semi-desert poorly differentiated cohesive and sandy loamy on undulating plains, underlain by a slab of sandstone from a depth of 1-1.5 m, solonetzes desert solonchak loamy and clayey loamy soils.

The models cover the following technical and legal aspects:

- Allocation of a land plot from the category of forest lands for the creation of a plantation for the cultivation of saxaul;
- Current state support for the establishment of saxaul plantations or tree breeding nurseries;
- Assessment of the potential revenue from the production and sale of carbon offset from the activities of the saxaul plantation;
- Estimation of production costs and potential revenues from the production of saxaul wood;
- Evaluation of the economic efficiency of the business model of the saxaul plantation;
- Estimation of production costs and potential revenues from the production of charcoal from saxaul (second redistribution, second business model), assessment of the economic efficiency of the business model of charcoal production.

It also provides recommendations on changes to the regulatory framework required to implement the business model.

4.1 "Model 1" - plantation on soils of the 1st or 2nd group of forest suitability

The model implies the creation of a saxaul plantation with an area of 100 hectares on soils of the 1st or 2nd group of forest suitability [5].

Plantations on these types of soils are distinguished by the following productivity indicators [6]:

- Phytomass above ground: 10 years – 16 m3/ha; 20 years – 38 m3/ha; 30 years – 46 m3/ ha; 40 years – 49 m3/ha;
- The maximum annual current growth of timber in 10-20 year old stands is 2.5 m3/ha per year.

The first cutting of saxaul plantations will be done in 26-30 years after planting, the second cutting in the next 15-17 years, the third cutting in the next 20-23 years. In total 50 m3 of commercial saxaul wood could be produced for the three cuttings [2], 25 m3 in the 1st cutting, 15 m3 in the 2nd, and 10 m3 in the 3rd.

On the basis of the above data, the curves of growth and accumulation of dry mass of saxaul wood in plantations were constructed (see Figure 1), which are necessary for calculating the carbon offset.

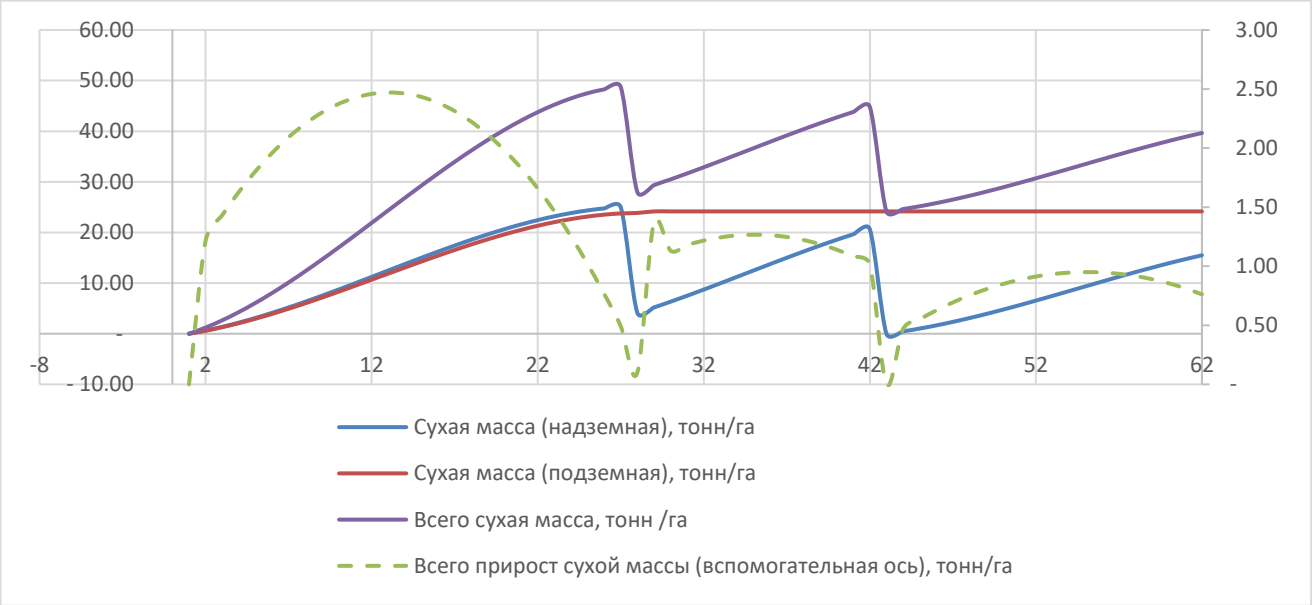

Figure 1. Increase and accumulation of dry mass of saxaul wood in plantations on lands of the first forest suitability group

The technology for growing such plantations and the necessary treatments is drawn up on the basis of the "Recommendations for plantation cultivation of fast-growing tree species and energy plantations of saxaul in Kazakhstan" [2]. The cultivation technology determines the costs of creating and caring for plantings. More detailed information on technology and costs are given in Appendix 1.

Initial costs for the creation of a saxaul plantation and the developed business model:

- Expenses for the allocation and/or purchase of a land plot for afforestation;
- Costs in Plantation project design;
- Costs for the development of a carbon offset project and validation.

Initial costs required during the first two years amount to 12.36 million tenge (Appendix 1).

In the developed business model of saxaul plantation per 100 hectares, the following categories of expenses are taken as current costs:

- Expenses for the payment of salaries to administrative and management personnel;
- Carbon offset verification costs.

Operating costs are shown in Appendix 1.

The following are taken into account as the main sources of income from the use of saxaul plantations for the developed business model:

(1) Production of charcoal or saxaul wood (for fuel use), including those obtained during the main felling.
(2) **Receipt of proceeds from the sale of carbon offset** produced during the cultivation of trees and the absorption of carbon dioxide. Here, estimates are given on the possible revenue, in the event of the actual implementation of the legislative initiative on trading in carbon credits. An overview

of regulations governing the carbon market is given in Section 4.3.

Economic efficiency

In the project for the cultivation of a saxaul plantation on 100 hectares on lands of the 1st forest suitability group with an offset at a price of 15 euros per ton of CO2, taking into account a discount rate of 10%, taken at the level of the refinancing rate plus 1%, the present value of investments will be 11.64 million tenge , due to the fact that a significant part of the costs of preparing and validating a carbon offset project is attributed to the 2nd year of the project's life, for the period from which it is economically feasible.

Table 3. Integral indicators of economic efficiency of "Model1" plantation per 100 hectares

INDICATOR	NO OFFSET	WITH OFFSET AT A PRICE OF 15 EUROS PER TCO2 EQUIVALENT	WITH OFFSET AT A PRICE OF 45 EUROS PER TCO2 EQUIVALENT
DISCOUNT RATE (ANNUAL)	10.0%	10.0%	10.0%
PRESENT VALUE OF INVESTMENTS, THOUSAND TENGE	-8,298.00	-11,643.00	-11,643.00
NPV OF THE PROJECT, THOUSAND TENGE	-13 123.90	2 169.14	37,847.52
IRR OF THE PROJECT,%	5.8%	10.8%	30.4%
SIMPLE PAYBACK PERIOD, YEARS	26	17	5
DISCOUNTED PAYBACK PERIOD OF THE PROJECT, YEARS	N/A	26	6

The net present value (NPV) of the project, calculated for 62 years (plantation life cycle), will amount to 2.17 million tenge, which indicates a low investment attractiveness of the project. At the same time, a positive cash flow from the project begins from the 2nd year of the project due to the possibility of obtaining proceeds from the sale of carbon offset.

The proceeds from the sale of timber do not come evenly, only from the 26th year of the project's life, but its potential covers all the costs of the project.

Simple payback period of the project is 17 years, discounted - 26 years.

If the price of the carbon offset increases to € 45 per tonne of CO2, the economic efficiency of the project significantly improves:

- Simple payback period is reduced to 5 years;
- The discounted payback period is 6 years;
- Internal rate of return will be at 30.4%;
- The present value of the project for 62 years will amount to 37.8 million tenge.

If the project does not provide for income from the sale of carbon offset, the economic efficiency indicators will be significantly worse (see table 3).

In this case, the present value of investments will be 8.3 million tenge, the net present value of the project for 62 years will be minus 13.1 million tenge, the simple payback period will be 26 years from the date of the first proceeds from the sale of timber.

4.2 "Model 2" - plantation on soils of the 3rd group of forest suitability. Technological and economic aspects

The model implies the creation of a saxaul plantation with an area of 100 hectares on soils of the third group of forest suitability [5].

Plantations on these types of soils are distinguished by the following productivity indicators [6]:

- Phytomass above ground: 10 years - 6.4 m3/ha; 20 years - 14 m3/ha; 30 years - 18 m3/ha; 40 years - 19 m3/ha;
- The maximum annual current growth of wood in 10-20-year plantations is 0.9 m3/ha per year.

Saxaul plantations on soils of the 3rd group of forest suitability are cut twice - the first time in 26-30 years after planting and the second time in the next 20-25 years; in this case, it is expected to receive, respectively, 6 and 3 m3, and in total - 9 m3 of commercial saxaul timber [2].

On the basis of the above data, the curves of growth and accumulation of dry mass of saxaul wood in plantations were constructed (see Figure 2), which are necessary for calculating the carbon offset.

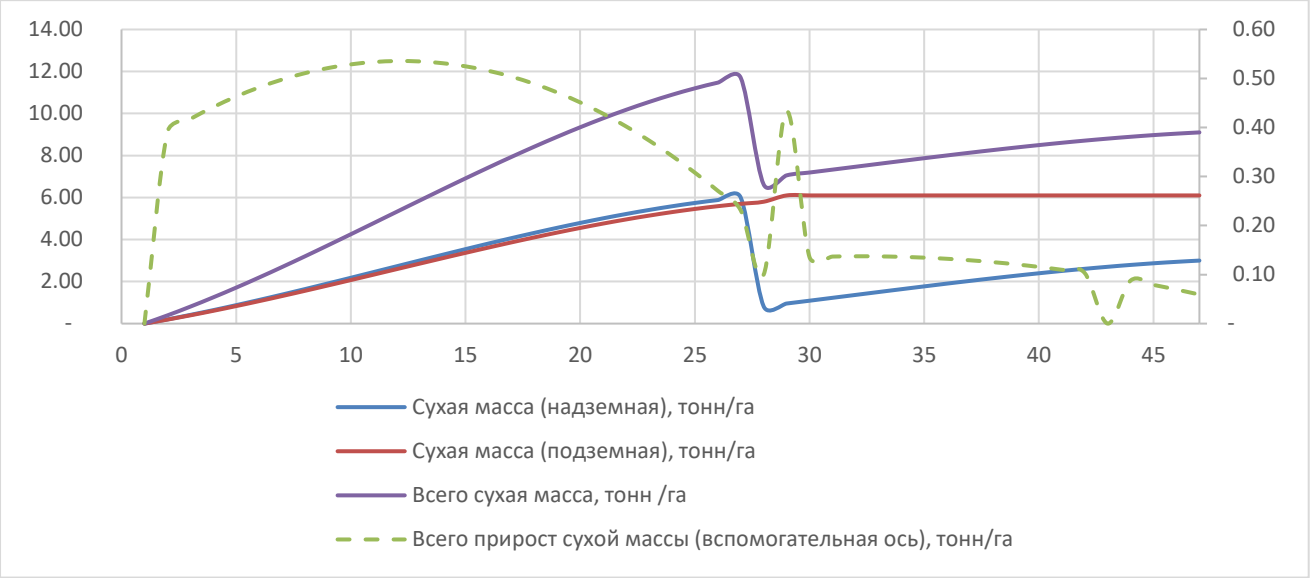

Figure 2. Increase and accumulation of dry mass of saxaul wood in plantations on lands of the third group of forest suitability

The technology for growing such plantations and the necessary treatments is drawn up on the basis of the "Recommendations for plantation cultivation of fast-growing tree species and energy plantations of saxaul in Kazakhstan" [2]. The cultivation technology determines the costs of creating and caring for plantings. More details on technology and costs are given in Appendix 2.

Initial costs for the creation of a saxaul plantation and the developed business model:

- Expenses for the allocation and/or purchase of a land plot for afforestation;
- Costs on Plantation project design;
- Costs for the development of a carbon offset project and its validation.

Initial costs required during the first two years amount to 12.36 million tenge (Appendix 2).

In the developed business model of saxaul plantation per 100 hectares, the following categories of expenses are taken as current costs:

- Expenses for the payment of salaries to administrative and management personnel;
- Carbon offset verification costs.

Operating costs are shown in Appendix 2.

The following are taken into account as the main sources of income from the use of saxaul plantations for the developed business model:

(1) Production of charcoal or saxaul wood (for fuel use), including those obtained during the main felling.
(2) **Receipt of proceeds from the sale of carbon offset** produced during the cultivation of trees and the absorption of carbon dioxide. Here, estimates are given on the possible revenue, in the event of the actual implementation of the legislative initiative on trading in carbon credits. An overview of regulations governing the carbon market is given in Section 4.3.

Economic efficiency

The characteristics of this model are due to the significantly lower productivity of such plantations, which is 4 times lower than in plantations on lands of the 1st forest suitability group.

Investments in the project for the cultivation of saxaul plantations on 100 hectares on the lands of the 3rd

forest suitability group may amount to about 12.3 million tenge.

Taking into account the discount rate of 10%, taken at the level of the refinancing rate plus 1%, the present value of investments will amount to 11.64 million tenge, due to the fact that a significant part of investments in the development of the plantation project is attributed to the second year of the project's life.

Table 4. Integral indicators of economic efficiency of "Model2" plantation per 100 hectares

INDICATOR	NO OFFSET	WITH OFFSET AT A PRICE OF 15 EUROS PER TCO2 EQUIVALENT	WITH OFFSET AT A PRICE OF 45 EUROS PER TCO2 EQUIVALENT
DISCOUNT RATE (ANNUAL)	10.0%	10.0%	10.0%
PRESENT VALUE OF INVESTMENTS, THOUSAND TENGE	-8,298.00	-11,643.00	-11,643.00
NPV OF THE PROJECT, THOUSAND TENGE	-23 540.90	-22,422.31	-13,300.86
IRR OF THE PROJECT,%	-6.0%	-5.1%	0.8%
SIMPLE PAYBACK PERIOD, YEARS	N/A	N/A	26
DISCOUNTED PAYBACK PERIOD OF THE PROJECT, YEARS	N/A	N/A	N/A

The net present value (NPV) of the project, calculated for 47 years (plantation life cycle), will be -22.4 million tenge, which indicates the negative investment attractiveness of the project.

The proceeds from the sale of timber do not come evenly only from the 26th year of the project's life, but its discounted value cannot cover all the costs of the project.

The simple payback period of the project has not been established, discounted - the term has not been determined.

The project cannot generate income from the sale of carbon offset at a price of 15 euros per tonne of CO2, since it is not economically viable - the revenue from the sale of offset is less than the cost of its annual verification.

If the price for carbon offset increases to 45 euros per tonne of CO2, the project performance improves slightly, but the project still turns out to be unprofitable:

- The present value of the project will amount to -13.3 million tenge;
- Simple payback period of 26 years;
- The internal rate of return is only 0.8%.

5. DEVELOPMENT OF A BUSINESS MODEL FOR THE PRODUCTION OF CHARCOAL FROM SAXAUL

A business model for the production of charcoal from saxaul is developed here in a volume comparable to 60% of the saxaul market in Kyzylorda and Mangistau regions, which is estimated at 3 thousand tons of saxaul annually, see section 1.

For such a volume, a set of equipment and investments is calculated as shown in the table below.

Table 5. Investments in the production of saxaul charcoal with a design capacity of 1.8 thousand tons of saxaul firewood per year

NO.	INVESTMENT OBJECT NAME	QUANTITY, PCS.	COST, THOUSAND TENGE
1	Pyrolysis oven Fantastic 12.5 / 3	one	10 530.0
2	Shed for equipment and warehouse 200 sq.m. / USD 130 / sq. M.	one	11,000.0
3	Land plot	one	1,000.0
4	Equipment and devices for splitting firewood	one	200.0
5	Batcher for packing coal SWEDA DVS-301-50-05	one	877.5
6	Sewing machine for sewing bags and sacks	one	87.8
7	Diesel forklift	one	5,900.0
	Total investment		29,595.3

Direct production costs for charcoal production consist of raw material and packaging costs. The yield of products from raw materials is estimated by the coefficient Wood consumption in terms of coal equal to 6 times. The main technological parameters of production that are significant for the model are shown in the table below.

Table 6. Main technological parameters

INDICATOR	MEANING
WOOD CONSUMPTION IN TERMS OF COAL, TIMES	6.00
ANNUAL CAPACITY OF THE UNIT FOR FEEDSTOCK, TONS / YEAR	1,800.00
DENSITY OF SAXAUL WOOD, KG / L	1.09
PACKING CAPACITY, KG / PACKING	3.00
COST OF 1 UNIT OF PACKING, TENGE / PIECE	40,00
PURCHASE PRICE OF SAXAUL WOOD, THOUSAND TENGE / CUBIC METER.	50,00
SELLING PRICE OF CHARCOAL IN A PACKAGE OF 3 KG, TENGE / PACKAGE	2,000.00

The required production and administrative personnel, as well as their monthly salaries, are shown in Table 7.

Table 7. Staff

STAFF	NUMBER, PEOPLE	MONTHLY SALARY, TENGE
DIRECTOR	1.0	50,000
ACCOUNTANT	1.0	50,000
PRODUCTION LINE OPERATOR	2.0	180,000
LOADER	2.0	120,000
SALES MANAGER	1.0	180,000
SECURITY GUARD	1.0	100,000

Upon reaching 100% load, monthly direct production costs will amount to 8.15 million tenge, administrative costs 980 thousand tenge, revenue 17.33 million tenge.

Indicators of economic efficiency of the project are shown in the table below.

Table 8. Indicators of the economic efficiency of a charcoal production project

INDICATOR	MEANING
DISCOUNT RATE (PER MONTH)	0.8%
PRESENT VALUE OF INVESTMENT	-29355
NPV PROJECT	508,478
IRR OF THE PROJECT,%	23.8%
SIMPLE PAYBACK PERIOD, MONTHS	5
DISCOUNTED PAYBACK PERIOD OF THE PROJECT, MONTHS	6

Simple payback period of the project is 5 months, discounted - 6 months.

6. LEGAL ASPECTS OF THE SAXAUL PLANTATION PROJECT

5

6

6.1 Information on legal requirements for the production and sale of raw materials and products from saxaul wood

Today, the turnover, trade in saxaul is prohibited by law since the entry into force of clauses 4-4) clause 3. Article 32 of the Law of the Republic of Kazakhstan dated April 12, 2004 No. 544-II "On the regulation of trading activities" [7], which states "It is forbidden to sell: ... 4-4) products from saxaul wood during the period of the ban on felling saxaul plantations on the sites the state forest fund, except for its implementation by state forest owners in accordance with the forest legislation of the Republic of Kazakhstan. "

The ban on felling of saxaul plantations in the areas of the state forest fund is enforced by the Orders of the Chairman of the Committee for Forestry and Wildlife of the Ministry of Ecology, Geology and Natural Resources. The current ban was introduced by the order of the Chairman of the Committee for Forestry and Wildlife of the Ministry of Agriculture of the Republic of Kazakhstan dated August 13, 2015 No. 211 "On the prohibition of felling in saxaul plantations on the sites of the state forest fund" [8].

Responsibility for violation of this prohibition is defined in Art. 196 of the Code of the Republic of Kazakhstan dated July 5, 2014 No. 235-V 3PK "On Administrative Offenses" [9]:

"Article 196. Illegal trade in goods or other items

Trade in goods and other items, the free trade of which is prohibited or limited by the legislation of the Republic of Kazakhstan - entails a fine in the amount of twenty-five monthly calculation indices ".

Thus, trade in saxaul is prohibited in the Republic of Kazakhstan during the period of the ban on felling in saxaul plantations in the areas of the state forest fund, which have been operating since at least 2015, and entails administrative liability for an offense in the amount of 25 monthly calculation indices, which is 72.9 thousand tenge in 2021.

6.2 Land use

Legal procedures for land use / ownership in accordance with national legislation are mainly regulated by the Land (Code of the Republic of Kazakhstan dated June 20, 2003 No. 442[10]) and Forestry (Code of the Republic of Kazakhstan dated July 8, 2003 No. 477 [11]) Codes of the Republic of Kazakhstan, as well as other regulatory legal acts.

According to the current legislation, private plantations are possible on lands with the designated purpose "For afforestation" in private ownership, or in a long-term lease, as indicated in paragraph 3. Art. 8 Forestry Code:

"Article 8. Lands of the forest fund

3. Lands of the private forest fund include lands provided to individuals and non-state legal entities for private ownership or long-term land use in accordance with the Land Code of the Republic of Kazakhstan with a designated purpose for afforestation, occupied by:

(1) artificial plantations;
(2) plantations of natural origin, which have arisen by seed and (or) vegetative means;
(3) private forest nurseries;
(4) special purpose plantations;
(5) agroforestry plantations;
(6) protective plantings on the right-of-way of economic highways that are in private ownership "

The procedure for obtaining a land plot for afforestation on the basis of private ownership or temporary land use is regulated in Art. 43, 43-1 of the Land Code. In general, the receipt of a land plot is carried out in the following order:

(1) acceptance for consideration of an application (application) for the granting of the corresponding right to a land plot;
(2) determination of the possibility of using the requested land plot for the declared intended purpose in accordance with the territorial zoning;
(3) preliminary selection of a land plot (when applying for a land plot for the construction of facilities, except for the construction of facilities within the boundaries of a settlement);
(4) preparation of an opinion by the land commission;
(5) development and approval of a land management project;
(6) making a decision by the local executive body of a region, a city of republican significance, the capital, a district, a city of regional significance, akim of a city of district significance, a village, a village, a rural district on the granting of the right to a land plot;
(7) conclusion of a sale and purchase agreement or temporary (short-term, long-term) compensated (gratuitous) land use;
(8) establishing the boundaries of a land plot on the ground;
(9) production and issuance of an identification document for a land plot, with the exception of a land plot intended for the construction of facilities within the boundaries of a settlement.

To determine the cadastral value of a land plot used to calculate the cost of redemption of a land plot from the state or obtaining a lease, the Base rates of payment for land plots specified in the Resolution of the Government of the Republic of Kazakhstan dated September 2, 2003 N 890 “On establishing base rates of payment for land plots " [12]. The cadastral value is determined by the State Corporation "Government for Citizens" (Article 10 of the Land Code).

For lands for afforestation, as well as for agricultural lands, there are restrictions on ownership by foreigners, stateless persons and legal entities with foreign participation, which is regulated by paragraph 4 of Art. 23 of the Land Code.

Basic rates for land of the category of pastures (suitable for growing saxaul) in Kyzylorda and Mangistau regions can be about 2 thousand tenge / ha. The cadastral value may differ from the size of the base rates, depending on the coefficients used, but at the same time, in accordance with paragraph 5. of Art. 11 of the Land Code: "The total amount of increase or decrease in the cadastral (estimated) value of a land plot for agricultural production should not exceed fifty percent of the base rates of payment established in accordance with paragraph 1Article 10 of this Code ”.

For the business model, investments in the acquisition of a land plot are taken into account, calculated at the level of the Cadastral value of the land, based on base rates. Thus 1 ha of land for plantations can cost about 3 thousand tenge/ha.

6.3 Carbon units market, trade in carbon offset produced by saxaul plantations

In accordance with national legislation, there is a market for carbon units in Kazakhstan, which is mainly regulated by the Environmental Code (Code of the Republic of Kazakhstan dated January 2, 2021 No. 400-VI "Environmental Code of the Republic of Kazakhstan" [13]) (hereinafter - the Code), as well as other regulatory legal acts.

Due to the fact that the Code was recently adopted, many sub-normative acts have not yet been approved, and are undergoing approval procedures. In this case, an overview of the latest working draft laws will be given.

According to paragraphs. 2) clause 2 of article 284 of the Code "State regulation in the field of emissions and removals of greenhouse gases is carried out through: 2) the establishment of a market mechanism for trading carbon units."

A carbon unit is an accounting unit of a carbon quota or carbon offset and is equal to one ton of carbon dioxide equivalent (clause 1 of Article 299 of the Code).

In the country, the operator of trade in carbon units is legally enshrined in clause 1 of Art. 288 of the Code states that “1. The operator of the carbon trading system is the subordinate organization for the regulation of greenhouse gas emissions of the authorized body in the field of environmental protection. " Now such an

organization is Zhasyl Damu JSC, a subordinate organization of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan.

As objects of trade in carbon units are directly carbon units from the category of the reserve of the National Plan of carbon quotas, which are implemented by the operator on the basis of an auction (clause 5) clause 5 of Art. 290 of the Code), as well as carbon offsets expressed in carbon units.

Trading in carbon units is carried out in accordance with the requirements of Art. 299 of the Code. The primary sale of quotas is carried out by the Carbon Units Trading Operator, the secondary sale can be carried out on commodity exchanges or in direct transactions between market participants, but at a price not less than the last quotation on the commodity exchange. Trading in carbon units is carried out in accordance with the "Rules for trading carbon units", which are developed and approved by the authorized body in the field of environmental protection. Now the Rules for trading in carbon units, approved by the Order of Acting Minister of Ecology, Geology and Natural Resources of the Republic of Kazakhstan dated June 29, 2021 No. 221 [14].

According to paragraph 1 of Art. 298 of the Code "1. Carbon offset refers to a reduction in greenhouse gas emissions and (or) an increase in greenhouse gas removals achieved as a result of activities or activities in any sector of the economy in the Republic of Kazakhstan aimed at reducing greenhouse gas emissions and (or) increasing greenhouse gas removals. Reduction of the quota-based greenhouse gas emissions of a quota-based installation cannot be recognized as carbon offset. " The approval of the carbon offset and the provision of offset units are carried out in accordance with the rules developed and approved by the authorized body in the field of environmental protection. To date, these rules have not been approved, there is a draft of the rules, which is undergoing approval, posted on the website of the Open Government [15].

The considered saxaul plantation and use project could generate carbon offsets by absorbing carbon dioxide into the plantations as the trees grow. It is possible to receive proceeds from the sale of carbon offset during the growth of trees on the plantation.

According to the draft "Updated NDC (Kazakhstan's commitments to reduce greenhouse gas emissions under the Paris Agreement until 2030)" [16], the cost of a carbon unit in Kazakhstan will grow from 1 euro / tCO2 in 2022. up to 15 EUR / tCO2 in 2023–2025 and 45 euro / tCO2 in 2026–2030. The projected carbon tax rate could be € 21.4 / tCO2 in 2023–2025. and 26 euro / tCO2 in 2026–2030.

For the business model, a carbon offset cost of 15 € / tCO2 was used.

6.4 Information on the investment climate and support (subsidies) from the state

According to Art. 112-1 of the current Forest Code of the Republic of Kazakhstan[eleven], (Code of the Republic of Kazakhstan dated July 8, 2003 No. 477) "State support for private afforestation is carried out in the following areas:

(1) plantation cultivation of fast-growing tree and shrub species for industrial and energy purposes;
(2) creation and development of forest nurseries."

The law provides for the following types of state support for private afforestation (Article 112-3 of the Forest Code):

(1) reimbursement (up to fifty percent) of expenses for the establishment and cultivation of plantations of fast-growing tree and shrub species for industrial and energy purposes;
(2) reimbursement (up to fifty percent) of expenses for the creation and development of private forest nurseries.

To date, according to the Committee for Forestry and Wildlife, the budget provides funds to subsidize the costs of planting fast-growing tree and shrub species in 2022. Funds will be distributed in accordance with the Rules [17], approved by Order of the Acting Minister of Agriculture of the Republic of Kazakhstan dated February 27, 2015 No. 18-02 / 169 "On approval of the Rules for reimbursement of expenses for the establishment and cultivation of plantations of fast-growing tree and shrub species, the creation and development of private forest nurseries" (Registered with the Ministry of Justice Of the Republic of Kazakhstan on July 10, 2015 No. 11633).

Since saxaul is not a fast-growing tree species, the development costs of saxaul plantations are not subject to subsidies. There is no data on the funds allocated for the development of private forest nurseries, so this type of subsidies is also not available for the cultivation of saxaul.

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21. Technological map of growing saxaul seedlings of the South-West region of the Republican State Enterprise "Republican Forest Seed Selection and Seed Center"

APPENDIX 1. Model 1

The technology of growing plantations on lands of the 1st and 2nd groups of forest suitability consists of the following stages:

1. Tillage (Option 1):

- It is used on soils of the 1st and 2nd groups of forest suitability with the presence of trees, shrubs, thick grass cover, usual for abandoned arable lands, or khmyz on non-renewed cutting areas. Initially, it is recommended to partially cultivate the soil (50%) in strips of 4.2 m every 4.2 m. Then, in the 3rd year of plantation establishment, plowing of the left inter-strip strips.

- The work begins in the warm season with rope felling of trees, clearing them of branches and transporting the trunks out of the site, then with the help of the marked landmarks every 8.4 m are marked with the lines of passage of the tillage units oriented across the prevailing winds. Further, with the help of a bulldozer shovel mounted on a tractor, the soil cultivation strips are cleaned from shrubs and mud and it is harvested into untreated inter-stripe belts, followed by burning in the cold season, in the presence of snow or rainy days.

- Soil cultivation is carried out according to the system of annual black fallow. In August, the soil is disking with heavy disc harrows in two tracks to a depth of 12-15 cm, followed by moldboard plowing to a depth of 22-25 cm without harrowing strips. In the second year, 2-3-fold disking of strips to a depth of 12-15 cm is carried out to destroy weeds and moldboard-free tillage to a depth of 27-30 cm (two pairs).

2. Sowing a plantation (Scheme 1):

- Soils of the 1st and 2nd groups of forest suitability are used with their processing according to options 1 and 2 in strips of 4.2 m every 4.2 m.

- The creation of saxaul plantations is carried out by sowing seeds in two belts 0.3 m wide, located on opposite edges of the treated strips.

- Sowing is carried out in the fall before the onset of stable cold weather with a rate of 1.05 g of the 1st class or 1.57 g of seeds of the 2nd quality class per 1 running meter of the sowing belt. In this case, seeders are used, equipped with rotary sowing devices of push-out action or converted spreaders of mineral fertilizers. The seeds are embedded in the soil with ring rollers to a depth of 1-2 cm.

- Depending on the biological characteristics of tree and shrub species, sowing of seeds can be carried out in spring, summer and autumn. Spring sowing is carried out in the shortest possible time (5-7 days) in moist soil.

- Taking into account the adopted scheme, it is required to create 1 hectare of saxaul plantations of seeds of the 1st class - 2.5 kg, of the 2nd quality class - 3.75 kg.

3. Plantation care:

- Plowing of untreated inter-lane belts and carrying out agrotechnical maintenance is carried out only on soils of the 1st and 2nd groups of forest suitability, in options 1 and 2, tillage when planting plantations according to scheme 1.

- The plowing of interstrip tapes is carried out in the third year after the planting is created. It is carried out to improve the growth and condition of plantations. At the same time, in August, the untreated inter-strip belts are initially disking to a depth of 12-15 cm, then - moldboard plowing of the soil to a depth of 22-25 cm.

- In the cultivated row spacings of plantations, during the first four years, 8-fold agrotechnical soil maintenance is carried out according to the 3-2-2-1 scheme with the cultivation of row spacings in the first year of plantation growth in the first decades of April, May, June; in the second and third years - in the first decades of April and May; in the

fourth year - in the first ten days of April. In untreated inter-strip strips in the first two years in July, a single mowing of the grass is carried out in the next two years - agrotechnical maintenance according to the 2-1 scheme, corresponding to the cultivation of the initially plowed strips.

- Thinning of plantations created according to scheme 1, with the removal of every second plant in a row, is carried out for 7-8 years of planting growth in September-October, leaving 1000-1200 saxaul specimens per hectare (taking into account mortality).

4. Cabin:

- Industrial logging in plantations has been carried out since the age of 26. Harvesting of saxaul is carried out with the help of a tumerwal with a cutting area of 50 m. They are laid with their long side perpendicular to the prevailing winds, in the northern subzone (Almaty, eastern part of the Zhambyl region) from December to March, in the presence of stable soil freezing; in the southern subzone of deserts - from December to February. The abandoned strips are assigned for felling for the third winter, starting from the moment of the first felling areas, when a two-year undergrowth undergrowth will be formed in their place. On each such coppice bush in the month of August, 3-4 of the most developed coppice shoots are left. This technique allows you to increase the stock of marketable wood and significantly reduce the formation period of plantations of the first coppice generation, which equals 15 years. Leaving less than three shoots in the bushes is not allowed due to the threat of their windbreak. Similarly, on the soils of the 1st and 2nd groups of forest suitability, the second coppice generation of plantations is formed within 20 years.

- Thus, the plantations created in the best growing conditions are cut down three times - the first time in 26-30 years, the second time in the form of the first coppice generation at 15-17 years, the third time in the form of the second coppice generation - at 20-23 years. At the same time, it is planned to obtain 25, 15 and 10 m (t), respectively, or 50 m (t) of marketable timber for three fellings.

The following is a technological map, which details the operations and the necessary costs for the implementation of operations for the cultivation of saxaul plantations on the lands of the first or second group of forest suitability.

Technological map for crops on soils of the 1st, 2nd groups of forest suitability

Field No.	
the culture	Saxaul
reproduction	
area, ha	one hundred
predecessor	
seeding rate, kg / ha	2.5
seed demand, kg	250
price of a discounted diesel fuel per 1 kg, tenge	235
average market price of distil oil for 1 kg, tenge	600

No. p \ p	Job title	unit of measurement	Workload	Workload	Terms of work		Unit composition		Number of people to fulfill the norm		The number of standard shifts in the scope of work	Labor costs for the entire volume of work, people / days		Tariff rate for the norm, tenge		Tariff salary fund for the entire volume of work, tenge		Percentage of additional payment,%	Additional and increased payment, tenge	Percentage of additional payment for harmfulness,%	Additional payment for harm, tenge	Total salary, thousand tenge	Fuel, diesel fuel, AI			diesel oil			Total fuel and lubricants, thousand tenge	Total costs, thousand tenge	Equipment rental		Hourly floor to workers	
					incl.		incl.																number											
		unit of measurement	amount (ha)	in hectares of conventional plowing	date	number of days	tractor	agricultural machines	tractor drivers	trailers and horse-manual workers	Production rate		tractor drivers	trailers and horse-manual workers	tractor drivers	trailers and horse-manual workers	tractor drivers	trailers and horse-manual workers	Percentage of additional payment,%		Percentage of additional payment for harmfulness,%			per unit, liter	total, liter	Price for 1 kg	total cost, thousand tenge (0.85 conversion factor liters to tons)	amount, kg (3% of fuel consumption)	Price for 1 kg	total cost, thousand tenge			The cost of renting equipment per standard day, thousand tenge / shift	Rent cost, thousand tenge	Cost of a worker's standard change,	Cost of payment to workers, thousand tenge
												group 3 / group 11	gr. 9 * gr. 12	group 10 * group 12			group 13 * group 15	gr. 14 * gr. 16		(column 17 + column 18) * column 19/100		gr. 17 * gr. 21/100	(group 17 + group 18 + group 20 + group 22) / 1000	gr. 3 * gr. 24		gr. 25 * gr. 26 * 0.85 / 1000	0.03 * gr. 25		gr. 29 * gr. 30/1000	room 27 + room 30	gr. 23 + gr. 31		gr. 13 * gr. 33		gr. 14 * gr. 35
	one	2	3	4	5	6	7	eight	9	10	eleven	12	thirteen	14	15	sixteen	17	eighteen	ninety	twenty	21	22	23	24	25	26	27	28	29	thirty	31	32	33	34	35	36
SOIL PREPARATION 1st year (steam)																																	512.45		
one	Rope felling of trees on the site	ha	one hundred		April	one	GAZ-53 (2 pcs)	tumerval	2		480	0.2	0,4	0.0	22400		9 333.3	0	50	4667		0	14	0.18	eighteen	210	3.2	one		-	3.2	17.2	43.68	18.20		

2	Clearing the area from tree trunks and branches	ha	one hundred		April	2	MTZ 82	mounted bulldozer shovel	one		17	5.9	5.9	0.0	22400		131,764.7	0	50	65882		0	198	2.62	262	210	46.7	eight	536	4.2	50.9	248.6	43.68	256.94		
3	PARTIAL (50%) soil disking with heavy disc harrows on 2 tracks to a depth of 12-15 cm	ha	one hundred		April	2	DT 75	Trailed double-row disc harrow DANA BDP-3,2 × 2	one		51	2.0	2.0	0.0	22400		43,921.6	0	50	21961		0	66	1.13	113	210	20.2	3	536	1.8	22.0	87.9	43.68	85.65		
4	PARTIAL (50%) moldboard plowing to a depth of 22-25 cm	ha	one hundred		April	5	K-700A	Plow PSKuM-3	one		28.8	3.5	3.5	0.0	22400		77,777.8	0	50	38889		0	117	2.00	200	210	35,7	6	536	3.2	38.9	155.6	43.68	151.67		
PICKING SEEDS																																		54.44		186.92
5	Seed collection	kg	250		October November	3		manually		one	10.7	23.4	0.0	23.3645		8000	-	186,916	50	93458		0	280		0	210	0.0	0	536	-	-	280.4	-	-	8.00	186.92
6	Trips to determine the yield of saxaul for a distance of up to 350 km, 350 km x21: 100 = 73.5 liters.	km	350																50					0.15	53	210	9.4	2	536	0.8	10.2	10.2	-	20.41	-	-
7	Transportation of workers up to a distance of 350 km, 350 km x 21: 100 = 73.5 liters	km	350				GAZ-53 Kung												50					0.25	88	210	15.6	3	536	1.4	17.0	17.0	-	34.02	-	-
LANDING 2nd year																																		565.20		

eight	PARTIAL (50%) soil disking in the second year with heavy disc harrows for 2 tracks to a depth of 12-15 cm	ha	one hundred		March	2	DT 75	Trailed double-row disc harrow DANA BDP-3,2 × 2	one		51	2.0	2.0	0.0	22400		43,921.6	0	50	21961		0	66	1.13	113	210	20.2	3	536	1.8	22.0	87.9	43.68	85.65		
9	PARTIAL (50%) moldboard-free plowing in the second year to a depth of 20 cm	ha	one hundred		October	5	K-700A	Plow PSKuM-3	one		28	3.6	3.6	0.0	22400		80,000.0	0	50	40,000		0	120	2.06	206	210	36.7	6	536	3.3	40.1	160.1	43.68	156.00		
10	Sowing with seeds	ha	one hundred		November	eight	MTZ 82	RUM 100	one		27	3.7	3.7	0.0	22400		82,963.0	0	50	41481		0	124	1.62	162	210	28.9	5	536	2.6	31.5	155.9	43.68	161.78		
eleven	Seed embedding	ha	one hundred		November	eight	MTZ 82	Wheel roller	one		27	3.7	3.7	0.0	22400		82,963.0	0	50	41481		0	124	1.62	162	210	28.9	5	536	2.6	31.5	155.9	43.68	161.78		
CARE 3rd year																																		472.40		
12	PARTIAL (50%) Cultivation of weed strips	ha	one hundred		April	5	MTZ 82	Cultivator KPS4	one		76.8	1.3	1.3	0	22400		29166.7	0	50	14583		0	44	0.57	57	210	10.2	2	536	0.9	11.1	54.8	43.68	56.88		
thirteen	Chemical treatment	ha	one hundred		May	2	MTZ 82	Mounted sprayer Badilli Kobra class 400	one		76.8	1.3	1.3	0	22400		29166.7	0	50	14583	twenty	5833	50	0.57	57	210	10.2	2	536	0.9	11.1	60.7	49.50	64.46		
14	PARTIAL (50%) Cultivation of weed strips	ha	one hundred		May	5	MTZ 82	Cultivator KPS4	one		76.8	1.3	1.3	0	22400		29166.7	0	50	14583		0	44	0.57	57	210	10.2	2	536	0.9	11.1	54.8	43.68	56.88		
15	PARTIAL (50%) Cultivation of weed strips	ha	one hundred		June	5	MTZ 82	Cultivator KPS4	one		76.8	1.3	1.3	0	22400		29166.7	0	50	14583		0	44	0.57	57	210	10.2	2	536	0.9	11.1	54.8	43.68	56.88		

sixteen	Plowing of inter-strip belts, PARTIAL (50%) disking of the soil with heavy disc harrows for 2 tracks to a depth of 12-15 cm	ha	one hundred		August	3	DT 75	Trailed double-row disc harrow DANA BDP-3,2 × 2	one		51	2.0	2.0	0.0	22400		43,921.6	0	50	21961		0	66	1.13	113	210	20.2	3	536	1.8	22.0	87.9	43.68	85.65		
17	Plowing of inter-strip belts PARTIAL (50%) moldboard plowing to a depth of 22-25 cm	ha	one hundred		August	3	K-700A	Plow PSKuM-3	one		28.8	3.5	3.5	0.0	22400		77,777.8	0	50	38889		0	117	2.00	200	210	35,7	6	536	3.2	38.9	155.6	43.68	151.67		
CARE 4th year																																			113.75		
eighteen	PARTIAL (50%) Cultivation of weed strips	ha	one hundred		April	5	MTZ 82	Cultivator KPS4	one		76.8	1.3	1.3	0	22400		3 776.0	0	50	1888		0	6	0.57	57	210	10.2	2	536	0.9	11.1	16.7	43.68	56.88		
nineteen	PARTIAL (50%) Cultivation of weed strips	ha	one hundred		May	5	MTZ 82	Cultivator KPS4	one		76.8	1.3	1.3	0	22400		3 776.0	0	50	1888		0	6	0.57	57	210	10.2	2	536	0.9	11.1	16.7	43.68	56.88		
CARE 5th year																																		-	113.75		
twenty	PARTIAL (50%) Cultivation of weed strips	ha	one hundred		April	5	MTZ 82	Cultivator KPS4	one		76.8	1.3	1.3	0	22400		3 776.0	0	50	1888		0	6	0.57	57	210	10.2	2	536	0.9	11.1	16.7	43.68	56.88		
21	PARTIAL (50%) Cultivation of weed strips	ha	one hundred		May	5	MTZ 82	Cultivator KPS4	one		76.8	1.3	1.3	0	22400		3 776.0	0	50	1888		0	6	0.57	57	210	10.2	2	536	0.9	11.1	16.7	43.68	56.88		
CARE 6th year																																		-	56.88		
22	PARTIAL (50%) Cultivation of weed strips	ha	one hundred		April	5	MTZ 82	Cultivator KPS4	one		76.8	1.3	1.3	0	22400		3 776.0	0	50	1888		0	6	0.57	57	210	10.2	2	536	0.9	11.1	16.7	43.68	56.88		
CARE 7th year																																			26.21		200,00
23	Thinning of plants	ha	one hundred		March	15		manually		one	4	25.0	0.0	25		8000	-	200,000	50	100,000		0	300		0	210	0.0	0	536	-	-	300.0	-	-	8.00	200,00	

24	Removal of scraps from the territory	tons	3		March	15	GAZ-53		one		5	0.6	0.6		22400		13,440.0	0	50	6720		0	twenty	8.00	24	210	4.3	one	536	0,4	4.7	24.8	43.68	26.21		
1st roll at age 26 (27th year)																																	6 911.97		-
25	Rope felling of trees on the site	ha	one hundred		October	2	GAZ-53 (2 pcs)	tumerval	2		50	2.0	4.0		22400		89 600.0	0	50	44800		0	134	1.80	180	210	32.1	5		-	32.1	166.5	43.68	174.72		
26	Collecting firewood with a bulldozer shovel	ha	one hundred		October	15	MTZ 82	mounted bulldozer shovel	one		eight	12.5	12.5		22400		280,000.0	0	50	140,000		0	420	5.20	520	210	92.7	sixteen	536	8.4	101.1	521.1	43.68	546,00		
27	Loading firewood with a Loader	tons	2500		October	15	Front loader LIUGONG 855H	3 cubes	one		160	15.6	15.6		24000		375,000.0	0	50	18750		0	563	0.40	1000	210	178.3	thirty	536	16.1	194.4	756.9	46.80	731.25		
28	Removal of firewood from the territory, transportation of 100 km	tons	2500		October	15	KAMAZ		one		twenty	125.0	125.0	0	22400		2,800,000.0	0	50	1,400,000		0	4200	4,00	10000	210	1783.5				1,783.5	5 983.5	43.68	5,460.00		
Pruning in the third year after the 1st fell to obtain the best shoots (manually) 30th year																																	-		200,00
29	Shoot pruning	ha	one hundred		March	15		manually		one	4	25.0	0.0	25		8000	-	200,000	50	100,000		0	300		0	210	0.0	0	536	-	-	300.0	-	-	8.00	200,00
2nd roll at the age of 26 + 15 years (42nd year)																																	4 435.47		-
thirty	Rope felling of trees on the site	ha	one hundred		October	2	GAZ-53 (2 pcs)	tumerval	2		50	2.0	4.0		22400		89 600.0	0	50	44800		0	134	1.80	180	210	32.1	5		-	32.1	166.5	43.68	174.72		
31	Collecting firewood with a bulldozer shovel	ha	one hundred		October	15	MTZ 82	mounted bulldozer shovel	one		eight	12.5	12.5		22400		280,000.0	0	50	140,000		0	420	5.20	520	210	92.7	sixteen	536	8.4	101.1	521.1	43.68	546,00		

32	Loading firewood with a Loader	tons	1500		October	15	Front loader LIUGONG 855H	3 cubes	one		160	9.4	9.4		24000		225,000.0	0	50	112500		0	338	0.40	600	210	107.0	eighteen	536	9.6	116.7	454.2	46.80	438.75		
33	Removal of firewood from the territory, transportation of 100 km	tons	1500		October	15	KAMAZ		one		twenty	75.0	75.0	0	22400		1,680,000.0	0	50	840,000		0	2520	4,00	6000	210	1070.1				1,070.1	3590.1	43.68	3,276.00		
Pruning in the third year after the 2nd fell to obtain the best shoots (manually) 45th year																																		–		200,00
34	Shoot pruning	ha	one hundred		March	15		manually		one	4	25.0	0.0	25		8000	-	200,000	50	100,000		0	300		0	210	0.0	0	536	-	-	300.0	-	-	8.00	200,00
3rd roll at the age of 26 + 15 + 20 years (62nd year)																																		3197.22		-
35	Rope felling of trees on the site	ha	one hundred		October	2	GAZ-53 (2 pcs)	tumerval	2		50	2.0	4.0		22400		89600.0	0	50	44800		0	134	1.80	180	210	32.1	5		-	32.1	166.5	43.68	174.72		
36	Collecting firewood with a bulldozer shovel	ha	one hundred		October	15	MTZ 82	mounted bulldozer shovel	one		eight	12.5	12.5		22400		280,000.0	0	50	140,000		0	420	5.20	520	210	92.7	sixteen	536	8.4	101.1	521.1	43.68	546,00		
37	Loading firewood with a Loader	tons	1000		October	15	Front loader LIUGONG 855H	3 cubes	one		160	6.3	6.3		24000		150,000.0	0	50	75000		0	225	0.40	400	210	71.3	12	536	6.4	77.8	302.8	46.80	292.50		
38	Removal of firewood from the territory, transportation of 100 km	tons	1000		October	15	KAMAZ		one		twenty	50.0	50.0	0	22400		1,120,000.0	0	50	560,000		0	1680	4,00	4000	210	713.4				713.4	2,393.4	43.68	2,184.00		

Such plantations are characterized by the following productivity indicators [6], which is used in the developed model:

- Ground phytomass (m3 / ha) in highly closed plantations: 10 years - 16 m3 / ha; 20 years - 38 cubic meters / ha; 30 years - 46 cubic meters / ha; 40 years - 49 cubic meters / ha;
- The maximum annual current growth of timber in 10-20 year old stands is 2.5 cubic meters / ha per year.

To calculate the amount of absorbed carbon dioxide (produced by carbon offset), models of the course of growth of saxaul plantations were built on the basis of the above data [6]. So, on the basis of the data, the growth curve of the aboveground phytomass of saxaul in plantations of the 1st quality class is plotted in the figure below. Equation of curve approximation is compiled, with approximation confidence factor R = 1.

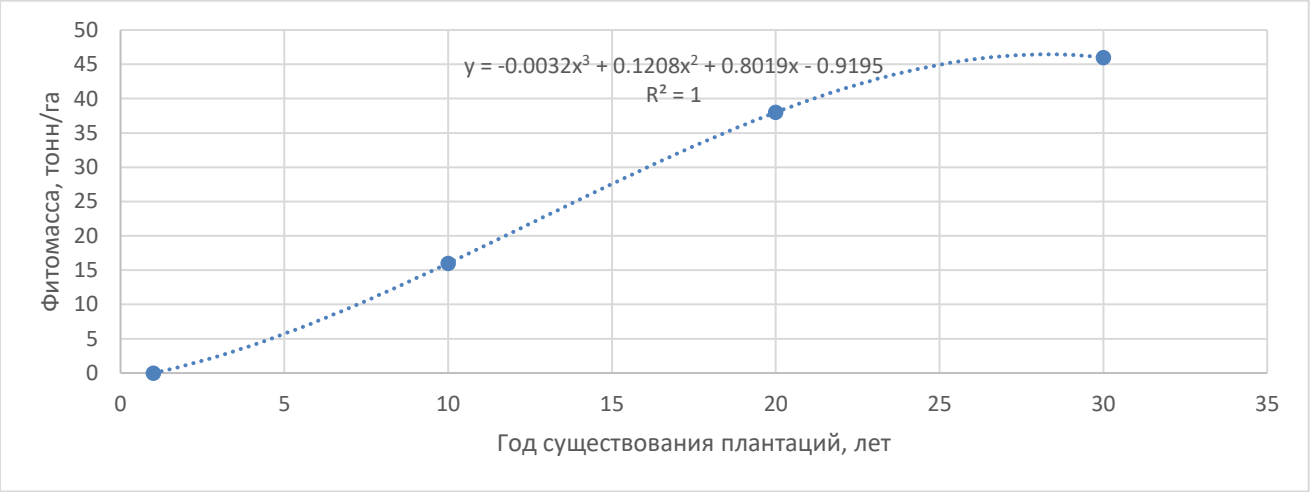

Figure 3. Growth curve of the aboveground saxaul phytomass in plantations of the 1st quality class

To convert the known data on the volume of plantation phytomass into dry wood mass, the following coefficient was used:

$$К_{масс1} = {M_{сух1}}/{M_{фито1}} \quad \text{(one)}$$

where:

$К_{масс1}$ - the ratio of dry mass to phytomass in saxaul plantations on soils of the first forest suitability group;

$M_{сух1}$ - dry weight of saxaul plantations on soils of the first group of forest suitability at the age of the first felling of 25 years = 25 tons / ha according to [2];

$M_{фито1}$ - phytomass of saxaul plantations of the 1st bonitet class at the age of the first felling of 25 years = 45.81 tons / ha according to the data approximation [6].

In this way,

$$К_{масс1} = \frac{25}{45,81} = 0,546$$

To calculate the amount of biomass in the underground part of saxaul plantations, we used data from the report of the Korean University [18], which conducted research on saxaul plantations in 2017-2018 in the northern part of the afforestation areas of the drained bottom of the Aral Sea:

- the average total accumulation of black saxaul biomass in the study areas was 20.57 g / m2. in year,
- of which 10.45 g / m2 is the accumulation of aboveground biomass,
- 9.93 g / m2 - accumulation of underground biomass.

$$К_{подзем} = {М_{подзем}}/{М_{надзем}} \quad (2)$$

where:

$К_{подзем}$ - the ratio of underground biomass to aboveground;

$М_{подзем}$- underground biomass of saxaul plantations = 9.93 g / m2. [eighteen];

$М_{надзем}$- aboveground biomass of saxaul stands = 10.45 g / m2. [eighteen].

In this way,

$$К_{подзем} = \frac{9,93}{10,45} = 0,95$$

Due to the use of the technology of growing plantings after the first and second felling on the remaining coppice bushes, the increase in the biomass of the underground part of saxaul stands at the stages after the specified felling is not calculated.

As a result, data on the growth and accumulation of dry weight of saxaul wood in plantations on lands of the first forest suitability group are shown in Figure 4.

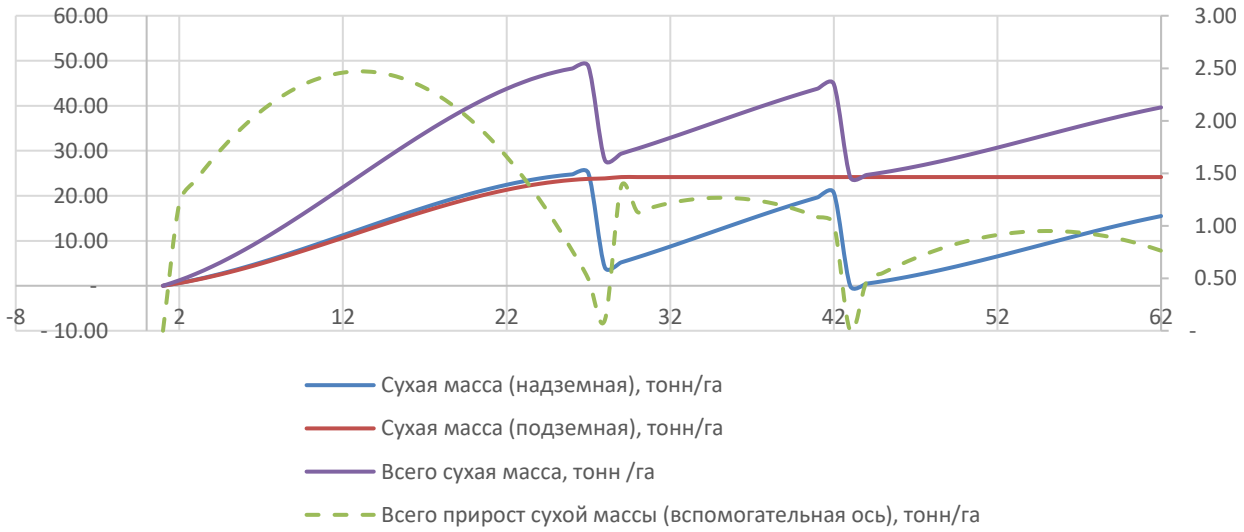

Figure 4. Increase and accumulation of dry mass of saxaul wood in plantations on lands of the first forest suitability group

To account for the amount of absorbed carbon dioxide (CO2), the following data were used: when 1 ton of absolutely dry wood is formed, regardless of the tree species, an average of 1.83 tons of carbon dioxide is absorbed and 1.32 tons of oxygen are released. Thus, the coefficient for calculating the absorbed carbon dioxide (produced by carbon offset) from the amount of dry mass of wood will be 1.83.

Based on the indicated physical parameters of the saxaul plantation, an economic model is calculated, taking into account the possible receipt of proceeds from the sale of saxaul wood after felling and the sale of the produced carbon offset in cases where its proceeds from its production cover the costs of verification.

Assessment of investments in the project of saxaul plantations for 100 hectares according to "Model 1"

Investments for the creation of a saxaul plantation and the developed business model:

- Expenses for the allocation and / or purchase of a land plot for afforestation;
- Plantation project development costs;
- Costs for the development of a carbon offset project, its primary validation.

The start-up costs for the establishment of a saxaul plantation are shown in the developed business model, see the table below.

Table 9. Investments in a saxaul plantation project for 100 hectares according to "Model 1"

NO.	INVESTMENT OBJECT NAME	PRICE	CURRENCY	QUANTITY, PCS.	INVESTMENT START DATE
1	Investments in the acquisition of a land plot	300,000.0	KZT	one	2022
2	Surveys for drawing up a working draft of the organization of a plantation	791 796.8	KZT	one	2022
3	Investment in the development of a carbon offset project	845,000.0	KZT	one	2022
4	Investment in carbon offset project validation and monitoring plan	2,500,000.0	KZT	one	2022
5	Investments in the development of a plantation project	7,926,822.6	KZT	one	2023

Investments in the acquisition of a land plot in private ownership are calculated at the cadastral value, in accordance with the Land Code [10] and the Resolution of the Government of the Republic of Kazakhstan dated September 2, 2003 N 890 "On the establishment of base rates of payment for land plots" [12]. Here, the base rates for pastures in Kyzylorda and Mangistau oblasts can be up to 2 thousand tenge / ha. Additional costs for transferring the category of land and obtaining permits were not taken into account.

Investments in the development of the plantation project were compiled according to the data of the North-Kazakhstan branch of the RSE on the REU "Kazgiproleskhoz" and amount to 8.8 million tenge [19].

Investments for the development of the carbon offset project, project validation were compiled according to the data of Eurasian GHG Management LLP [20]. Here, the start date of a carbon project is tied to economic efficiency, when the cost of carbon offset from a plantation project may be greater than investment in the development and validation of the project, which depends on the stage of plantation growth. In our case, this is 2027.

For our project, possible investments for the purchase of agricultural equipment were not taken into account, due to the incomparably low load on the set of equipment compared to its cost. The necessary machine operations for tillage and maintenance are calculated as the current costs of renting the necessary agricultural equipment for the production of specific technological operations.

Direct manufacturing costs. Production processes of saxaul plantations according to "Model 1"

The model assumes that all production personnel are temporarily hired - seasonal workers, who are calculated piece-rate wages at current market prices.

All technological operations involving agricultural machinery are carried out on rented machinery; the model takes into account the costs in the form of rental costs.

The production processes of saxaul plantations, expressed in terms of production costs, include the following:

1. Collecting saxaul seeds for planting in a nursery for the production of seedlings is produced according to the recommendations given in Appendix 2. (Hereinafter, on the technology of cultivation of saxaul and the creation of plantations, the following sources were used: "The main provisions of the organization and management of forestry in the Kyzylorda region. RGKP" Kazakh forest management company ", Almaty - 2019" [5] and "Verzunov AN RECOMMENDATIONS for plantation cultivation of fast-growing tree species and energy plantations of saxaul in Kazakhstan. Scientific and Production Center of Forestry - Shchuchinsk, 2005" [2] (hereinafter - Recommendations).

The collection of saxaul includes visits to collect samples and determine the quality of seed material in forest nurseries, as well as directly collecting seeds.

For the developed business model of saxaul plantation on 100 hectares according to the proposed planting scheme, only 250 kg of saxaul seeds are needed 1 class at the rate of 2.5 kg per 1 ha.

Table 10. Seed picking operation costs

NO. P \ P	JOB TITLE	EQUIPMENT RENTAL COST, THOUSAND TENGE	COST OF PAYMENT TO WORKERS, THOUSAND TENGE
PICKING SEEDS		54.44	186.92
1	Seed collection	-	186.92
2	Trips to determine the yield of saxaul for a distance of up to 350 km.	20.41	-
3	Transportation of workers up to 350 km	34.02	-

The costs of collecting seeds in a nursery at a distance of 350 km may amount to 241.35 thousand tenge.

The indicated costs are calculated from the standards of production by workers per shift, in detail in the technological map Appendix 1.

2. Establishment of a plantation, sowing seeds (for the business model selected for the description)produced according to the recommendations given in Appendix 3 for Option 1 tillage and Sowing Scheme 1. The calculation of the cost of the seeding operation used for the developed model is given intechnological map, appendix 1.

Works include:

1.preparation of steam in the first year: clearing the site from existing vegetation, tillage (disking and harrowing),

2. pre-sowing soil treatment in the second year, seed treatment, sowing with seeds.

Due to the small amount of work and the inexpediency of purchasing equipment for such a number of works, in the developed business model it is proposed to use the estimated costs of renting equipment and hiring seasonal handymen, nevertheless, the technological map (Appendix 1) also provides information on the norms of labor costs, fuel consumption and production main machines and busy person.

Table 11. Steam preparation and landing costs for the second year

NO. P \ P	JOB TITLE	EQUIPMENT RENTAL COST, THOUSAND TENGE	COST OF PAYMENT TO WORKERS, THOUSAND TENGE
SOIL PREPARATION 1ST YEAR (STEAM)		512.45	
1	Rope felling of trees on the site	18.20	
2	Clearing the site from tree trunks and branches	256.94	
3	PARTIAL (50%) soil disking with heavy disc harrows on 2 tracks to a depth of 12-15 cm	85.65	
4	PARTIAL (50%) moldboard plowing to a depth of 22-25 cm	151.67	
SEEDING 2ND YEAR		565.20	
8	PARTIAL (50%) soil disking in the second year with heavy disc harrows for 2 tracks to a depth of 12-15 cm	85.65	
9	PARTIAL (50%) moldboard-free plowing in the second year to a depth of 20 cm	156.00	
10	Sowing with seeds	161.78	

11	Seed embedding	161.78
	TOTAL	1,077.66

Expenses for preliminary processing of the site for fallow and planting in the second year may amount to 1,077.66 thousand tenge.

3. Caring for the plantation, ways to increase productivity produced according to the recommendations given in Appendix 4. The main data required for the economic model of the plantation at the stage of plantation maintenance are estimates of the increase in plantation productivity in units of dry mass of wood produced per unit of plantation area as a result of the care measures taken. The necessary maintenance operations are given in the technological map, Appendix 1.

Plantation maintenance consists of:

- processing (cultivation) of strips for the destruction of weeds and four years after planting according to the 3-2-2-1 scheme (i.e. 3 cultivations in the first year after planting, 2 cultivations each in the second and third years, 1 cultivation in the 4th year);
- plowing of inter-strip strips to improve the growing conditions of saxaul;
- spraying from pests if necessary;
- thinning of shoots for the 7th year.

Table 12. Plantation maintenance costs

NO. P \ P	JOB TITLE	EQUIPMENT RENTAL COST, THOUSAND TENGE	COST OF PAYMENT TO WORKERS, THOUSAND TENGE
CARE 3RD YEAR		472.40	
1	PARTIAL (50%) Cultivation of weed strips	56.88	
2	Chemical treatment	64.46	
3	PARTIAL (50%) Cultivation of weed strips	56.88	
4	PARTIAL (50%) Cultivation of weed strips	56.88	
5	Plowing of inter-strip belts, PARTIAL (50%) disking of the soil with heavy disc harrows for 2 tracks to a depth of 12-15 cm	85.65	
6	Plowing of inter-strip belts PARTIAL (50%) moldboard plowing to a depth of 22-25 cm	151.67	
CARE 4TH YEAR		113.75	
7	PARTIAL (50%) Cultivation of weed strips	56.88	
8	PARTIAL (50%) Cultivation of weed strips	56.88	
CARE 5TH YEAR		113.75	
9	PARTIAL (50%) Cultivation of weed strips	56.88	
10	PARTIAL (50%) Cultivation of weed strips	56.88	
CARE 6TH YEAR		56.88	
11	PARTIAL (50%) Cultivation of weed strips	56.88	

CARE 7TH YEAR		26.21	200,00
12	Thinning of plants	-	200,00
13	Removal of scraps from the territory	26.21	
	Total	782.98	200,00

The costs of operations for the necessary care of the saxaul plantation per 100 hectares may amount to 982.98 thousand tenge.

4. Main wheelhouse. Recommendations for the main felling in the mature stands of the saxaul plantation are given in Appendix 5. The main characteristic for the economic model is the production of dry mass of wood per unit area of the plantation. The required data are given in the technological map, Appendix 1.

According to the recommendations provided, felling is carried out in the 25th year after the plantation was laid, then after another 15 years, then after another 20 years. At the same time, it is expected that the dry mass of wood from the first felling is 25 tons / ha, the second felling - 15 tons / ha, and the third felling - 10 tons / ha. There are nursing measures for thinning shoots in the second year after the first and second felling.

Here there is work on felling trees and mechanized collection of wood with the help of appropriate equipment.

Table 13. Costs of felling and maintenance after felling

NO. P \ P	JOB TITLE	EQUIPMENT RENTAL COST, THOUSAND TENGE	COST OF PAYMENT TO WORKERS, THOUSAND TENGE
1ST ROLL AT AGE 26 (27TH YEAR)		6 911.97	-
1	Rope felling of trees on the site	174.72	
2	Collecting firewood with a bulldozer shovel	546,00	
3	Loading firewood with a Loader	731.25	
4	Removal of firewood from the territory, transportation of 100 km	5,460.00	
PRUNING IN THE THIRD YEAR AFTER THE 1ST FELL TO OBTAIN THE BEST SHOOTS (MANUALLY) 30TH YEAR		-	200,00
5	Shoot pruning	-	200,00
2ND ROLL AT THE AGE OF 26 + 15 YEARS (42ND YEAR)		4 435.47	-
6	Rope felling of trees on the site	174.72	
7	Collecting firewood with a bulldozer shovel	546,00	
8	Loading firewood with a Loader	438.75	
9	Removal of firewood from the territory, transportation of 100 km	3,276.00	
PRUNING IN THE THIRD YEAR AFTER THE 2ND FELL TO OBTAIN THE BEST SHOOTS (MANUALLY) 45TH YEAR		-	200,00
10	Shoot pruning	-	200,00

3RD ROLL AT THE AGE OF 26 + 15 + 20 YEARS (62ND YEAR)		3 197.22	-
1	Rope felling of trees on the site	174.72	
12	Collecting firewood with a bulldozer shovel	546,00	
13	Loading firewood with a Loader	292.50	
14	Removal of firewood from the territory, transportation of 100 km	2,184.00	
	Total	14,544.66	400.00

Costs for three felling of saxaul and post-felling maintenance per 100 hectares in current prices may amount to 14,544.66 thousand tenge.

At the same time, the proceeds from the sale of saxaul in current (estimated) prices at 50 tenge / kg may amount to over 125 million tenge per felling, see the table below.

Table 14. Proceeds from the sale of saxaul

YEAR	REVENUE, THOUSAND TENGE
27	125,000.0
42	75,000.0
62	50,000.0

An additional, non-technological step in the process for the developed business model is the receipt of a carbon offset from the plantation project. This stage includes obtaining the necessary documents: development of a carbon offset project, its validation and annual verification, registration with the Authorized Body and receipt of carbon units from the project, as well as their sale on the carbon market. The sale of carbon offset allows you to get revenue at the stages of plantation growth before cutting.

Indirect, administrative costs

In the developed business model of saxaul plantation per 100 hectares, the following categories of expenses are taken as current costs:

- Expenses for the payment of salaries to administrative and management personnel (AUP);
- Carbon offset verification costs.

To carry out activities to create a saxaul plantation, an AUP consisting of a director and an accountant is sufficient, who are assigned a minimum wage of 50 thousand tenge / month in the model. At the same time, it is considered that the director is the owner of the project, so he can claim all the profits from the project and does not need market wages. The rate of payment to the accountant is set at the market rate, comparable to the cost of hiring an accountant on an outsourced basis or an accounting company for the available volume of accounting work.

The cost of the annual verification of the carbon offset according to the data of Eurasian GHG Management LLP [20] is 20% of the cost of the carbon offset, but not less than 500 thousand tenge and not more than 2.5 million tenge. It is advisable to carry out the indicated expenses only if the income from the sale of offset is greater than the cost of verifying the report. Therefore, the model includes the proceeds from the sale of the carbon offset, when the revenue is greater than the cost of verification, respectively, in this case, the verification costs are calculated.

Income, revenue

The following are taken into account as the main sources of income from the use of saxaul plantations for the developed business model:

1. Production of charcoal or saxaul wood (for fuel use), including those obtained during the main felling.

2. Receipt of proceeds from the sale of carbon offset produced during the cultivation of trees and the absorption of carbon dioxide. Here, estimates are given on the possible revenue, in the event of the actual implementation of the legislative initiative on trading in carbon credits.

APPENDIX 2. Model 2

The technology for growing such plantations and the necessary treatments is based on the following recommendations [2]:

1. Tillage (Option 4):

   - It is used on soils of the third group of forest suitability, represented by takyrs with an upper dense horizon up to 1 m. Soil cultivation is carried out in April-May by cutting double furrows 30-35 cm deep and 35-40 cm wide along the upper edge.

   - Double furrows on takyrs are located parallel to the horizontal lines, with the distance between the furrows inside such pairs equal to 0.5 m and the placement of double furrows on an area every 10 m waterways break through, if the furrows are cut in the usual way, the dumps of the furrows should be located on the lower side of the site, opposite to the moisture drain. Otherwise, atmospheric moisture from a 10-meter inter-furrow space freely flows into the moisture-collecting furrow, first from the side of the drain.

2. Plantation plantation (Scheme 3):

   - Used soils of the 3rd group of forest suitability - takyrs. At the same time, it is important to emphasize that a sufficient amount of moisture is accumulated in the cut double grooves with the soaking of takyrs to a depth of 60 cm or more. This is observed in the middle and best years in terms of precipitation, and therefore the establishment of plantations can occur in 1 year, and in 2-3 years after cutting double furrows.

   - Plantations are created by the spring planting of standard saxaul seedlings in the first 10 days after thawing of the soil in 1 row with the placement of a row along the dump of a moisture-accumulating furrow located on the opposite side of the moisture drain, the planting step is 1 m.

3. Plantation care:

   - For forest crops of black saxaul in desert zones, mechanical maintenance should be carried out between rows once a year for the first four years. In the conditions of the Kyzylorda region, the soil in the plantings is cultivated once a season (in April) for four years. Scheme: 1-1-1-1.

   - The cultivation of the soil is carried out to a depth of 10-12 cm.Carrying out agrotechnical cares is provided only when laying crops according to schemes 3 (planting one row along the periphery of the strip 2.8 m wide) and 4 (planting in two rows on opposite edges of the strip 5.6 m wide) ... In crops laid according to scheme 3, cultivation is carried out from one side of the row in one pass of the unit. In the crops laid according to scheme 4, the cares are carried out only in the aisles and also in one pass of the tillage unit.

4. Cabin:

   - Industrial logging in plantations has been carried out since the age of 26. Harvesting of saxaul is carried out with the help of a tumerwal with a cutting area of 50 m. They are laid with their long side perpendicular to the prevailing winds, in the northern subzone (Almaty, eastern part of the Zhambyl region) from December to March, in the presence of stable soil freezing; in the southern subzone of deserts - from December to February. The abandoned strips are assigned for felling for the third winter, starting from the moment of the first felling areas, when a two-year undergrowth undergrowth will be formed in their place. On each such coppice bush in the month of August, 3-4 of the most developed coppice shoots are left. This technique allows you to increase the stock of marketable wood and significantly reduce the formation period of plantations of the first coppice generation, which equals 15 years. Leaving less than three shoots in the bushes is not allowed due to the threat of their windbreak.

- On the soils of the 3rd group of forest suitability, plantations are cut down twice - the first time in 26-30 years and the second time in the form of the first coppice generation - in 20-25 years; in this case, it is expected to receive, respectively, 6 and 3 m (t) or for two fellings 9 m (t) of marketable timber.

The technological map is given below.

Technological map for crops on soils of the 3rd group of forest suitability

Field No.	
the culture	Saxaul
reproduction	
area, ha	one hundred
predecessor	
seeding rate of seedlings, pcs / ha	1,000
need for seedlings, pcs	100,000
price of a discounted diesel fuel per 1 kg, tenge	235
average market price of distil oil for 1 kg, tenge	600

No. p \ p	Job title	unit of measurement	Workload	Workload	Terms of work		Unit composition		Number of people to fulfill the norm		The number of standard shifts in the scope of work	Labor costs for the entire volume of work, people / days		Tariff rate for the norm, tenge		Tariff salary fund for the entire volume of work, tenge		Percentage of additional payment,%	Additional and increased payment, tenge	Percentage of additional payment for harmfulness,%	Additional payment for harm, tenge	Total salary, thousand tenge	Fuel, diesel fuel, AI			diesel oil			Total fuel and lubricants, thousand tenge	Total costs, thousand tenge	Equipment rental		Hourly floor to workers	
					incl.		incl.																number											
			amount (ha)	in hectares of conventional plowing	date	number of days	tractor	agricultural machines	tractor drivers	trailers and horse-manual workers	Production rate		tractor drivers	trailers and horse-manual workers	tractor drivers	trailers and horse-manual workers	tractor drivers	trailers and horse-manual workers					per unit, liter	total, liter	Price for 1 kg	total cost, thousand tenge (0.85 conversion factor liters to tons)	amount, kg (3% of fuel consumption)	Price for 1 kg	total cost, thousand tenge			The cost of renting equipment per standard day, thousand tenge / shift	Rent cost, thousand tenge	Cost of a worker's standard change, thousand tenge / shift	Cost of payment to workers, thousand tenge
												gro up 3 / gro up 11	gr. 9 * gr. 12	grou p 10 * grou p 12			group 13 * group 15	gr. 14 * gr. 16		(colu mn 17 + colu mn 18) * colu mn 19/1 00		gr. 17 * gr. 21/1 00	(gro up 17 + grou p 18 + grou p 20 + grou p 22) / 100 0	gr. 3 * gr. 24		gr. 25 * gr. 26 * 0.8 5 / 100 0	0.03 * gr. 25		gr. 29 * gr. 30/10 00	roo m 27 + roo m 30	gr. 23 + gr. 31		gr. 13 * gr. 33		gr. 14 * gr. 35
	one	2	3	4	5	6	7	eight	9	10	elev en	12	thirte en	14	15	sixte en	17	eighte en	ninet een	twent y	2 1	22	23	24	25	26	27	28	29	thirty	31	32	33	34	35	36
SOIL PREPARATION 1st year (steam)																																	78,00		74.77

one	Cutting double furrows with a double digger, every 0.5 m and an inter-furrow space 10 meters wide. (1 pass of 1 km per 1 ha)	ha	one hundred		April	2	K-700A	Ditch digger (Arychnik), two-hull, 45 cm each	one		56	1.8	1.8	0.0	22400		40,000.0	0	50	20,000		0	60	1.03	102.8571	210	18.3	3		-	18.3	78.3	43.68	78,00		
2	Setting the drainage in ditches, manually	ha	one hundred		April	2		manually		one	10.7	9.3	0.0	9.34579		8000	-	74,766		0		0	75		0	210	0.0	0	536	-	-	74.8	-	-	8.00	74.77
LANDING 2nd year																																		251.61		34.56
4	Planting seedlings	ha	one hundred		March	eight	DT 75	Forest planting machine MLU-1A	one		17.36	5.8	5.8	5.8	22400	6000	129,032.26	34,562.21	50	81797		0	245	3.32	332	210	59.2	10	536	5.3	64.5	309.9	43.68	251.61	6.00	34.56
CARE 3rd year																																		45.50		
5	Cultivation of strips in one pass for scheme 3	ha	one hundred		April	5	MTZ 82	Cultivator KPS4	one		96	1.0	1.0	0	22400		23 333.3	0	50	11667		0	35	0.57	57	210	10.2	2	536	0.9	11.1	46.1	43.68	45.50		
CARE 4th year																																		45.50		
6	Cultivation of strips in one pass for scheme 3	ha	one hundred		April	5	MTZ 82	Cultivator KPS4	one		96	1.0	1.0	0	22400		23 333.3	0	50	11667		0	35	0.57	57	210	10.2	2	536	0.9	11.1	46.1	43.68	45.50		
CARE 5th year																																		45.50		
7	Cultivation of strips in one pass for scheme 3	ha	one hundred		April	5	MTZ 82	Cultivator KPS4	one		96	1.0	1.0	0	22400		23 333.3	0	50	11667		0	35	0.57	57	210	10.2	2	536	0.9	11.1	46.1	43.68	45.50		
CARE 6th year																																		45.50		
eight	Cultivation of strips in one pass for scheme 3	ha	one hundred		April	5	MTZ 82	Cultivator KPS4	one		96	1.0	1.0	0	22400		23 333.3	0	50	11667		0	35	0.57	57	210	10.2	2	536	0.9	11.1	46.1	43.68	45.50		

1st roll at age 26 (27th year)																																2 148.12		-
9	Rope felling of trees on the site	ha	one hundred		October	2	GAZ-53 (2 pcs)	tumerval	2		50	2.0	4.0		22400		89 600.0	0	50	44800		0	134	1.80	180	210	32.1	5		-	32.1	166.5	43.68	174.72		
10	Collecting firewood with a bulldozer shovel	ha	one hundred		October	15	MTZ 82	mounted bulldozer shovel	one		eight	12.5	12.5		22400		280,000.0	0	50	140,000		0	420	5.20	520	210	92.7	sixteen	536	8.4	101.1	521.1	43.68	546,00		
eleven	Loading firewood with a Loader	tons	600		October	15	Front loader LIUGONG 855H	3 cubes	one		160	3.8	3.8		24000		90,000.0	0	0	0		0	90	0.40	240	210	42.8	7	536	3.9	46.7	136.7	31.20	117.00		
12	Removal of firewood from the territory, transportation of 100 km	tons	600		October	15	KAMAZ		one		twenty	30.0	30.0	0	22400		672,000.0	0	50	336000		0	1008	4,00	2400	210	428.0				428.0	1,436.0	43.68	1 310.40		
Pruning in the third year after the 1st fell to obtain the best shoots (manually) 30th year																																-		200,00
thirteen	Shoot pruning	ha	one hundred		March	15		manually		one	4	25.0	0.0	25		8000	-	200,000		0		0	200		0	210	0.0	0	536	-	-	200.0	-	-	8.00	200,00
2nd roll at the age of 26 + 20 years (47th year)																																1,434.42		-
14	Rope felling of trees on the site	ha	one hundred		October	2	GAZ-53 (2 pcs)	tumerval	2		50	2.0	4.0		22400		89 600.0	0	50	44800		0	134	1.80	180	210	32.1	5		-	32.1	166.5	43.68	174.72		
15	Collecting firewood with a bulldozer shovel	ha	one hundred		October	15	MTZ 82	mounted bulldozer shovel	one		eight	12.5	12.5		22400		280,000.0	0	50	140,000		0	420	5.20	520	210	92.7	sixteen	536	8.4	101.1	521.1	43.68	546,00		

sixteen	Loading firewood with a Loader	tons	300		October	15	Front loader LIUGONG 855H	3 cubes	one		160	1.9	1.9		24000		45,000.0	0	0	0		0	45	0.40	120	210	21.4	4	536	1.9	23.3	68.3	31.20	58.50		
17	Removal of firewood from the territory, transportation of 100 km	tons	300		October	15	KAMAZ		one		twenty	15.0	15.0	0	22400		336,000.0	0	50	168000		0	504	4,00	1200	210	214.0				214.0	718.0	43.68	655.20		

Such plantations are characterized by the following productivity indicators [6], which is used in the developed model:

- Ground phytomass (cubic meters / ha) in highly closed plantations: 10 years - 6.4 cubic meters / ha; 20 years - 14 cubic meters / ha; 30 years - 18 cubic meters / ha; 40 years - 19 cubic meters / ha;
- The maximum annual current growth of wood in 10-20-year plantations is 0.9 cubic meters / ha per year.

To calculate the amount of absorbed carbon dioxide (produced by carbon offset), models of the course of growth of saxaul plantations were built on the basis of the above data [6]. So, on the basis of the data, the growth curve of the aboveground phytomass of saxaul in the plantations of the 2nd quality class is plotted in the figure below. Equation of curve approximation is compiled, with approximation confidence factor R = 1.

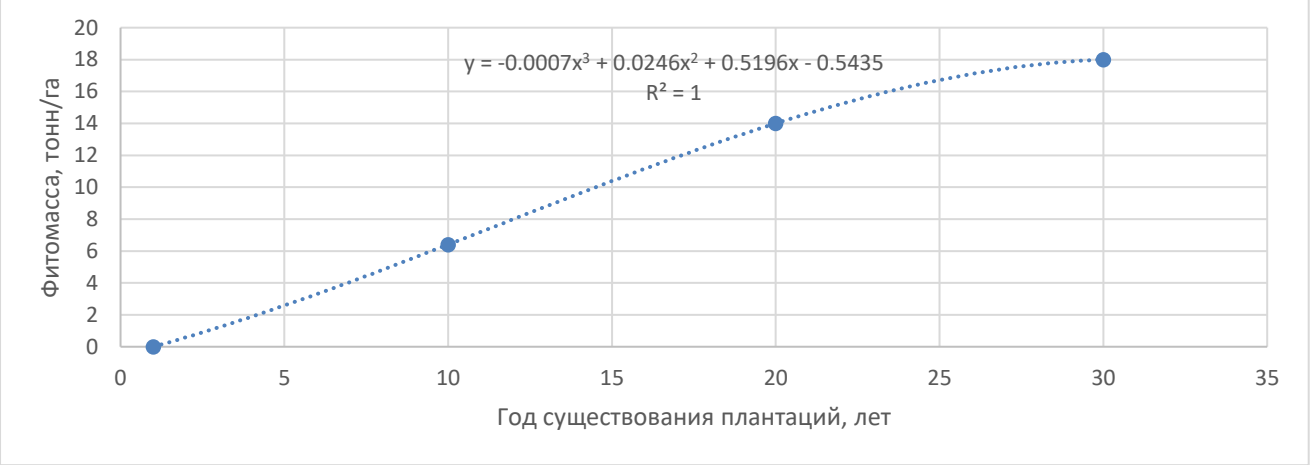

Figure 5. Growth curve of the aboveground saxaul phytomass in plantations of the 2nd quality class

To convert the known data on the volume of plantation phytomass into dry wood mass, the following coefficient was used:

$$К_{масс2} = {M_{сух2}}/{M_{фито2}} \quad (3)$$

where:

$К_{масс2}$ - the ratio of dry mass to phytomass in saxaul plantations on soils of the first forest suitability group;

$M_{сух2}$ - dry weight of saxaul plantations on soils of the first group of forest suitability at the age of the first felling of 25 years = 6 tons / ha according to [2];

$M_{фито2}$ - phytomass of saxaul plantations of the 2nd bonitet class at the age of the first felling of 25 years = 17.64 tons / ha according to the data approximation [6].

In this way,

$$К_{масс1} = \frac{6,0}{17,64} = 0,34$$

To calculate the amount of biomass of the underground part of saxaul plantations, a coefficient was used, the calculation of which is given above.$К_{подзем} = 0,95$

Due to the use of the technology of growing plantings after the first felling on the remaining undergrowth bushes, the increase in the biomass of the underground part of saxaul stands at the stages after the first felling is not calculated.

As a result, data on the growth and accumulation of dry weight of saxaul wood in plantations on lands of the first forest suitability group are shown in Figure 6.

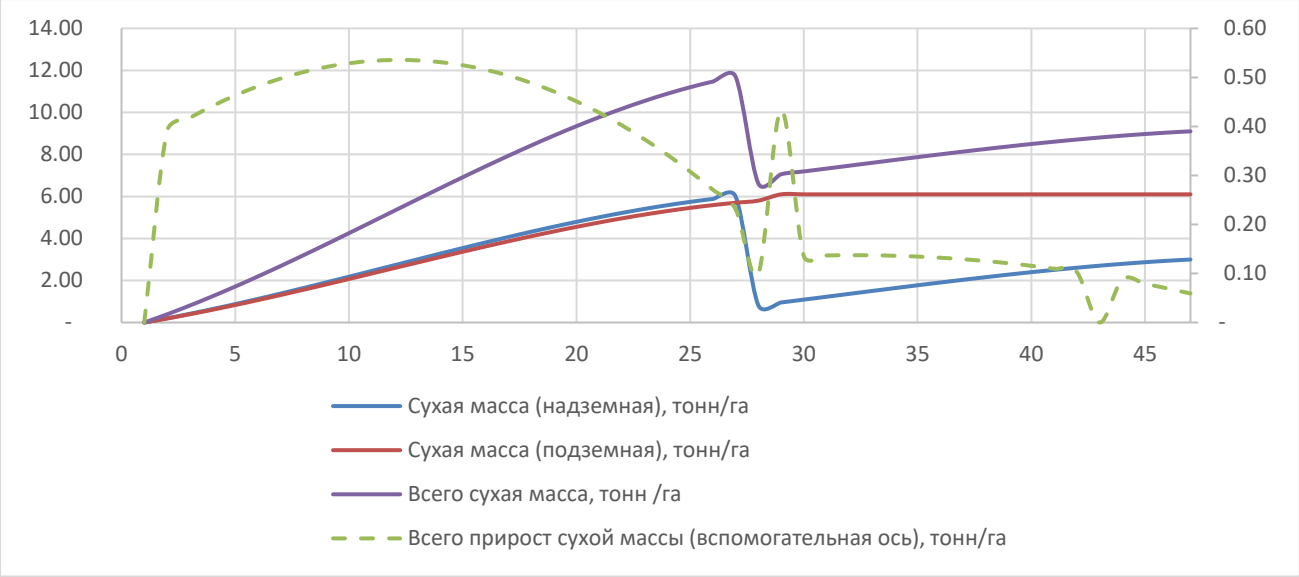

Figure 6. Increase and accumulation of dry mass of saxaul wood in plantations on lands of the third group of forest suitability

Based on the indicated physical parameters of the saxaul plantation, an economic model is calculated, taking into account the possible receipt of proceeds from the sale of saxaul wood after felling and the sale of the produced carbon offset in cases where its proceeds from its production cover the costs of verification.

Assessment of investments in the project of saxaul plantations for 100 hectares according to "Model 2"

Investments for the establishment of a saxaul plantation and the developed business model for "Model 2" will be the same as for the case with "Model 1".

For our project, possible investments for the purchase of agricultural equipment were not taken into account, due to the incomparably low load on the set of equipment compared to its cost. The necessary machine operations for tillage and maintenance are calculated as the current costs of renting the necessary agricultural equipment for the production of specific technological operations.

Direct manufacturing costs. Production processes of saxaul plantations according to "Model 2"

The model assumes that all production personnel are temporarily hired - seasonal workers, who are calculated piece-rate wages at current market prices.

All technological operations involving agricultural machinery are carried out on rented machinery; the model takes into account the costs in the form of rental costs.

The production processes of saxaul plantations for "Model2" are reflected in the following costs:

1. Purchase of seedlings of the 1st year

The purchase is set at the price level of 2021 according to the data of the branch of the South-West region of the Republican State Enterprise "Republican Forest Seed-Breeding Center" [21]. For the developed business model of a saxaul plantation per 100 hectares, it will be necessary to plant 1 thousand seedlings per 1 hectare of the plantation area, a total of 100 thousand seedlings and 4.4 million tenge.

Details in the technological map appendix 1.

2. Establishment of a plantation, sowing seedlings (for the business model selected for the description)is produced according to the recommendations given in Appendix 3 for Option 4 of tillage and Scheme 3 of sowing. The calculation of the cost of the seeding operation used for the developed model is given intechnological map, appendix 1.

Works include:

1. Cutting double furrows with a double digger, every 0.5 m. For the formation of an inter-furrow space 10

meters wide. (1 pass of 1 km per 1 ha), Adjustment of drainage in ditches, manually

2. Mechanized planting of seedlings, using a forest planting machine MLU-1A.

Due to the small amount of work and the inexpediency of purchasing equipment for such a number of works, in the developed business model it is proposed to use the estimated costs of renting equipment and hiring seasonal handymen, nevertheless, the technological map (Appendix 1) also provides information on the norms of labor costs, fuel consumption and production main machines and busy person.

Table 15. Steam preparation and landing costs for the second year

NO. P \ P	JOB TITLE	EQUIPMENT RENTAL COST, THOUSAND TENGE	COST OF PAYMENT TO WORKERS, THOUSAND TENGE
SOIL PREPARATION 1ST YEAR (STEAM)		78,00	74.77
1	Cutting double furrows with a double digger, every 0.5 m and an inter-furrow space 10 meters wide. (1 pass of 1 km per 1 ha)	78,00	
2	Setting the drainage in ditches, manually	-	74.77
LANDING 2ND YEAR		251.61	34.56
3	Planting seedlings	251.61	34.56
	TOTAL	329.61	109.33

Expenses for preliminary processing of the site for fallow and planting for the second year may amount to 438.94 thousand tenge.

3. Caring for the plantation, ways to increase productivity produced according to the recommendations given in Appendix 4.... The necessary maintenance operations are given in the technological map, Appendix 1.

Plantation maintenance consists in cultivating strips to a depth of 10-12 cm in one pass in April, four years after planting the seedlings - once every year.

Table 16. Plantation maintenance costs

NO. P \ P	JOB TITLE	EQUIPMENT RENTAL COST, THOUSAND TENGE	COST OF PAYMENT TO WORKERS, THOUSAND TENGE
CARE 3RD YEAR		45.50	
1	Cultivation of strips in one pass for scheme 3	45.50	
CARE 4TH YEAR		45.50	
2	Cultivation of strips in one pass for scheme 3	45.50	
CARE 5TH YEAR		45.50	
3	Cultivation of strips in one pass for scheme 3	45.50	
CARE 6TH YEAR		45.50	
4	Cultivation of strips in one pass for scheme 3	45.50	
	Total	182.00	

The costs of operations for the necessary care of the saxaul plantation per 100 hectares may amount to 182.0 thousand tenge.

4. Main wheelhouse. Recommendations for the main felling in the mature stands of the saxaul plantation are given in Appendix 5. The main characteristic for the economic model is the production of dry mass of wood per unit area of the plantation. The required data are given in the technological map, Appendix 1.

According to the recommendations provided, felling is carried out in the 25th year after the plantation was laid, then after another 20 years. At the same time, it is expected to obtain dry mass of wood from the first felling of 6 tons / ha, the second felling - 3 tons / ha [2]. There are nursing measures for thinning shoots in the second year after the first felling.

Here there is work on felling trees and mechanized collection of wood with the help of appropriate equipment.

Table 17. Costs of felling and maintenance after felling

NO. P \ P	JOB TITLE	EQUIPMENT RENTAL COST, THOUSAND TENGE	COST OF PAYMENT TO WORKERS, THOUSAND TENGE
1ST ROLL AT AGE 26 (27TH YEAR)		2 148.12	-
1	Rope felling of trees on the site	174.72	
2	Collecting firewood with a bulldozer shovel	546,00	
3	Loading firewood with a Loader	117.00	
4	Removal of firewood from the territory, transportation of 100 km	1 310.40	
PRUNING IN THE THIRD YEAR AFTER THE 1ST FELL TO OBTAIN THE BEST SHOOTS (MANUALLY) 30TH YEAR		-	200,00
5	Shoot pruning	-	200,00
2ND ROLL AT THE AGE OF 26 + 20 YEARS (47TH YEAR)		1,434.42	-
6	Rope felling of trees on the site	174.72	
7	Collecting firewood with a bulldozer shovel	546,00	
8	Loading firewood with a Loader	58.50	
9	Removal of firewood from the territory, transportation of 100 km	655.20	
	Total	3,582.54	200,00

Expenses for three felling of saxaul and post-felling maintenance per 100 hectares in current prices may amount to 3,782.54 thousand tenge.

At the same time, the proceeds from the sale of saxaul in current (estimated) prices at 50 tenge / kg may amount to over 125 million tenge per felling, see the table below.

Table 18. Proceeds from the sale of saxaul

YEAR	REVENUE, THOUSAND TENGE
27	30,000.0
47	15,000.0

An additional, non-technological step in the process for the developed business model is the receipt of a carbon offset from the plantation project. This stage includes obtaining the necessary documents: development of a carbon offset project, its validation and annual verification, registration with the Authorized Body and receipt of carbon units from the project, as well as their sale on the carbon market. In the case of a specific project, the cost of the produced carbon offset at a price of 15 Euro / tCO2 does not cover the cost of project verification, therefore it is inappropriate to engage in carbon offset at such productivity indicators.

Indirect, administrative costs

In the developed business model of saxaul plantation per 100 hectares, the following categories of expenses are taken as current costs:

- Expenses for the payment of salaries to administrative and management personnel;
- Carbon offset verification costs.

To carry out activities to create a saxaul plantation, an AUP consisting of a director and an accountant is sufficient, who are assigned a minimum wage of 50 thousand tenge / month in the model. At the same time, it is considered that the director is the owner of the project, so he can claim all the profits from the project and does not need market wages. The rate of payment to the accountant is set at the market rate, comparable to the cost of hiring an accountant on an outsourced basis or an accounting company for the available volume of accounting work.

The cost of the annual verification of the carbon offset according to the data of Eurasian GHG Management LLP [20] is 20% of the cost of the carbon offset, but not less than 500 thousand tenge and not more than 2.5 million tenge. It is advisable to carry out the indicated expenses only if the income from the sale of offset is greater than the cost of verifying the report. Therefore, the model includes the proceeds from the sale of the carbon offset, when the revenue is greater than the cost of verification, respectively, in this case, the verification costs are calculated.

Income, revenue

The following are taken into account as the main sources of income from the use of saxaul plantations for the developed business model:

1. Production of charcoal or saxaul wood (for fuel use), including those obtained during the main felling.

2. Receipt of proceeds from the sale of carbon offsetproduced during the cultivation of trees and the absorption of carbon dioxide. Here, estimates are given on the possible revenue, in the event of the actual implementation of the legislative initiative on trading in carbon credits.

APPENDIX 3. Calculation of the demand for saxaul of public catering enterprises in terms of per capita urban population

INDICATOR	UNIT	NUR-SULTAN		ALMATY	
		Barbecue establishments	Kebabs	Barbecue establishments	Kebabs
NUMBER OF ESTABLISHMENTS	units	425	89	495	206
AVERAGE NUMBER OF SEATS	people	twenty	twenty	twenty	twenty
OCCUPANCY	%	thirty%	thirty%	thirty%	thirty%
SHARE OF THOSE ORDERING BARBECUE	%	2%	50%	2%	50%
AVERAGE SERVING SIZE	kg	0.2	0.2	0.2	0.2
AVERAGE DAILY ORDER FOR THE SEASON	kg / person	10.2	53.4	11.9	123.6
NUMBER OF DAYS OF THE SEASON	days	160	160	161	162
TOTAL TONS OF BARBECUE PER YEAR	tons	326.4	1708.8	382,536	4004.64
KEBAB CONSUMPTION PER YEAR	tons	2035		4,387	
URBAN POPULATION	people	1 184 411		1,977,258	
SHISH KEBAB CONSUMPTION PER URBAN POPULATION	kg / person	1.72		2.22	
THE AMOUNT OF COAL FOR THE PRODUCTION OF 1 KG OF KEBABS	kg	0.50		0.50	
TOTAL DEMAND FOR CHARCOAL FROM SAXAUL	tons	1,017.60		2,193.59	
COEFFICIENT OF CONVERSION OF SAXAUL TO COAL	odds	2.10		2.10	
THE NEED FOR SAXAUL IN URBAN AREAS	tons	2 136.96		4,606.53	
DEMAND FOR SAXAUL PER CAPITA OF URBAN POPULATION	kg / person	1.80		2.33	
AVERAGE DEMAND FOR SAXAUL PER CAPITA OF URBAN POPULATION IN KAZAKHSTAN	kg / person	2.07			

Source: data of BNS ASPiR RK, 2GIS, own calculations