

**Water Resources Sustainability Project
(WRS)**

**COST BENEFIT ANALYSIS OF THE CHROMIUM
RECUPERATION UNIT FOR THE TANNERIES
IN DOKKARAT INDUSTRIAL PARK
CITY OF FES, MOROCCO**

**Deliverable for
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CHAPTER 1. FINANCIAL ANALYSIS

1.1 GOAL OF FINANCIAL ANALYSIS

The objective of this financial analysis is to determine whether the chromium recuperation unit project at Doukkarat is financially viable. This chapter covers a discussion of costs and the options to recover these costs. Several scenarios are analyzed based on the project (base case scenario). For purposes of the analysis, all costs and revenues are stated in constant 1997 prices.

1.2 SCENARIOS AND ASSUMPTIONS FOR THE BASE CASE

Main assumption: The base case scenario is based on the assumption that Doukkarat tanneries' production is 14.25 tons a day¹. This is important since the chromium effluent from the tanneries, and in consequence the amount of chromium recuperated and available for sale is proportional to the daily production of the tanneries.

Two options have been chosen to build the chromium recuperation unit at Doukkarat:

- Pipelines from the tanneries to the recuperation unit, or
- Trucking the chromium effluent from the tanneries to the recuperation unit.

The financial analysis is done considering two sub-scenarios:

- The Capital cost, the Operation and Maintenance costs, and the resale of the recuperated chromium, and
- The O&M costs and the sale of the recuperated chromium, ignoring the initial foreign capital cost since it is a grant.

Now the price level at which the chromium would be sold will be:

- Let free to establish itself,
- Set at 100 % of the market price, or
- Set at 50 % of the market price.

¹ Another scenario could be easily generated based on a production growth rate of 3 percent per year

The goals for the financial analysis is to get a:

- Net Present Value (NPV) positive with a 12 % discount rate, and
- a Benefit Cost Ratio (B/C) above 1.

Each table presenting the scenario lists the additional assumptions for that scenario.

The following table lists the scenarios:

	Chromium Price		
	Free Adjustment	Maerket Price With Effluent Fee	50% of Market Price with Effluent Fee
With Pipelines	X	X	X
With Trucks	X	X	X

In summary there will be 6 scenarios for the Capital Cost and O&M fmancial analysis, and only four scenarios for the O&M fmancial analysis without the initial foreign capital cost since the chromium price established freely is lower than the market price for the flrst scenario in that case.

1.3 REVENUES

The revenues form the chromium recuperation unit are coming from the sale of the recuperated chromium. The price at which this chromium will be sold is an important variable.

Two possibilities are considered here: market price and 50 % of the market price². The scenarios will demonstrate that with either one possibility, an effluent fee and/or a subvention is mandatory.

With a production of 14.25 T/day of hide, the chromium recuperation will be Ton per year³.

² The market price is assumed to be constant during the analysis period, and is set at US \$ 7.0 per kilo.

³ As mentioned in the technical part of this report, there is a one to one relation between the amount of hide processed, the amount of chromium effluent, and the amount of chromium recuperated. The present production of the tanneries is at 50 % of their capacity. The recuperation unit has been dimensioned at more than 1.5 time the actual total capacity.

1.4 FINANCIAL COSTS

The Capital Cost and the O&M costs of the recuperation unit have been estimated by the design engineers of the project. They will be presented at the beginning of each scenario.

1.5 SCENARIOS

1.5.1 Pipelines Scenario

Capital and the O&M Costs Scenarios

Table 1.1 presents the estimated Capital and the O&M costs.

Table 1.2 presents the scenario where the chromium price is left to adjust freely. The price of the chromium reached a little over twice the market price: US \$ 14.09.

Table 1.3 presents the scenario where the chromium price is the market price. To get an NPV positive and a B/C above 1, it is necessary to balance with either an effluent fee or a subvention or both. Based on 200 days of work per year, the effluent fee or subvention amounts to US \$ 602.5 per day, or US \$ 42.28 per Ton of hide. This represents for the tanneries about 1.1 % on the estimated revenue from a ton of hide, or 15.2 % of the profit generated by a ton of hide⁴.

Table 1.4 presents the scenario where the chromium price is 50 % of the market price. To get an NPV positive and a B/C above 1, it is necessary to balance with either an effluent fee or a subvention or both. Based on 200 days of work per year, the effluent fee or subvention amounts to US \$ 900 per day, or US \$ 63.1 per Ton of hide. This represents for the tanneries about 1.0 % on the estimated revenue from a ton of hide, or 22.7 % of the profit generated by a ton of hide.

O&M Costs Scenarios

Taking into consideration that the initial foreign capital cost is a grant, these scenarios do not take into account in the computation of the NPV, B/C, and effluent fee or subvention, the part of that capital cost.

Table 1.5 presents the Capital and O&M costs taking into consideration in the following analysis.

⁴ Due to sketchy information on the tanneries' financial data, caution should be addressed in reading these numbers, especially the percentage on the estimated profit. More credibility should be given to the percentage on the revenue.

Table 1.6 presents the scenario where the chromium price is left to adjust freely. The price of the chromium reached US \$ 6.0 or 85.7 % of the market price.

Table 1.7 presents the scenario where the chromium price is set at 50 % of the market price. To get an NPV positive and a B/C above 1, it is necessary to balance with either an effluent fee or a subvention or both. Based on 200 days of work per year, the effluent fee or subvention amounts to US \$ 215.0 per day, or US \$ 15.09 per Ton of hide. This represents for the tanneries about 0.4 % on the estimated revenue from a ton of hide, or 5.4 % of the profit generated by a ton of hide.

1.5.2 Trucks Scenario

Capital and the O&M Costs Scenarios

Table 1.8 presents the Capital and the O&M costs taking into account in the following analysis. The only noticeable element on the O&M side is the planned mechanical overall of the tanker trucks on the 10th year after the start of the station operation, in an effort to prolong their life up to 15 years of service. This will postpone the buying of new trucks until the 16th years after the start of the project.

Table 1.9 presents the scenario where the chromium price is left to adjust freely. The price of the chromium reached almost twice the market price: US \$12.7.

Table 1.10 presents the scenario where the chromium price is the market price. To get an NPV positive and a B/C above 1, it is necessary to balance with either an effluent fee or a subvention or both. Based on 200 days of work per year, the effluent fee or subvention amounts to US \$ 487.5 per day, or US \$ 34.2 per Ton of hide. This represents for the tanneries about 0.9 % on the estimated revenue from a ton of hide, or 12.3 % of the profit generated by a ton of hide.

Table 1.11 presents the scenario where the chromium price is 50 % of the market price. To get an NPV positive and a B/C above 1, it is necessary to balance with either an effluent fee or a subvention or both. Based on 200 days of work per year, the effluent fee or subvention amounts to US \$ 785 per day, or US \$ 55 per Ton of hide. This represents for the tanneries about 1.4 % on the estimated revenue from a ton of hide, or 29.8 % of the profit generated by a ton of hide.

O&M Costs Scenarios

Taking into consideration that the initial foreign capital cost is a grant, the following scenarios do not take into account this capital cost in the computation of the NPV, B/C, the effluent fee and/or the subvention.

Table 1.12 presents these data.

Table 1.13 presents the scenario where the chromium price is left to adjust freely. The price of the chromium reached US \$ 6.7 or 96 % of the market price.

Table 1.14 presents the scenario where the chromium price is set at 50 % of the market price. To get an NPV positive and a B/C above 1, it is necessary to balance with either an effluent fee or a subvention or both. Based on 200 days of work per year, the effluent fee or subvention amounts to US \$ 267.5 per day, or US \$ 18.8 per Ton of hide. This represents for the tanneries about 0.5 % on the estimated revenue from a ton of hide, or 6.8 % of the profit generated on a ton of hide.

1.6 SUMMARY

Both scenarios, Pipelines and Trucks, necessitate an effluent fee or a subvention or both to be financially viable. Even when the initial capital is ignored in the computation, there is a need of effluent fee and/or subvention.

The following table summarizes the total subvention needed for each scenario:

Table 1.15
Total Annual Subvention Needed Per Year
Without Consideration of Chromium Sale
1997 US Dollars

Scenarios	With Initial Capital Considered	Without Consideration of Initial Capital
Pipelines	239 500	102 500
Trucks	216 500	113 000

Table 1.16 presents a summary of the scenarios and their impact on the revenue of one Ton of hide.

Table 1.16
Summary of the Impacts on the Revenue of one Ton of Hide in Percent
Considering that the Chromium Will Be Sold at 50 Percent of the Market Price

Scenarios	With Initial Capital Considered	Without Consideration of Initial Capital
Pipelines	1.6	0.4
Trucks	1.4	0.5

CHAPTER 2. COST BENEFIT ANALYSIS

2.1 COST BENEFIT ANALYSIS' GOAL

The economic benefits considered in this analysis are the direct, indirect, and induced benefits.

2.2 BENEFITS AND COSTS

The direct benefits are the one generated by the income of the workers during construction, during operation of the station, and all the expenditures made locally, minus all taxes applicable to wages and goods. All goods and service purchased outside Morocco are not counted in this analysis since they do not have an impact on the local economy. These have been estimated and presented in **Table 2.1** for the Pipelines Scenario, and **Table 2.2** for the Trucks Scenario.

The induced benefits are the results of the multiplier effect of the direct benefits in the economy.

The indirect benefits are the one generated by the existence of the station, and loosely speaking are called environmental benefits. They comprise:

- Incremental health improvement due to a decrease in the chromium discharge in the oued Sebou from the 12 tanneries in operation in
- Doukkarat;
- Incremental decrease in the cost of treating drinkable water; Incremental decrease in the pollution of underground water; Incremental positive impact on agriculture; and
- Incremental increase in the yield of fluvial fishery.

All of these benefits are difficult to evaluate for the portion of chromium pollution due to the 12 tanneries at Doukkarat, and would no doubt be small, since chromium pollution is but a small part of the overall pollution in Fes.

The stated goal of this chromium recuperation unit is to decrease first the amount of chromium untreated, and second lower the concentration to 1 ppm of chromium before the effluent reach the future Water Treatment Plant of the Greater Fes. According to various experts in water treatment plants, it is mandatory that all chromium effluent be at 1 ppm concentration before it reach the planned water treatment of the Greater Fes. If this is not realized, the water treatment of the Greater Fes would not be able to function. Furthermore, according to these experts, there does not exist any water treatment plant that could take the chromium load untreated.

Taking into account that another chromium recuperation unit is planned at Ain Nokbi where tanneries from the Medina would be relocated, the portion of the Doukkarat chromium recuperation unit is 5.7 % of all the chromium recuperated in Fes⁵.

Considering that the planned water treatment plant of the Greater Fes would treat the water and realize all the benefits previously listed at a larger scale, the environmental benefits of Doukkarat chromium recuperation unit is estimated at the portion of the capital investment of the water treatment plant of the Greater Fes equal to its percentage of chromium recuperation of the Greater Fes, i.e., 5.7% times US \$ 101 million is equal to US \$ 5.8 million.

According to the Scandiaconsult report of Fevrier 1996, 66.6 % of the expenses would occur during the first 6 years, and 33.4 % would be disbursed over the next 10 years. Doukkarat benefits will be distributed accordingly. Assuming that the first year of disbursement is planned in 2000, the benefits will start in 2000 and finish in 2015. However the Doukkarat analysis is done only up to 2012, therefore only 7 years of the second trench of benefits will be counted up to 2012. The total discounted benefits is US \$ 3.1 million.

2.3 RESULTS

Table 2.3 (Pipelines Scenario) and **Table 2.4** (Trucks Scenario) present the results of this analysis for the 50% Chromium Price Scenario. The Benefit Cost Ratio is above 3 for the Pipelines Scenario and above 4 for the Trucks Scenario. The Doukkarat chromium recuperation unit is therefore feasible on the economic side if the environmental benefits are included.

⁵ Taking the quantity of chromium recuperated estimated by the PREM Project and by the AinNokbi Study, this number stands at 5.7%.

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ANNEXES

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- Xanthoulis D., Projet MOR 86/018, PNUD-FAO-OM.