

These savings could be used to finance an environmental management system, which may possibly produce even greater savings, as this is a yearly and not a once-off saving.

With this information, it is hypothesized that the quality of the wine will increase, primarily due to better documentation of the process of winemaking, which will lead to a deeper understanding of it.

Scenario 2 - combined environmental saving for various sized cellars

The model shown in figure 3.1 can be used for economic calculations for any sized cellar. It could be used to predict inputs and outputs. In figure 3.2, a graph has been plotted to show how a ten per cent reduction of the aforementioned variables will reduce the operating costs for different sized cellars.

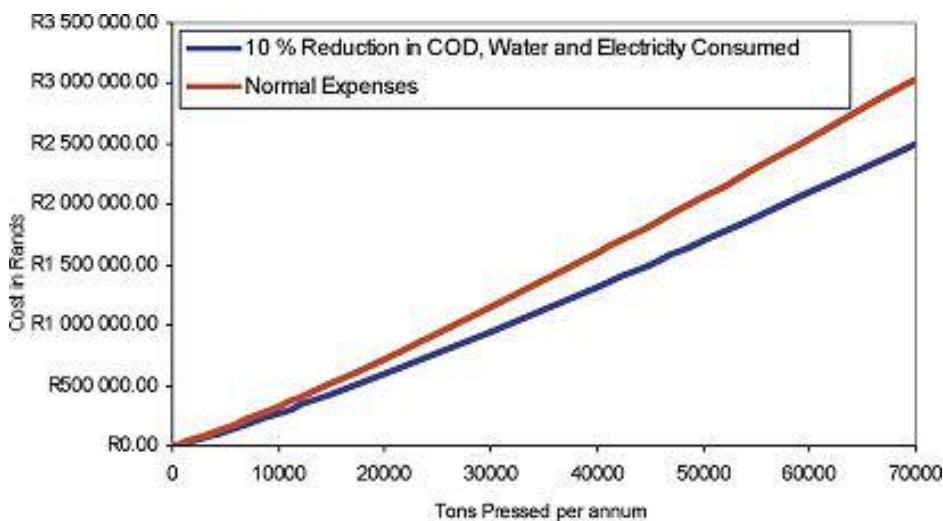


Figure 3.2: 10% Reduction of Variables for Different Size Cellars.

This data shows that the savings increase with cellar size, due to the non-linearity inherent in the model. For a cellar that presses 100 tons of grapes per annum, the predicted savings are approximately 14%, whereas for a cellar that presses 70 000 tons of grapes per annum, the decrease in costs is nearly 18%.

This implies that although environmental savings may significantly reduce operating costs for smaller cellars, large cellars (which generally have the worst levels of pollution) stand to gain the most from implementing cleaner production systems.

Discussion

Correlations have been established, which may allow a rough prediction of winery inputs and outputs. Based on the preliminary model developed, certain inputs and outputs of a normal cellar can be assigned if data for a cellar is unknown, although there are low coefficients of regression for some of the correlations. This is indicative of the variation of cellars within the industry. It is clear that more data is required to transform this model into an accurate prediction tool.

With regard to the effluent, it was shown that the COD, TDS and SAR of the effluent can be positively correlated to the tons pressed. It was also shown that the SAR does not appear to be a critical effluent parameter at this stage. The COD has been identified as the parameter that is most important when designing or discussing winery effluent. Other variables should

not be neglected though. Chemicals should be used sparingly in any cellar and only if necessary. They reduce the quality of the effluent and can significantly increase the operating costs of a cellar. For minimisation of the effluent COD, solids should be removed from the effluent stream as soon as possible (Drew, 2001). It is recommended that cellars invest in environmental management systems, and read up on Best Management Practices.

Based on the correlations derived in this study, an empirical model of a winery was developed, and this was used to perform costing calculations. It was shown that there are significant savings to be made if one produces wine in a more environmentally friendly manner. Indeed, these savings alone should pay for the implementation of an Environmental Management System. Savings on chemicals used after the implementation of the ISO14001 system at a certain winery paid for the implementation of this system (Barnardt, 2002). These savings could lead to substantial decreases in the operating costs of the cellar. It was also shown that a reduction in operating costs is greater for large cellars than for small cellars. This occurs because large cellars tend to have higher strength effluent and lower specific water consumption than smaller cellars. For those cellars that have higher cash flows, the motivation to become proactive towards implementing cleaner production and EM Systems is greatest. However, since the reduction in operating costs is still significant for smaller cellars, there is sufficient motivation for them to become proactive too. As more information becomes available, and the consumption of chemicals becomes logged, one can expect these percentages of savings to rise even further. Furthermore, since it is likely that environmental law will become more aggressive in the next few years, results such as these become a valuable tool for showing winemakers the benefits of cleaner production and EM Systems.

This model should be seen as being preliminary, and should be refined by further studies, where further information is assessed.

Recommendations for further work

It appears that one problem facing the South African Wine Industry at present is a lack of information. As such, any further work needs to concern itself with the collection of data. In light of the difficulty in obtaining the data for this project, this will be hard to do. This problem is also being addressed (to a large extent) by the continuing effluent characterisation program being performed by Winetech.

Future work should concern itself with refinement of the model developed in this study and the collection of additional data to make the model more accurate. It would also be useful to implement a similar study at cellars where EM systems are in place and to develop the models at these cellars to compare different process designs' efficiencies with respect to their environmental impacts.

Further research could also focus on the problems highlighted by the respondents in this study. These include, specifically, designing more efficient systems to reduce the losses of wine that occur from settling and filtration, and designing efficient climate control systems for barrel cellars to reduce the rate of evaporation.

It is this author's opinion that both Elsenburg College and the University of Stellenbosch should implement a water chemistry/environmental science course for winemaking students

at undergraduate level. This would improve the knowledge of future winemakers on environmental and water issues.

References

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A full list of study references is available from the author on request.

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All those cellars that completed the questionnaire, and in particular, those three cellars that were kind enough to let me onto their premises over the 2002 harvest.