



## Investigation on MDF market demand in Iran

M.R. Dehghani Firouzabadi<sup>a</sup>, P. Ghorbannezhad<sup>b</sup>

<sup>a</sup> Associate Professor, <sup>b</sup> PhD Student, Department of Pulp and Paper Technology, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

\*Corresponding author. E-mail: [m\\_r\\_dehghani@mail.ru](mailto:m_r_dehghani@mail.ru)

Received: 14 November 2013, Accepted: 12 March 2014.

### Abstract

The medium density fiberboard (MDF) market demand was investigated during the years from 2004 to 2013 in Iran. Estimation of MDF demand was made by exponential smoothing method by the year 2018. The insight into the level of demand that might exist by the year 2013 was obtained by reviewing the production, import, export, and consumption of MDF on the Iran. The results show that the consumption of MDF has been risen by 4.7 times since 2004. The estimated demand for MDF in Iran shows that the total MDF demand will reach more than 1642000 m<sup>3</sup> in the year 2018, which increases by 42% in comparison with that in 2013. By now, 61% of domestic MDF in Iran still relies on import while economic sanction effect on import ratio and business competitiveness among MDF manufactures in Iran especially in 2013. The estimated consumption of MDF in future provides a base for expanding the present demand in terms of its present level in Iran. According to our results, to encourage the continued development, the Iran MDF industries require a forestry program providing the raw material needed.

**Keywords:** Exponential smoothing, Market, Medium Density Fiberboard.

### 1. Introduction

Forest resources are one of Iran's most valuable natural assets. In fact, Iran is sparsely forested. Less than 5 percent of the nation's total area of 163 million hectares is forest. There are about 1.8 million acres of commercial forestland in the

Iran. The future of wood product industries in Iran will depend on availability of raw materials. Availability of raw material will hinge on a sound forestry and import program. Due to the limited supply of raw material, wood-based panel industries operate at far less than their nominal capacity. One of the main wood-based industries is medium density fiberboard (MDF) manufacture. MDF is widely used in the manufacturing of furniture, kitchen cabinets, door parts, moulding, laminate flooring and embossing. The current challenges facing this industry are to provide their raw materials to obtain main share of MDF products in the Iranian market.

At the present, six MDF factories are active in Iran with annual consumption of raw material nearly 600000 m<sup>3</sup> round wood. Wood panel industries are operating less than full capacity excluded MDF manufacture. The main reasons are the limited supply of raw materials and low-technology machinery. These problems are most serious in plywood and veneer manufacturing, which need high-quality raw materials and high technologies. Domestic sources of high-quality logs are very limited, and there is a ban on importing round wood with bark into Iran.

Despite the current industry structure in Iran, MDF manufactures are running with higher technologies machinery rather than other wood panels manufactures. Azizi (2008) suggested that due to the destruction of the forests and lack of proper plantation, replacement of the forest wood by the fast growing wood is vital to satisfy all requirements of factories in Iran. It is also critical to minimize cost at MDF manufacture. MDF panel has being downgraded by the waste due to inappropriate use of raw material during wood chips conversion. Improved production efficiency and business competitiveness of MDF can significantly reduce production costs in the current situation. In general, the variation in consumption is associated with population changes.

Considering the ever increasing rate of Iran's population, consumption of wood panels is increasing each year, but the economic impact of sanction affected consumption ratio and business competitiveness among MDF manufactures in Iran, especially in 2013. Since MDF was first imported to Iran in 1996, import of MDF panels had increased dramatically from 217081 m<sup>3</sup> in 2004 to 1078472 m<sup>3</sup> in 2012 (Table 1). Before 2004, the total of domestic consumption of MDF completely relied on import. By now, 61% of domestic MDF in Iran still relies on import, of which 30% is imported from Thailand, 24% from Turkey, 21% from China, 14% from Emirates United Arab, 10% from Malaysia, and 1% from other countries.

**Table 1.** The amount of production, export, import and consumption in MDF in Iran during 2004 to 2013.

Year	Production (m <sup>3</sup> )	Export (m <sup>3</sup> )	Import (m <sup>3</sup> )	Consumption (m <sup>3</sup> )
2004	26300	0	217081	243381
2005	40426	0	259771	300197
2006	48219	0	351324	399543
2007	70127	0	497500	567627
2008	75412	0	411706	487118
2009	142206	0	765428	907634
2010	185317	0	791374	976691
2011	301639	0	1084812	1386451
2012	411949	0	1078472	1490421
2013	429359	0	882886	1312425

In 2004, the first MDF factory was established with an annual capacity of 40000 m<sup>3</sup> in Iran and in 2012, production of MDF has increased nearly 16 times in compare of 2004 (Table 2).

In 2013, the production, import and export of particleboard amounted to 980559 m<sup>3</sup>, 54548 m<sup>3</sup>, 19037 m<sup>3</sup>, respectively. The particleboard dominated over the wood panel's market until 2009. Azizi et al. (2009) reported that the particleboard is generally a mature product in Iran while MDF is still gaining market share as new applications. Demand for MDF in Iran is growing fast. The authors estimated that MDF demand will be more than particleboard demand since 2009. MDF is also in competition with traditional hardboard markets. The main reasons for acceptability of MDF among Iranian consumers are aesthetics features and resistance to moisture (Moradi and Rafiqhi, 2013).

Increasing consumption lets to the establishing of new manufacturing capacity using imported machinery. Table 3 shows the amount of MDF production factories which have been establishing in Iran. MDF manufactures contribute to market in two forms, laminated and raw. All MDF consumed in Iran is surfaced by melamine paper, paper foils and high pressure laminates. Domestic laminators are buying raw MDF and selling it in the domestic market after laminating. There are no exports of MDF from Iran because of adequate domestic demand consumes the limited domestic production.

**Table 2.** MDF production factories in Iran (m<sup>3</sup>).

Factory	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Caspian	26300	40426	48219	46602	48000	44909	47864	47800	46761	47413
Arian Sina	0	0	0	16000	33270	63500	71000	74323	104612	102620
Pars	0	0	0	17525	28631	33797	44953	41575	47452	50131
Arian	0	0	0	0	0	0	20000	114068	160700	147300
Loh-Sabz	0	0	0	0	0	0	1500	23873	52424	56170
Jonoub	0	0	0	0	0	0	0	0	0	25725
Kimia	0	0	0	0	0	0	0	0	0	25725
Choob	0	0	0	0	0	0	0	0	0	25725
Total	26398	40426	48219	80127	109901	142206	185317	301639	411949	429359

**Table 3.** Newly established MDF factories.

Factory Name	Location (Province)	Annual Capacity (m <sup>3</sup> )
MDF Foumanat	Gilan	120000
Arta	Ardabil	105000
MDF Caspian	Mazandaran	105000
MDF Bartar Mashhad	North of Khorasan	90000
MDF Boushehr	Boushehr	60000

Therefore, estimating the future demand for wood panels helps the decision makers to develop long-term programs for this industrial sector. Forecasting is a general term used to denote the estimation purpose and mainly is applied to estimate the future demand for goods and services.

Several methods have been applied to forecast the future demands of wood products. Alexander and Handfield (2003) applied time series for forecasting of lumber demand in the United State. They found that simple smoothing models are more appropriate than ARIMA model for forecasting. The results also indicated that monthly seasonal models fit better than weekly moving average models. The exponential smoothing methods are widely used in business for forecasting demand for inventories (Gardner, 1985). They have also performed surprisingly well in forecasting competitions against more sophisticated approaches (Makridakis et al., 1982; Makridakis and Hibon, 2000). Investigation of the exponential smoothing model selection for forecasting pointed out simple exponential smoothing common approach to select the method appropriate to a particular time series is based on prediction validation on a withheld part of sample using criteria such as the mean absolute percentage error (Billah et al., 2006).

In the following, the present condition of MDF panels market is explained briefly based on the date provided by Ministry of Mines & Industries and Statistics

Organization. Amiri (1990) studied the positions of raw materials used in Iran wood industries from which the rate of production and the level of the import of wood raw material to compensate the industry needs were determined. Consuming market of MDF product has been investigated by means of regression analysis of the past consumption and the market share of MDF among other wood pressed sheets. It has been anticipated that the process of consumption increase in the future years would continue with high speed and reach about 60% of the market share of wood pressed sheets in 2014 (Moradi and Rafighi, 2013). Bayatkashkoli et al. (2008) reported the estimation of timber and wood products export and import trend in Iran. The authors indicated that some of wood products (for example; particle board order imports) trend are conflicted because the products price oscillate and these weight amounts are decreasing and these products tariff change to depreciate tariff.

The products trade will flourish in next decade because of increasing the trends in exports and imports. Azizi et al. (2009) reported that the deficient amount of wood panels in Iran estimated over 1400000 m<sup>3</sup> in 2012. The authors also indicated that in the overall scheme of structural wood panels markets, the consumption level of wood panels, especially MDF, will increase in 2012. Particleboard is generally a mature product in Iran while MDF is still gaining market share as new applications. Demand for MDF in Iran is growing, which will be more than particleboard demand in 2012. MDF is also in competition with traditional hardboard markets. The objective of this study is to investigate and predict MDF market demand in Iran using exponential smoothing methods.

## **2. Method for Prediction of Consumption Pattern of MDF Panels**

Exponential smoothing is probably the widely used class of procedures for smoothing discrete time series in order to forecast the immediate future. This popularity can be attributed to its simplicity, its computational efficiency, the ease of adjusting its responsiveness to changes in the process being forecast, and its reasonable accuracy (Montgomery et al, 1990).

The idea of exponential smoothing is to smooth the original series the way the moving average does and to use the smoothed series in forecasting future values of the variable of interest. In exponential smoothing, however, we want to allow the more recent values of the series to have greater influence on the forecast of future values than the more distant observations. Exponential smoothing is a simple and pragmatic approach to forecasting, whereby the forecast is constructed from an exponentially weighted average of past observations. The largest weight is given to the present observation, less weight to the immediately preceding observation, even less weight to the observation before that, and so on, exponential decay of influence of past data (Aczel, 1989).

Based on the available data in both the national Iranian statistics institute and the ministry of industry, the capacity of wood panels' production and the level of their imports were provided for a ten years period, then the rate in which such products are consumed was calculated. The prediction of consumption of these products is obtained until 2018. It requires little computation.

This method is used when data pattern is approximately horizontal (i.e., there is no neither cyclic variation nor pronounced trend in the historical data). Let  $y_t$  be the actual value of the time series and  $\hat{y}_t$  be the forecasting value for time period  $t$ .  $\hat{y}_{t+1}$  is the forecast value for time period  $t+1$  and  $\alpha$  is the smoothing constant (Brown and Meyer, 1961). The Forecast  $\hat{y}_{t+1}$  is based on weighting the most recent observation  $y_t$  with a weight of  $1-\alpha$ . Smoothing constant  $\alpha$  is a selected number between zero and one,  $0 < \alpha < 1$ . When  $\alpha=1$ , the original and smooth version of the series are identical. At the other extreme, When  $\alpha=0$ , the series is smooth flat. Exponential smoothing used the following model:

$$\hat{y}_2 = y_1 \tag{1}$$

$$\hat{y}_{t+1} = \hat{y}_t + \alpha(y_t - \hat{y}_t) \tag{2}$$

$$\hat{y}_{t+1} = \alpha \hat{y}_t + (1-\alpha) \hat{y}_t \text{ for } t = 2,3,4,\dots \tag{3}$$

The forecast equation in general form is:

$$\hat{y}_{t+1} = \alpha y_t + \alpha(1-\alpha)y_{t-1} + \alpha(1-\alpha)^2 y_{t-2} + \dots + \alpha(1-\alpha)^{t-2} y_2 + \alpha(1-\alpha)^{t-1} y_1 = \alpha \sum_{k=0}^{t-1} (1-\alpha)^k y_{t-k} \tag{4}$$

where  $\hat{y}_{t+1}$  is the forecast value of the variable  $Y$  at the time period  $t+1$  from knowledge of the actual series values  $y_t, y_{t-1}, y_{t-2}$  and so back in time to the first known value of the time series,  $y_1$ . Therefore,  $\hat{y}_{t+1}$  is the weighted moving average of all past observations.

The series of weights used in producing the forecast  $\hat{y}_{t+1}$  is  $\alpha, \alpha(1-\alpha), \alpha(1-\alpha)^2, \dots$ . These weights decline toward zero in an exponential fashion; thus, as we go back in the series, each value has a smaller weight in terms of its effect on the forecast. The exponential decline of the weights toward zero is evident (Aczel, 1989).

After the model specified, its performance characteristics should be verified or validated by comparison of its forecast with historical data for the process it was designed to forecast.

We can use the error measures such as MAPE (mean absolute percentage error), MSE (meansquare error) or RMSE (root mean square error):

$$MAPE = \frac{1}{n} \sum_{t=1}^n \frac{|e_t|}{y_t} \cdot 100\%, \quad (5)$$

$$MSE = \frac{1}{n} \sum_{t=1}^n e_t^2, \quad (6)$$

$$RMSE = \sqrt{MSE} \quad (7)$$

Selection of an error measure has an important effect on the conclusions about which of a set of forecasting methods is most accurate.

The speed at which the older responses are dampened (smoothed) is a function of the value of  $\alpha$ . When smoothing constant  $\alpha$  is close to 1, dampening is quick and when  $\alpha$  is close to 0, dampening is slow. If we want predictions to be stable and random variation smoothed, a small  $\alpha$  is needed. If we want a rapid response a larger  $\alpha$  value is required. On the other hand, the choice of the smoothing constant is important in determining the operating characteristics of exponential smoothing.

The smaller the value of  $\alpha$ , the slower the response. Larger values of  $\alpha$  cause the smoothed value to react quickly-not only to real changes but also random fluctuations (Montgomery et al, 1990). Like the moving average technique, we cannot tell ahead of time what the best value of  $\alpha$  might be; it must be chosen by experimentation ( $\alpha$  in this research=0.45). Usually, the MSE or RMSE can be used as the criterion for selecting an appropriate smoothing constant. For instance, by assigning  $\alpha$  values from 0.1 to 0.99, we select the value that produces the smallest MSE or RMSE (Aczel, 1989).

Simple exponential smoothing model is only good for non-seasonal patterns with approximately zero-trend and for short-term forecasting because if we extend past the next period, the forecasted value for that period has to be used as a surrogate for the actual demand for any forecast past the next period. Consequently, there is no ability to add corrective information (the actual demand) and any error grows exponentially.

### 3. Results and Discussion

Estimating MDF demand in Iran was much more difficult to deal with statistical approach for several reasons. First, the consumption data are available for only 10 years. Third, the consumption of MDF in Iran has been undergoing severe changes because of lack of raw material and economic sanction. It causes a rapid decrease in the import for MDF until 2012. Nematollahi and Garshasbi (2014) indicated that export diversification has shown a declining trend before new sanctions in 2010. For these reasons no regression analyses were attempted to provide predictor equations. Some insight into the level of demand that might exist by the year 2013 may be obtained by reviewing the consumption of MDF in the

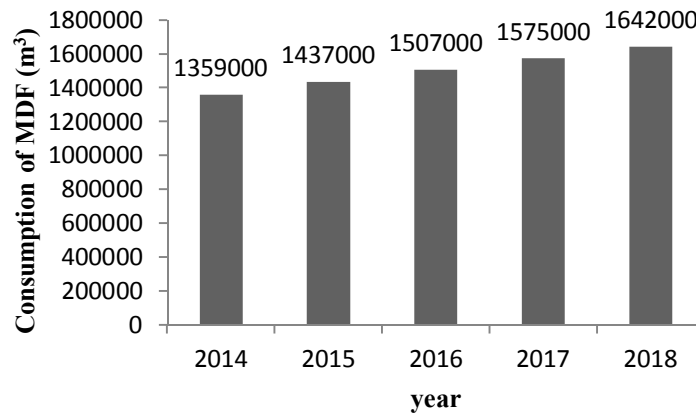
Iran. Since 2004, consumption of MDF there has risen by 4.7 times (Table 1). The estimated demand for MDF in Iran shows that the total MDF demand will reach more than 1642000 m<sup>3</sup> in the year 2018 (Figure 1), which increases by 42% in comparison with that in 2013. The forecasting of MDF demand indicated that MDF manufacture will be faced a lack of raw materials in the future. This challenge will be more critical by emerging new factories.

To satisfy the raw material requirement for MDF manufactures, a series of strategies are required. First, expanding domestic plantations is a long-term strategy to increase raw material supply by wood industry associations. To date, the public sector has not been successful in plantations because of the inexistence supervisory control. It appears that the risk in developing a long-term investment in plantations is considered too high relative to continuing to import raw materials or finished goods.

It is necessary for the wood industry development to put the stagnant projects into operations, utilization of the forests would be made in a scientific way, forests are revived and expand by necessary afforestation (Azizi and Faezipour, 2006). Second, persuading the government to lift bark log ban by preserving and fumigating of imported logs. The Caspian Sea between Iran and Russia could facilitate importation of coniferous species and access to other import markets through the Persian Gulf. Third, changing log resource has increased the demand for engineered wood products, which are able to use the available forest resources. This includes the use of smaller diameter, lower quality logs and the use of previously underutilized species for an overall wood fiber savings. Finally, utilization of other lignocellulosic resources can play vital role in the future development of wood based panel industries in Iran.

Lignocellulosic materials are the most abundant renewable resource and their efficient utilization provides a practical route to address these challenges. The bagasse and non-wood residues are feasible for expanding the use of these materials for the wood panel industries. In spite of current challenges, the MDF manufacture has a high potential to improve and grow. In terms of MDF products quality in Iran, MDF manufacture represents a growth potential in domestic market and in the Arab countries. With an improving economy and cohesive industry, government, and academic support, the Iranian MDF products industry really does have a chance to flourish.





**Figure 1.** The estimated consumption of MDF in Iran from 2014 to 2018 (m<sup>3</sup>).

#### 4. Conclusions

This study investigated the demand of MDF with the aid of the panel data approach. The analysis was carried out with the data collected on MDF productions, imports and exports over 10 years (2004-2013). Consuming market of this product has been estimated by exponential smoothing. The results showed that total demand for MDF is forecast to increase by 1642000 m<sup>3</sup> over the next 5 years. The results showed that the consumption of MDF increase in the future years and will remain the main share of wood panels market in Iran. In the absence of a substantial investment in local production this demand will met wholly from imports. The needs of future generations for wood based composites in Iran will be met by increasing of both domestic production and imports. MDF and particleboard industries are the largest commercial consumers of small diameter timber, and yet MDF and particleboard capacities in the North of Iran have increased in recent year and are projected to increase significantly. It can drastically intensify the forest harvesting in the North of Iran. Financial risks to investment in North of Iran including uncertain timber supplies from public land. With regards to economic conditions, the following pathways could be considered:

- In the long term, the change in demand for MDF panel is related to economic growth which is largely determined by international trade growth and technological progress.
- In the short term, change in policy such as trade barriers. The economic sanction impact on the international timber trade in Iran. The general effect of trade barriers is to alter trade flows. Government intervention in trade-through tariffs and export subsidies can have the effect of disrupting the link between prices in different countries.

- Inventory management influences supply and demand. For example, when demand drops, inventories will increase. This will lead the producers to manage inventories by increasing production and accepting lower prices. In fact, the process of inventory management acts to balance changes in demand and supply and reduce short-term fluctuations in MDF prices.

According to our results, to encourage the continued development, the Iranian forest industries require a forestry program providing the raw material needed.

## References

- Aczel, A.D. 1989. Complete Business Statistics, Irwin.
- Alexander, K. 2003. An industrial application of time series forecasting of lumber demand. M.Sc Thesis. North Carolina State University publication. p87.
- Amiri, S. 1990. Review the production and import of wood in Iran. Iran Nat. Resour. J., 44: 39-56.
- Azizi M. 2008. A model of supplying poplar wood for Iranian paper and wood factories. J. For. Res., 19: 323-328.
- Azizi, M. Faezipour, M. 2006. Consumption forecasting of Iran plywood industry with respect to its substitution rate in building application. J. Appl Sci., 6:1040-1046.
- Azizi, M., Ghorbannezhad, P., Hatefnia, H. 2009. Estimation of demand for wood panels in Iran by the year of 2012. J. For. Res., 20: 179-182.
- Bayatkashkoli, A., Azizi, M., Rafighi, A., Amiri, S. Kabourani, A., 2008. Estimate of timber and wood products export and import trend in Iran. J. Agric. Sci. Nat. Resour., 15: 73-83.
- Billah, B., King, M.L., Snyder, R.D., Koehler, A.B. 2006. Exponential smoothing model selection for forecasting. Int. J. Forecast., 22: 239-247.
- Brown, R.G., Meyer, R.F. 1961. The fundamental theory of exponential smoothing, Oper. Res., 9: 673-685.
- Gardner, E.S. 1985. Exponential smoothing: The state of the art. J. Forecast., 4:1-28.
- Nematollahi S, Garshasbi A. 2014. The study of non-oil export diversification in the status of the international sanction during the period of 2004-2012. Q. J. Econ. Growth Develop. Res., 4:73-93.
- Makridakis, S., Andersen, A., Carbone, R., Fildes, R., Hibon, M., Lewandowski, R., Newton, J., Parzen, E., Winkler, R. 1982. The accuracy of extrapolation (time series) methods: Results of forecasting competition. J. Forecast., 1: 111-153.
- Makridakis, S., Hibon, M. 2000. The m3-competition: results, conclusions and implications. Int. J. Forecast., 16: 451-476.
- Montgomery, D.C., Johnson, L.A., Gardiner, J.S. 1990. Forecasting and Time Series Analysis. 2nd edition, McGraw-Hill, New York.
- Moradi, K., Rafighi, A. 2013. Investigation the effective factors on MDF acceptability and analysis of Market Demand in Iran. J. Wood For. Sci. Technol, 20: 77-93.