

## AN OPTIMIZED MODEL TO EVALUATE THE PERFORMANCE OF DATE SUPPLY CHAIN

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**ABSTRACT:** *The competitive atmosphere of modern businesses makes it essential for organizations to highly consider the supply chains. This study focuses on supply chain for palm industry in Sistan and Baluchestan Province. First, the problems involved in the palm industry are discussed and solutions are provided; then a supply chain model for date industry is introduced and requirements to increase the performance and agility are discussed. At the end, to evaluate the performance, two models are presented.*

**KEYWORDS:** Supply Chain, Agility, Date, Logistics Performance Index (LPI), Relationship Management, Information Management

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### INTRODUCTION

Intense competition in the business environment, increasing environmental developments, increasing customer needs, and the ability to quickly respond are factors making organizations to consider all aspects of the supply chain. This is because the supply chain involves a wide range of activities related to the product from raw material procurement to final product delivery to the consumer (Well,2014). Considering logistic problems, correctly managing the supply chain, and quickly responding to changes in the market (i.e. the agility) are capabilities guaranteeing the profit. Supply chain management means the management of the flows between various elements in a chain aiming at maximizing the usefulness. It involves management of information and relationship between different elements of a chain. Since supply chain coordination is crucial, the appropriate and correct information transfer can improve the performance while simplifying the management of processes. Therefore, a coordinated and appropriate information management has a positive influence on decision-making, speed, accuracy, quality and other aspects. On the other hand, relationship management is another important area in the supply chain having a significant impact on all aspects of the supply chain including the performance. Many of early failures in the supply chain are due to poor communication of expectations and the consequent misbehaviors of parties involved in the chain. Then, it must be highly considered. Logistics includes all physical activities (from procurement of raw materials to delivery of finished product) and management of flows of materials (from raw materials, production, and delivery) (Welle,2014). To evaluate it, a factor is introduced: Logistics Performance Index (LPI). LPI is a comprehensive multi-dimensional index rated on a scale ranging from one (the worst) to five (the best). LPI is introduced to help countries to identify the bottlenecks and opportunities in the logistic process. Here, efficiency means that customers' needs are responded in a right amount, place, and time. Therefore, the definition of such a chain for each product can be very useful. This study seeks to apply it on a tropical valuable fruits: date.

Date is fruit of the palm tree (scientific name: phoenix dactylifera) which is a nutritious tropical fruit. It is cultivated in a particular climate suitable in a small area of the world including South

Asia. Iran is a country with a tropical climate in the southern provinces (such as Sistan and Baluchistan) suitable to cultivate this product. Palm is known as the queen of plant species (Bahrami, 1954). Due to the significance of this fruit, this study investigates problems, solutions, models and features involved in the supply chain.

### **Problem statement**

This study attempts to introduce a supply chain model for palm and its products to promote the date industry. After investigation, it was found that the introduced palm supply chain for the country, especially Sistan and Baluchistan, involved problems in all elements of the chain from the primary supplier to the end customer. Palm growers use traditional methods in all steps of planting, cultivating, harvesting and selling. They do not care to supply the product to particular individuals or entities and sell it in bulk to dealers or traditional customers of other provinces (IANA,2013). There are also other problems preventing a true understanding about this industry such as inadequate transport, poor storage, lack of processing and packaging workshops, barriers to export, etc.

### **Supply chain management scope**

In this study, the case is Sistan and Baluchistan Province.

## **LITERATURE REVIEW**

### **Supply Chain**

Azar et al. (2004), with extensive surveys on agility and interviews with experts in steel supply chain, identified 11 factors determining success for an agile supply chain. They employed interpretative-structural modeling technique to find the sequence and the relationship between factors. According to the obtained results, three factors are key factors for agility in the supply chain: employee skills, the use of IT, and appropriate planning. In other words, to have an agile system, the tree factors must be highly considered. Razmi et al(2004) ,assessed potential market through combining Analytic Hierarchy Process (AHP) with ideal planning while considering various restrictions. They finally selected the best markets and defined the distribution program. Goodarzi et al. (2006) argued that the supply chain have a competitive potential in an industrial organizations if in addition to strong and competitive components, it benefits from agility. In this regard, they investigated an agile supply chain. At the end, using a technical - theoretical approach, they introduced the main obstacles for an agile supply chain. Shekari et al (2006) investigated different aspects of principles affecting supply chain to define performance indices improved by techniques and principles. They also listed problems in different elements of the chain to tackle using effective techniques if required. Rahmanseresht et al. (2009) in a study entitled " The impact of information sharing on competitive strategies and the performance of supply chain " investigated the steel supply chain based on the viewpoints of 95 managers and industry experts as population samples. The results showed that there is a positive significant relationship between information sharing and competitive strategy for supply chain as well as between competitive strategy and supply chain performance (Rahmanseresht et al., 2009). Hedari (2009), in his study, discussed history, formation, and definition of supply chain management, features and the main elements of the supply chain, factors affecting the formation of supply chain management, and the supply chain operations reference model. Based on desk and field studies, he conducted a descriptive -

survey research and concluded the outputs of applying supply chain management in small and medium-sized companies are: improved customer interactions, improved exchange of physical materials, improved market communications, and improved supply chain. He finally explained how to apply it in small and medium-sized companies.

### **Studies Conducted on Date Palm:**

Najafi, in a book titled "Iran's agricultural economy" addressing date marketing problems, believed it is possible to increase the producers' income and reduce date prices for consumers by tackling marketing problems. The results showed that main problems in the marketing services are packing, expensive raw materials, and not grading products (Najafi, 1997). Hosseinzadeh & Kashanifar (2004) employed DEA to find a suitable place to establish a palm plant. According to the results, Chabahar, Saravan, Iranshahr, Nikshahr, Zahedan, and Khash are suitable for a palm plant construction. Abbasian et al (2007) introduced marketing margin models and investigated economic factors and strategies influencing models. According to the obtained results, the initial price and harvest cost are factors affecting the marketing margin. Since the total initial price plus marketing cost is less than the retail price, the investigated paths are not clear and this reduces the market performance. Karbasi & Mousavi (2013) examined the relationship between export and productivity for date in Iran. The results of this study showed that in the export function, there is a negative relationship between the exchange rate and export to domestic price ratio with export volume for dates. Bastani et al (2014) evaluated the performance of distributors in the supply chain using data envelopment analysis (DEA). They first defined main factors affecting evaluation of distributors and then calculated the distributors' efficiency scores using DEA. Finally, they employed a combined model to decide how to distribute products among distributors.

Kord et al. (2014) attempted to identify and prioritize factors affecting the creation of industrial cluster for Saravan's date. The results indicated that among the examined factors, geographic concentration and communication between firms had the highest and lowest impact on the industrial cluster for date in Saravan. Cheraghi & Hamdami (2015) check the quality of packed date's tissue over a period of six months under vacuum and atmospheric pressure and temperatures of -20, 4, 25, and 40°C. According to the results, temperature, storage duration and packing type have a significant impact on stiffness, cohesion, and elasticity of dates with 1% probability, and time and type of packing have a significant impact on cohesion with 1% and 5% probability, respectively. In addition, temperature has no significant impact on tissue properties.

### **Palm Industry Problems and Effective Solutions**

This section outlines palm industry challenges and provides solutions. Palm growers employ traditional approaches in various steps of planting, cultivating, harvesting and selling. They do not care to supply the product to particular individuals or entities. Based on the studies, if traditional agriculture approaches are replaced by modern ones and the farmers' knowledge about agriculture and date value as well as date important role in export, economic development of the region and even the country's, income, and stable employment is increased, palm industry problems could be partially solved. To remove dealers from the chain in sale step in order to support date growers, it is suggested that government and the private sector provide low-interest loans and facilities for farmers while training them on industrial agriculture freely. The presence of one or more integrated, decision-maker, and executive organization to manage all activities in date industry including policy making, sale and pricing,

packing, loading and transport helps removal of dealers thus farmers will have no concern about low prices and not selling products. Such a system also reduces waste at various steps of harvesting, loading, and transport. Thereby the quality of the product is preserved. Secondly, such an organization allows the correct management of information between supplier and buyer and consequently all activities within the chain including the transportation, warehousing, order processing, packaging, marketing, etc. are completed based on logistics and regulations. As a result, relationship management, as a key element of the supply chain between the buyer and the supplier, is fully done and this will motivate farmers to take advantages of new agricultural methods. Using improper and non-standard transportation for date is another case. Farmers are needed to properly pick dates and put them in containers or boxes considered for this. They must avoid piling up dates, since it make dates rancid or spoiled. Therefore, container, picking, and packing must be highly considered. In addition, loading and transport systems must be selected based on type of packing. This can significantly reduce wastes while preserving the quality of dates. In fact, the most important point is to deliver a healthy and high-quality product to consumers. In this regard, using moisture-insulated containers and transport systems with preservation indices in accordance with standards can be helpful (Ghasemkhani,2008). To solve problems involved in transportation phase, we need to introduce correct transportation systems and containers to farmers. In this way, logistics will be implemented properly. Having detailed information on suppliers, volume of the product, proper time to transport date from farm to storage, as well as decisions about the number and type of transportation system establishes a proper flow of information between supplier and buyer. This results in a more efficient chain simpler to manage. It is also crucial to take warehousing principles and product maintenance indices into account. Wrong warehousing causes problems such as abundant wastes and low-quality products. To avoid such problems, it is essential to consider some factors:

1. Warehouse location should be near the production centers.
2. Warehouse and refrigerator temperature and humidity must be permanently controlled to prevent spoil during storage.
3. Type of dates and the storage duration should be considered.
4. Size and construction of the warehouse should be appropriate.
5. To process customer order, inventory must be updated.

Lack of workshops for date packaging is another factors causing problems in the supply chain. In fact, construction of workshops and applying packaging principals make it possible to have a share in date world market. Packaging is an important link between the product and the customer (Ghasemkhani,2008). In fact, if package can reflect properties and benefits, it will act as an important factor to persuade consumer to buy the product. The correct packaging also preserve the product in warehousing, transportation and distribution of the product among consumers. Here, the main objective of establishing packaging workshops is to minimize the distribution costs, to have a reliable distribution for customers, and to increase profits. To make the supply chain efficient allowing the wide introduction of the product, we need to establish packaging workshops in accordance with standards and under the supervision of the Office for food products supervision. Packaging workshops must properly do operations as sterilization, separation, washing, dehumidification, grading, classification, and final inspection to prevent wastes. At this point, it is necessary to consider the tastes of customers. Considering a proper

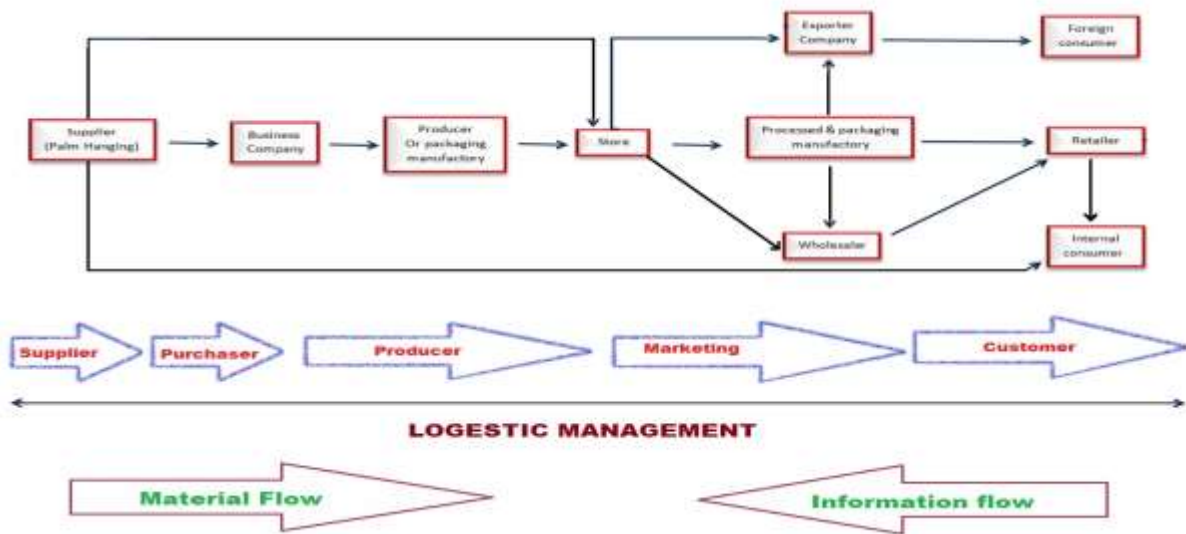
package size can help for better transport and export. Generally, in packing phase, the target market and views, values, and habits must be considered. Product can be delivered from the production site through three ways: 1) exporters; 2) packaging and processing companies; and 3) wholesalers.

In Sistan and Balouchestan, there are only a few non-standard packaging workshops with no modern mechanized processing industry. In fact, early-harvested products or products damaged during warehousing, transportation, and packaging that are not suitable for sale yet usable need to be processed. That is why processing is necessity. Establishing such an industry, in addition to solve the aforementioned problems by reducing the waste, provides job opportunities. In export sector, there is no export with a brand specific to the region, and the product is exported under the name of other cities and countries. To create export opportunities, it is needed to consider the followings:

- Having suitable package and introducing a brand for the product;
- Considering the tastes of customers;
- Improving equipment and employing specialists;
- Strong advertising;
- Holding conference on dates palm in this region;
- Compliance with export standards in packaging;
- Providing cold storage facilities to develop exports;
- Establishing quality control centers;
- Active participation of officials in prestigious and international exhibitions;
- Establishing institutions to support exports;
- Raising awareness of farmers and exporters on the export (Saharkhiz,2011)Selling the product at a fair price equal to the global average price (not less) which requires a known brand.

### **An Efficient Supply Chain for Date Industry:**

Fig. 1 shows the supply chain proposed for date industry in the region.



**Fig. 1. The proposed supply chain**

The supply chain has a dynamic nature including constant flow of information, materials and funds between various elements of the chain. In fact, the main goal of any supply chain is to fulfill customer needs while making profits. The term "supply chain" evokes the image of a product or service moving along a chain from suppliers to manufacturers, distributors, retailers, vendors and customers. The important issue is to be able to apply the flows reciprocally in both directions. The logistics management allows to fulfill these objectives. To properly design a supply chain we need to recognize both the customer requirements and the role played by each element.

**The Requirements of the Supply Chain to Increase Efficiency and Agility**

**Table 1. Supply Chain Requirements**

Steps	Requirements
Planting, cultivating, and harvesting	<ul style="list-style-type: none"> <li>• Considering proper distances for palms;</li> <li>• Having skills in how to pick dates;</li> <li>• Correct pruning (7 to 10 branches on the tree);</li> </ul>
Transportation	<ul style="list-style-type: none"> <li>• Using containers and vehicles appropriate to product;</li> </ul>
Warehousing	<ul style="list-style-type: none"> <li>• Controlling temperature, humidity, and other parameters;</li> <li>• Properly keeping the product and preventing it from piling up;</li> <li>• Considering the type and life of the product (period of storage)</li> </ul>
Packing	<ul style="list-style-type: none"> <li>• Appropriate packaging to avoid wastes;</li> <li>• Compliance with standards;</li> </ul>
Export	<ul style="list-style-type: none"> <li>• Compliance with export standards;</li> </ul>
Processing	<ul style="list-style-type: none"> <li>• Considering the right sell time to avoid wastes;</li> <li>• Considering customers' needs to products.</li> </ul>

To increase efficiency and agility of a supply chain, it is necessary to implement the requirements listed in Table 1. In this regard, violation of even one requirement is not acceptable.

### **A Model to Evaluate the Performance of Dates Supply Chain**

In general, the performance of a supply chain is subject to many factors. However, after examining all aspects and indicators of supply chain performance particularly in industries such as palm, the following factors were identified as determinants.

1. Time (t): it is the time interval from harvesting to delivering the final product (such as the packed date or any other production) to the final customer. The less the process takes time, the more successful the supply chain is.
2. Price (c): direct and indirect costs are involved to deliver a final product to customers, such as: 1. shipping cost; 2. warehousing cost; 3. the cost of delay in delivery; 4. advertising, information and marketing cost; and 5. waste and low quality cost.

For a high-performance supply chain, the total cost is reduced. Therefore, cost is inversely proportional to the supply chain performance (Jafarnejad & Darvish, 2009).

3. Agility (a): for a supply chain, agility means how quickly the chain adapts to environmental changes as well as the flexibility of processes and products. The agility can be defined as a number between 1 (no agility) to five (smart agility). So this parameter needs to be accurately measured for a supply chain in palm industry.
4. Reliability (r): it depends on many factors, including: responsiveness to the customer, application of information technology within the chain, degree of compliance with standards, sustainability, and safe functioning during the time.

Considering the four above factors, the logistic index is calculated as follows:

$$L_I = \frac{a \cdot r}{c \cdot t} \quad (1)$$

To evaluate the performance of a supply chain, it is necessary to measure  $L_I$  for a fixed period (e.g. six months, one year, and three years) then compare to a corresponding value for the same period in the past. If the index does not grow during a specified period (or decreased), it is necessary to define projects continuously improving the supply chain based on the Deming cycle.

### **Calculating the Capability of Logistics**

To calculate the capability of a supply chain, it is essential to define the logistic index ( $L_I^*$ ) as Eq. 2.

$$L_I^* = \frac{a^* \cdot r^*}{c^* \cdot t^*} \quad (2)$$

where:

$a^*$ : the average agility in an efficient supply chain = 3;

$r^*$ : acceptable level for reliability and tracking = 3;

c\*: cost for the supply chain;

t\*: standard time to transfer product throughout the supply chain.

The performance of a supply chain can be obtained using Eq. 3.

$$C_L = \frac{L_I}{L_I^*} \quad (3)$$

Here,  $C_L = 1$  means the capability is 100% for the supply chain and it fully takes advantages of the capacity. And  $C_L > 1$  means that the chain exceeded the defined standard (minimums), and consequently  $C_L < 1$  indicates that the chain operates poor compared to the standards.

## CONCLUSIONS

In this study, we first demonstrated problems involved in different sections of the palm industry including transportation, warehousing, packaging and processing, marketing, export, etc. Then we proposed solutions to tackle the problems as much as possible. Considering various aspects, we introduced a model for the supply chain in palm industry. To have an efficient and agile supply chain, we need to meet requirements listed above. To evaluate the performance ( $L_I$ ) and capability ( $C_L$ ), four indices were defined: time, cost, agility and reliability. Two models were introduced to calculate  $L_I$  and  $C_L$ . At the end, it was shown that if  $C_L = 1$ , the proposed supply chain is fully (100%) capable according to the defined standards. If  $C_L > 1$ , the capability is beyond the standard (the defined minimums) and  $C_L < 1$  indicates the poor capability of the chain compared to the standards.

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