

# Improving Supply Chain Planning Management Responsiveness and Agility: FMCG Company Case

Basheer F. Reda

Department of Industrial Engineering, Faculty of Engineering, King Abdulaziz University, Jeddah

Email Id: [basheer7764@gmail.com](mailto:basheer7764@gmail.com)

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**Abstract:** In today's progressively competitive market, a precise and clear evaluation of the supply planning management is necessary to seek the protection of the market position as well as the market shares from expected and unexpected future threats. This paper presents the methodology of evaluating and selecting the most appropriate methods to improve the Supply chain Planning Management Responsiveness and Agility by implementing E2E LT, Production Capacity, SS and DOC, OTIF, Planning Segmentation, Planning Zones, and Crop Calendar.

**Keywords:** SCM, Agility, FMCG, End-To-End Lead Time

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## I. INTRODUCTION

In the late 1960s, the founder of one of the leading FMCG companies in Saudi had an idea - what if he started a food company that did everything better? The plan was simple – to bring Saudi consumers delicious, healthy, affordable food – to help them to make their meals more delicious. When you decide to do things better, you empower everybody in the chain. And that brings out the very best in them.

Over the years, this vision further evolved. The leading FMCG Company aimed to not only empower families by giving them “best in class” ingredients, but it set out to provide them with “best in class” tools that would assist them in their daily quest to amaze. Now, the leading FMCG company provides more than 200 different products. It is expanding across the GCC, South Africa, and eventually around the globe. The leading FMCG company believes that this and other achievements are possible due to the power of its people to activate progress, appreciate consumers, and introduce innovation into the market. Indeed, behind the company's success is a team of individuals who stand behind the brands they believe in. Behind these individuals is a company that strives to continuously empower its people and provide them with a place to amaze more.

## II. LITERATURE REVIEW

Responsiveness and Agility in Supply Chain planning management are essential parts associated with a lot of the processes in the supply chain.

To understand agility and responsiveness comprehensively, parameters of a supply chain, which have relations with agility and responsiveness, must have been examined. Starting from the main segments of a supply chain, these three parameters must be remembered: (i) sourcing, (ii) manufacturing, (iii) delivery. The flexibility and speed of these three supply chain segments lead to the definition of supply chain agility [Gunasekaran, 2006]. The original meaning of “agility” is “a continual readiness to change, sometimes to change radically” (Goldman *et al.*, 1995). From a market perspective, “agility” is defined as “using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile marketplace” (Naylor *et al.*, 1999). According to Christopher (2000), agility is the capability to embrace organizational structures, information systems, logistics processes, and mindsets.

Agility is about the supply chain. Hence, some terms about the supply chain could be confused with agility. The most confused term with agility is leanness. Agility should not confuse with leanness. Lean is about doing more with less, says Christopher (2000).

Gunasekaran (2008) defined a Responsive Supply Chain in their work as “*a network of firms that is capable of creating wealth to its stakeholders in a competitive environment by reacting quickly and cost-effectively to changing market requirements*”. They also call Responsive Supply Chain as a strategy that combines the positive sides of Agile Manufacturing and Supply Chain Management. Most researchers defined a Responsive Supply Chain by its quick response and reduced cost features.

### III. METHODOLOGY

This paper is conducted using quantitative methods. Quantitative methods were chosen to allow the leading FMCG Company to reach its aim. Here the leading FMCG Company has calculated and identified the following:

#### 1- Calculated the End-to-End E2E LT.

The leading FMCG Company has calculated the end-to-end lead time (E2E LT) for all the suppliers in this step, which include the Order Review LT, Order Placement LT, Frozen Period LT, Production Scheduling LT, Origin In-Transit LT, Port-to-Port Transit LT, Clearance LT, Destination In-Transit LT, WH Receiving LT, Distribution Review LT, and Branch Transit LT. All of these data will give the leading FMCG Company the actual total E2E LT. This data was extracted from an online platform that the leading FMCG Company uses to track the orders with the suppliers. And this platform was implemented at the end of 2019.

#### 2- Calculated the Production Capacity Vs. Placed orders for the top 2 portfolios.

In this step, the leading FMCG Company has calculated the production capacity for all the suppliers that directly impact the placed orders always shared with the suppliers. The leading FMCG Company only calculated it for the top 2 portfolios. Here the leading FMCG Company has used the Demand Replenishment Planning tool (DRP) to calculate the adequate and proper volumes to be shared to consider the production capacity. This data was extracted from an internal Demand Replenishment Planning tool (DRP) that the leading FMCG Company uses to ensure that the days of coverage (DOC) are within the targeted DOC. Furthermore, this calculation will help make sure that the leading FMCG Company has available stocks for future market demand.

#### 3- Calculated the new SS and DOC.

In this step, the leading FMCG Company has calculated the safety stock (SS) and days of coverage (DOC) for all the stock-keeping units (SKUs). Here, the leading FMCG Company used the Root Mean Squared Error approach (RMSE) to calculate the adequate and proper SS and DOC. This data was extracted from an internal system (SAP System) that the leading FMCG Company uses to track the sales against the SKU's forecast. And this system was also implemented at the end of 2019.

#### 4- Calculated the OTIF %.

The leading FMCG Company has calculated the On Time In Full (OTIF) for all the suppliers in this step. Including the on-time delivery and in full quantity delivered. This data was extracted from an internal system (SAP System) that the leading FMCG Company uses to track orders arriving with the suppliers. And this system was also implemented at the end of 2019.

#### 5- Identified the Planning Segmentation.

In this step, the leading FMCG Company has identified two dimensions. First, the Service Level Segment, which will be as follows: Core SKUs (C), Non-Core SKUs (NC), Food Service SKUs (FS), and New Launch (NP). Second is the Planning Zone Segment, which will be Rigid, Balanced, Agile,

and Crop for all the SKUs in the leading FMCG Company. In identifying the two dimensions, the leading FMCG Company will better understand the adequate and proper actions needed to lock and share the needed volumes to be shared with suppliers considering the production capacity. This data was identified by comparing the sales volume of the leading FMCG Company and the end customer specifications. And in Table 1 and Table 2 are the two dimensions and their definition of them.

(a) Service Level Segment

Table 1: Service Level Segment in research methodology

#	Service Level Segment	Definition
1	Core (C)	Products that have relatively high-volume value indices
2	Non-Core (NC)	Products that have relatively Low-volume value indices
3	Food Service (FS)	Products that are dedicated to food service sales channel
4	New Launch (NP)	Products that are launched within 36 months

(b) Planning Zone Segment

Table 2: Planning Zone Segment in research methodology

#	Planning Zone Segment	Definition
1	Rigid	Products that have relatively high volume and long reaction time
2	Balanced	Products that have relatively Moderate volume and reaction time
3	Agile	Products that have relatively low volume and short reaction time
4	Crop	Products that are constrained to crop sourcing cycle

6- Identified the Planning Zones.

In this step, the leading FMCG Company has identified three planning zones. They are the main underlying parameter describing and managing the supply expectations related to the time factor in the overall business planning cycles. Planning zones are divided into three zones that are defined below:

- Fixed Zone: It occurs throughout supply ordering & forecast creation, production scheduling, and any frozen period applied by source unit or driven by-product nature. It is fixed behind the constrained in transit and under production supplies.
- Flexible Zone: It takes place over the longest lead time to acquire raw & packaging material. It has limited supply flexibility tolerance and is constrained to the available/allocated raw and pack material stock within the supply network.
- Open Zone: It takes place over and beyond the Fixed and Flexible Zones and is constrained only to source unit maximum allocated production capacity.

7- Identified the Actual Crop Calendar.

In this step, the leading FMCG Company has identified all the dimensions and parameters of the Crop calendar. They are the main underlying parameters that manage the expectations of the sales and marketing departments. This will help achieve maximum performance and provide optimal securing availability, customer service, and cost and time savings. The Crop calendar is divided into the below based on each SKU:

- Crop Period Production starts and ends month date.
- Shipment forecast Start and end month date.

- Sales Start and end month date.
- Submission of FCST to Supply Team by Demand Team.
- Calculating the volumes by Supply Team to submit to Sourcing Team.
- Sourcing - Lock Final Cost and Volumes with Suppliers.

#### IV. ANALYSIS AND RESULTS

##### 4.1 Evaluation of end-to-end lead time (E2E LT):

The details of the E2E LT model will be illustrated in this section. The leading FMCG Company has gathered and calculated the Order Review LT, Order Placement LT, Frozen Period LT, Production Scheduling LT, Origin In-Transit LT, Port-to-Port Transit LT, Clearance LT, Destination In-Transit LT, WH Receiving LT, Distribution Review LT, and Branch Transit LT. all the previous steps that are used in calculating the E2E LT will be explained in Table 3 and how the data were gathered and calculated.

Table 3: E2E LT After Improvement.

Lead Time (LT)	Method of Data Gathering and Calculations
Order Review LT	it is a part of an agreement with the leading FMCG Company and all suppliers, which is a standard across all suppliers, and this data was gathered from the agreement document.
Order Placement LT	it is a part of an agreement with the leading FMCG Company and all suppliers, which is a standard across all suppliers, and this data was gathered from the agreement document.
Frozen Period LT	it is a part of an agreement with the leading FMCG Company and all suppliers, which is a standard across all suppliers, and this data was gathered from the agreement document.
Production Scheduling LT	it is based on the location of the supplier, and it was calculated as below: Any SKU that will come from the Far East will be 60 Days. Any SKU that will come from the Americas will be 60 Days. Any SKU that will come from Europe will be 45 Days. Any SKU that will come from Asia will be 45 Days. Any SKU that will come from Egypt, Saudi, and UAE will be 30 Days.
Origin In-Transit LT	This was calculated through the online platform that the leading FMCG Company uses to track the shipments of all the SKUs. Here we have gathered the actual data of all arrived orders and used the statistical approach to calculate the actual mean.
Port-to-Port Transit LT	This was calculated through the online platform that the leading FMCG Company uses to track the shipments of all the SKUs. Here, we have gathered the actual data of all arrived orders and used the statistical approach to calculate the mean of the 60th percentile, the 70th percentile, the 80th percentile, and the 90th percentile.
Clearance LT	the logistics department calculated it, and the data was shared.
Destination In-Transit LT	the logistics department calculated it, and the data was shared.
WH Receiving LT	the logistics department calculated it, and the data was shared.
Distribution Review LT	the logistics department calculated it, and the data was shared.
Branch Transit LT	the logistics department calculated it, and the data was shared.
Total LT in Days	This is the summation of all the previous steps in days.
Total LT in Month	This is the summation of all the previous steps in months.

##### 4.1.1 Results of end-to-end lead time (E2E LT):

After applying the Method of Data Gathering and Calculations, the below will show the results for each parameter of the E2E LT.

###### 1- Order Review LT

Since it was stated in the table of the E2E LT that this parameter is a part of an agreement document, the lead time (LT) is 15 Days, and it will be applied to all the suppliers.

## 2- Order Placement LT

Since it was stated in the table of the E2E LT that this parameter is a part of an agreement document, the lead time (LT) is 5 Days, and it will be applied to all the suppliers.

## 3- Frozen Period LT

Since it was stated in the table of the E2E LT that this parameter is a part of an agreement document, the lead time (LT) is 0 Days, and it will be applied to all the suppliers.

## 4- Production Scheduling LT.

Since it was stated in the table of the E2E LT that this parameter is based on the location of the supplier. The lead time (LT) for a sample of five suppliers is shown in Table 4.

Table 4: Production Scheduling LT Improvement.

Suppliers	Production Scheduling LT
Supplier A A	60
Supplier A B	45
Supplier A C	60
Supplier A D	30
Supplier A E	45

## 5- Origin In-Transit LT

Since it was stated in the table of the E2E LT that this parameter is based on the online platform that the leading FMCG Company uses to track the shipments of all the suppliers. The lead time (LT) for a sample of five suppliers is shown in Table 5

Table 5: Origin In-Transit LT After Improvement

Suppliers	Origin In-Transit LT
Supplier A A	18
Supplier A B	12
Supplier A C	15
Supplier A D	12
Supplier A E	7

## 6- Port-to-Port Transit LT

Since it was stated in the table of the E2E LT that this parameter is based on the online platform that the leading FMCG Company uses to track the shipments of all the suppliers. The lead time (LT) for a sample of five suppliers is shown in Table 6.

Table 6: Port-to-Port Transit LT After Improvement

Suppliers	Port-to-Port Transit LT
Supplier A A	49
Supplier A B	33
Supplier A C	67
Supplier A D	18
Supplier A E	27

## 7- Clearance LT

Since it was stated in the table of the E2E LT that the logistics department calculated this parameter, it is also an average time. The lead time (LT) is 6 Days, and it will be applied to all the suppliers.

#### 8- Destination In-Transit LT

Since it was stated in the table of the E2E LT that the logistics department calculated this parameter, it is also an average time. The lead time (LT) is 2 Days, and it will be applied to all the suppliers.

#### 9- WH Receiving LT

Since it was stated in the table of the E2E LT that the logistics department calculated this parameter, it is also an average time. The lead time (LT) is 1 Day, and it will be applied to all the suppliers.

#### 10- Distribution Review LT

Since it was stated in the table of the E2E LT that the logistics department calculated this parameter, it is also an average time. The lead time (LT) is 1 Day, and it will be applied to all the suppliers.

#### 11- Branch Transit LT

Since it was stated in the table of the E2E LT that the logistics department calculated this parameter, it is also an average time. The lead time (LT) is 3 Days, and it will be applied to all the suppliers.

#### 12- Total LT

Since the leading FMCG Company has stated all the parameters and their respective LT in the below table, the total of the E2E LT for a sample of five suppliers is shown in Table 7.

Table 7: Total LT After Improvement.

Suppliers	Total LT in Days	Total LT in Month
Supplier A A	159	5.30
Supplier A B	122	4.07
Supplier A C	174	5.80
Supplier A D	92	3.07
Supplier A E	111	3.70

## 4.2 Evaluation of Production Capacity for the top 2 Portfolios:

The Production Capacity details for the top 2 portfolios model will be illustrated in this section. The leading FMCG Company has calculated the production capacity for all the suppliers that directly impact the placed orders always shared with the suppliers. The leading FMCG Company only calculated it for the top 2 portfolios (PA1 & PA2). Here, the leading FMCG Company has used the Demand Release Planning tool (DRP) to calculate the adequate volumes to share considering the production capacity. This data was extracted from an internal Demand Release Planning tool (DRP) that the leading FMCG Company uses to ensure that the days of coverage (DOC) are within the targeted DOC. Furthermore, this calculation will help ensure that the leading FMCG Company is available for future market demand.

### 4.2.1 PA1 Portfolio:

For the PA1 portfolio, the leading FMCG Company has only one supplier handling all the orders. The data for the capacity was shared from the supplier after the leading FMCG Company shared Table 8 model templet. This model templet was created in order to split the portfolio into smaller groups of SKUs which is called the marketing group (MG). This MG will help the leading FMCG Company ensure that future orders will be within the supplier's production capacity throughout the year.

Table 8: PA1 Production Capacity After Improvement.

Production Capacity	Method of Data Gathering and Calculations
MG 1	Based on splitting the portfolio into smaller groups of SKU's.
Supplier Production Capacity	Data was shared from the supplier based on the MG, and it is shared for the total year with the actual phasing for it in months.
Future Order Volumes	the leading FMCG Company Planning Team calculated data based on the MG, and it is shared for the total year with the actual phasing for it in months.
Capacity Vs. Volumes	Here the leading FMCG Company will calculate the Volumes and divide by the Capacity to be within the capacity limits.

#### 4.2.1.1 PA1 Portfolio Capacity Results:

Since we have only one supplier for PA1 Portfolio, the leading FMCG Company has requested the production capacity and compared it against the future order volumes. Figure 1 is the result of the comparison. As shown, the supplier can meet most of the future order volumes if compared against the total volumes against the capacity. But if the leading FMCG Company wants to have the future order volumes as per the below phasing, the leading FMCG Company will face an issue in the supplier's capacity. So, this capacity assessment will help adjust future order volumes to follow the supplier capacity and be within the acceptable SS and DOC levels.

#### 4.3.1 PA2 Portfolio:

For the PA2 portfolio, the leading FMCG Company has three suppliers handling all the orders. The data for the capacity was shared from the supplier after the leading FMCG Company shared Table 9 model templet. This model templet was created in order to split the portfolio into smaller groups of SKU's which is called the marketing group (MG). This MG will help the leading FMCG Company make sure that future orders will be within the production capacity of all suppliers throughout the year.

Table 9: PA2 Portfolio Production Capacity After Improvement.

Production Capacity	Method of Data Gathering and Calculations
MG 1	Based on splitting the portfolio into smaller groups of SKUs.
Supplier Production Capacity	Data was shared from the supplier based on the MG, and it is shared for the total year with the actual phasing for it in months.
Future Order Volumes	The leading FMCG Company Planning Team calculated data based on the MG, and it is shared for the total year with the actual phasing for it in months.
Capacity Vs. Volumes	Here the leading FMCG Company will calculate the Volumes and divide by the Capacity to be within the capacity limits

#### 4.3.2 PA2 Portfolio Capacity Results:

Since we have three suppliers for PA2 Portfolio, the leading FMCG Company, we have requested the production capacity and compared it against the future order volumes. Figure 2 is the result of the comparison. As shown, the suppliers can meet most of the future order volumes if compared against the total volumes against the capacity. But if the leading FMCG Company wants to have the future order volumes as per the below phasing, the leading FMCG Company will face an issue in the supplier's capacity. So, this capacity assessment will help in adjusting the future order volumes to follow the supplier capacity and be within the acceptable SS and DOC levels.

**4.4 Evaluation of new SS and DOC:**

The details of the new SS and DOC model will be illustrated in this section. The leading FMCG Company has calculated the new SS and DOC for all the SKUs. The leading FMCG Company has used safety stock (SS) calculation based on the Normal Distribution method with Uncertainty On-Demand and Independent Lead Time. This calculation will help adjust the safety stock and the days of coverage for all the SKUs in the leading FMCG Company to have them available for future market demand. They are explained in Table 10 and how the data were gathered and calculated.

Table 10: New SS and DOC After Improvement

Safety Stock (SS) and Days of Coverage (DOC)	Method of Data Gathering and Calculations
Stock Keeping Unit (SKU)	All the SKUs are active in the leading FMCG Company.
Forecast (FCST)	This is the sales demand for the previous 12 months, and the demand department shared it
Actual Sales	This is the actual sales for the previous 12 months, and the demand department shared it
Error	This is the difference in the FCST and sales in cases
Root Mean Squared Error (RMSE)	This is a formula that will calculate the Root Mean Squared Error of the sales in cases
Demand Average	This is the average sales for the previous 12 months
Lead Time Average	This is the lead time Average for the previous 12 months
Lead Time standard deviation	This is the lead time standard deviation for the previous 12 months
Service Level	This is the target of the availability for all the SKUs, defined by the leading FMCG Company.
Z - Value	This is a statistical value, and it is calculated based on the service level target
Safety Stock in Cases (SS)	This is the term that describes the level of the stocks that the leading FMCG Company should have to mitigate the risk of stockouts
Days of Coverage (DOC)	This is the interpretation of the SS but in days

**4.4.1 Results of new SS and DOC:**

After applying the Method of Data Gathering and Calculations in point 4.5, the new SS and DOC results are below.

1- Forecast (FCST)

Since it was stated in the new SS and DOC table that this parameter is for the previous 12 months, Table 12 is a sample data of five SKU’s shared by the demand department.

Table 12: Forecast

Item Name	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
ITEM A A	438	563	694	405	129	149	129	129	129	129	282	149
ITEM A B	1,200	1,127	891	660	341	441	341	341	341	341	607	441
ITEM A C	538	553	562	305	266	313	266	266	266	266	463	313
ITEM A D	531	543	429	335	316	369	316	316	316	316	615	369
ITEM A E	182	182	182	182	0	0	0	0	0		0	

2- Actual Sales

Since it was stated in the new SS and DOC table that this parameter is for the previous 12 months, Table 13 is a sample data of five SKU’s shared by the demand department.



MG 1	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total Year	DIFF
Future Order Volumes	46,800	51,060	53,460	53,460	53,460	14,520	38,940	34,500	28,950	45,600	57,900	56,700	535,350	
Supplier Production Capacity	91,412	78,353	91,412	91,412	43,094	91,412	91,412	91,412	91,412	91,412	91,412	91,412	1,035,565	500,215
Capacity Vs Volumes Ratio	1.95	1.53	1.71	1.71	0.81	6.30	2.35	2.65	3.16	2.00	1.58	1.61	1.93	
MG 2	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total Year	DIFF
Future Order Volumes	17,760	22,200	24,420	8,880	8,880	8,880	16,650	17,760	11,100	17,760	24,420	27,750	206,460	
Supplier Production Capacity	21,000	18,000	21,000	21,000	12,000	21,000	21,000	21,000	21,000	21,000	21,000	21,000	240,000	33,540
Capacity Vs Volumes Ratio	1.18	0.81	0.86	2.36	1.35	2.36	1.26	1.18	1.89	1.18	0.86	0.76	1.16	
MG 3	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total Year	DIFF
Future Order Volumes	40,000	44,000	48,000	12,000	12,000	12,000	32,000	30,000	26,000	34,000	46,000	54,000	390,000	
Supplier Production Capacity	112,941	96,471	112,941	112,941	54,118	112,941	112,941	112,941	112,941	112,941	112,941	112,941	1,280,000	890,000
Capacity Vs Volumes Ratio	2.82	2.19	2.35	9.41	4.51	9.41	3.53	3.76	4.34	3.32	2.46	2.09	3.28	
MG 4	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total Year	DIFF
Future Order Volumes	76,160	80,640	89,600	60,480	58,240	60,480	58,240	60,480	44,800	58,240	87,360	103,040	837,760	
Supplier Production Capacity	72,000	59,000	72,000	72,000	35,000	72,000	72,000	72,000	72,000	72,000	72,000	72,000	814,000	- 23,760
Capacity Vs Volumes Ratio	0.95	0.73	0.80	1.19	0.60	1.19	1.24	1.19	1.61	1.24	0.82	0.70	0.97	

Figure 1: PA1 Production Capacity Assessment After Improvement

MG 1	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total Year	DIFF
Future Order Volumes	36,248	22,000	1,456	15,904	33,488	45,696	52,528	47,264	39,872	172,256	232,960	135,968	835,640	
Supplier Production Capacity	102,250	109,750	109,750	109,750	109,750	109,750	109,750	67,563	109,750	109,750	109,750	82,438	1,240,000	404,360
Capacity Vs Volumes Ratio	2.82	4.99	75.38	6.90	3.28	2.40	2.09	1.43	2.75	0.64	0.47	0.61	1.48	
MG 2	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total Year	DIFF
Future Order Volumes	100,000	51,000	13,513	60,371	83,808	114,181	131,093	116,765	98,499	437,485	581,937	331,169	2,119,821	
Supplier Production Capacity	259,000	259,000	259,000	259,000	259,000	259,000	259,000	104,035	247,750	255,250	259,000	217,500	2,896,535	776,714
Capacity Vs Volumes Ratio	2.59	5.08	19.17	4.29	3.09	2.27	1.98	0.89	2.52	0.58	0.45	0.66	1.37	
MG 3	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total Year	DIFF
Future Order Volumes	10,000	6,000	2,000	2,000	2,000	5,670	13,770	12,474	10,530	43,956	60,372	36,936	205,708	
Supplier Production Capacity	45,500	45,500	45,500	45,500	45,500	45,500	45,500	23,400	45,500	45,500	40,250	35,000	508,150	302,442
Capacity Vs Volumes Ratio	4.55	7.58	22.75	22.75	22.75	8.02	3.30	1.88	4.32	1.04	0.67	0.95	2.47	

Figure 2: PA2 Production Portfolio Capacity Assessment After Improvement

Table 13: Actual Sales

Item Name	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
ITEM A A	366	356	444	100	251	203	465	493	179	345	227	425
ITEM A B	1,028	658	837	330	692	406	506	527	151	329	793	655
ITEM A C	388	113	768	128	467	289	403	393	205	278	489	518
ITEM A D	628	348	762	79	430	419	531	343	192	240	512	476
ITEM A E	53	30	52	24	50	17	-2	0	-6		-1	

3- Error

Since it was stated in the new SS and DOC table that this parameter is the difference in the FCST and sales in cases for the previous 12 months, Table 14 is a sample data of five SKU’s and the result of the calculation.

Table 14: Error

Item Name	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
ITEM A A	-72	-207	-250	-305	122	54	337	364	51	216	-55	276
ITEM A B	-172	-469	-54	-330	351	-35	165	186	-190	-12	186	214
ITEM A C	-150	-440	206	-177	201	-24	137	127	-61	12	27	205
ITEM A D	97	-195	333	-256	114	50	214	26	-125	-77	-103	106
ITEM A E	-129	-152	-130	-158	50	17	-2	0	-6	0	-1	0

4- Root Mean Squared Error (RMSE)

Since it was stated in the table of the new SS and DOC that this parameter is the calculation of Square Root  $((\text{Error } 1)^2 + (\text{Error } 2)^2 + \dots + (\text{Error } 12)^2) / 12$ , Table 15 is a sample data of five SKU’s and the result of the calculation.

Table 15: Root Mean Squared Error (RMSE)

Item Name	Root Mean Squared Error (RMSE)
ITEM A A	223
ITEM A B	235
ITEM A C	186
ITEM A D	166
ITEM A E	84

5- Demand Average

Since it was stated in the table of the new SS and DOC that this parameter calculates the average of the actual sales for the previous 12 months, Table 16 is a sample data of five SKU’s and the result of the calculation.

Table 16: Actual Sales Average

Item Name	Actual Sales Average
ITEM A A	321
ITEM A B	576
ITEM A C	370
ITEM A D	413
ITEM A E	22

## 6- Lead Time Average

Since it was stated in the table of the new SS and DOC that this parameter calculates the average lead time for the previous 12 months, Table 17 is a sample data of five SKU's and the result of the calculation.

Table 17: Lead Time Average

Item Name	Lead Time Average in Months
ITEM A A	3
ITEM A B	3
ITEM A C	3
ITEM A D	3
ITEM A E	3

## 7- Lead Time Standard Deviation

Since it was stated in the table of the new SS and DOC that this parameter calculates the average lead time standard deviation for the previous 12 months, Table 18 is a sample data of five SKU's and the result of the calculation.

Table 18: Lead Time Standard Deviation

Item Name	Lead Time Standard Deviation in Months
ITEM A A	0.17
ITEM A B	0.17
ITEM A C	0.17
ITEM A D	0.17
ITEM A E	0.17

## 8- Service Level

Since it was stated in the table of the new SS and DOC, this parameter is a target of the availability for all the SKUs, which is defined by the leading FMCG company itself, and the target is 98.5% availability for all the SKUs.

## 9- Z – Value

Since it was stated in the new SS and DOC table, this parameter is a statistical value. It is calculated based on the service level target, and the Z- value is 2.17 in the normal distribution table.

## 10- Safety Stock in Cases (SS)

Since it was stated in the table of the new SS and DOC that this parameter is the calculation of = Z - Value \*Square Root ((Avg LT \*(RMSE<sup>2</sup>))+((Avg sales<sup>2</sup>)\*(STD LT<sup>2</sup>))), Table 19 is a sample of five SKU's and the result of the calculation.

Table 19: Safety Stock in Cases (SS)

Item Name	SS (Cs)
ITEM A A	845
ITEM A B	908
ITEM A C	710
ITEM A D	640
ITEM A E	316

## 11- Days of Coverage (DOC)

Since it was stated in the new SS and DOC table that this parameter is the calculation of =  $SS (Cs) / \text{Avg sales} * 30$ , Table 20 is a sample of five SKU's and the result of the calculation.

Table 20: Days of Coverage (DOC)

Item Name	DOC
ITEM A A	79
ITEM A B	47
ITEM A C	58
ITEM A D	47
ITEM A E	437

**4.5 Evaluation of On Time In Full (OTIF):**

The On-Time In Full (OTIF) model will be illustrated in this section. The leading FMCG Company has calculated the On Time In Full (OTIF) for all the suppliers. Here, the leading FMCG Company has used the standard calculation of the on-time delivery and in full quantity delivered. This calculation will help understand the supplier's reliability which will be directly connected to calculating the future order volumes for all the SKUs, explained in Table 21, and how the data were gathered and calculated.

Table 21: On Time in Full (OTIF) Calculation After Improvement

On Time In Full (OTIF)	Method of Data Gathering and Calculations
OT%	This KPI measures the number of finished goods delivered to the leading FMCG Company on time, and the data were gathered through the integration of the online platform and the internal system of the leading FMCG Company (SAP)
IF%	This KPI measures the volume of finished goods delivered to the leading FMCG Company in Volume against the Ordered volumes. There is no limitation on the % of the delivered volumes. The data were gathered by integrating the online platform and the internal system of the leading FMCG Company (SAP).
OTIF%	This KPI is the multiplication of $OT * IF$

**4.6.1 Results of On Time in Full (OTIF):**

After applying the Method of Data Gathering and Calculations, the below will show the Time In Full (OTIF) results.

## 1- On-Time Delivery (OT%)

Since it was stated in the On Time In Full (OTIF) Table 21, this parameter measures the number of finished goods delivered within the agreed time. The data were gathered through the integration of the online platform and the internal system of the leading FMCG Company (SAP) for all the suppliers, and they are in Table 22.

Table 22: On Time Delivery (OT%) Results After Improvement

On-Time Delivery								
Suppliers	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Supplier A A	100%	55%	57%	100%	100%	0%	42%	88%
Supplier A B	100%	100%	100%	100%	100%	100%	100%	
Supplier A C	60%	91%		100%	100%	100%	100%	
Supplier A D		100%						
Supplier A E	83%	0%	88%		100%	0%	100%	

## 2- In Full Quantity (IF%)

Since it was stated in the On Time in Full (OTIF) Table 21 that this parameter is the measure of volumes of finished goods delivered in volume against the ordered volumes, there is no limitation on the percentage of the delivered volumes. The data were gathered through the integration of the online platform and the internal system of the leading FMCG Company (SAP) for all the suppliers, and they are in Table 23.

Table 23: In Full Quantity (IF%) Results After Improvement

In Full Quantity (IF%)								
Suppliers	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Supplier A A	100%	96%	100%	100%	100%	100%	97%	89%
Supplier A B	95%	100%	100%	100%	100%	100%	100%	
Supplier A C	80%	91%		100%	100%	100%	100%	
Supplier A D		100%						
Supplier A E	83%	29%	100%		100%	100%	100%	

## 3- On-Time In Full (OTIF)

Since it was stated in Table 21 of the On Time in Full (OTIF) that this parameter is the measure of multiplying the Results of the On-Time Delivery (OT%) \* In Full Quantity (IF%), the data were gathered through the integration of the online platform and the internal system of the leading FMCG Company (SAP) for all the suppliers, and they are in Table 24.

Table 24: On Time in Full (OTIF) Results After Improvement

On-Time in Full (OTIF%)								
Suppliers	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Supplier A A	100%	53%	57%	100%	100%	0%	41%	78%
Supplier A B	95%	100%	100%	100%	100%	100%	100%	
Supplier A C	48%	83%		100%	100%	100%	100%	
Supplier A D		100%						
Supplier A E	69%	0%	88%		100%	0%	100%	

## 4.6 Evaluation of Planning Segmentation:

The details of the Planning Segmentation model will be illustrated in this section. The leading FMCG Company has identified two dimensions. First, is the Service Level Segment, which will be as follows: Core SKUs (C), Non-Core SKUs (NC), Food Service SKUs (FS), and New Launch (NP). Second is the Planning Zone Segment, which will be Rigid, Balanced, Agile, and Crop for all the SKUs in the leading FMCG Company. In identifying the two dimensions, the leading FMCG Company will better understand the adequate and proper actions needed to lock and share the needed volumes to be shared with suppliers considering the production capacity. This data was identified by comparing the sales volume of the leading FMCG Company and the end customer specifications and explained in Table 25 and how the data were gathered and identified.

## 1- Service Level Segment

Table 25: Service Level Segment After Improvement

Service Level Segment	Definition
Core (C)	Products that have relatively high-volume value indices and the data were gathered and identified by comparing the sales volume of the leading FMCG Company and the end customer specifications.
Non-Core (NC)	Products that have relatively Low-volume value indices and the data were gathered and identified by comparing the sales volume of the leading FMCG Company and the end customer specifications.
Food Service (FS)	Products that are dedicated to food service sales channels and the data were gathered and identified by comparing the sales volume of the leading FMCG Company and the end customer specifications.
New Launch (NP)	Products that are launched within 36 months and the data were gathered and identified by comparing the sales volume of the leading FMCG Company and the end customer specifications.

Since it was stated in Table 25 of Service Level Segment that this parameter is about identifying the segment of all the active SKUs, it will help the leading FMCG Company understand the adequate and proper actions that are needed to be taken with the suppliers. This data was identified by comparing the sales volume of the leading FMCG Company and the end customer specifications for all the SKUs, and here the leading FMCG Company has identified it by marketing group (MG) level. Then it will be cascaded to the SKU level, and in Table 26.

## 2- Planning Zone Segment

Table 26: Planning Zone Segment After Improvement

Planning Zone Segment	Definition
Rigid	Products with relatively high volume and long reaction time where the leading FMCG Company have used the data from the E2E LT calculation to identify the adequate zone.
Balanced	Products with relatively Moderate volume and reaction time where the leading FMCG Company has used the data from the E2E LT calculation to identify the adequate zone.
Agile	Products with relatively low volume and short reaction time where the leading FMCG Company has used the data from the E2E LT calculation to identify the adequate zone.
Crop	Products constrained to crop sourcing cycle where the leading FMCG Company has used the data from the E2E LT calculation to identify the adequate zone.

### 4.6.1 Results of Planning Segmentation:

After applying the method of the planning segmentation in the two dimensions, the below will show the results for Planning Segmentation.

## 1- Service Level Segment

Since it was stated in Table 25 of Service Level Segment that this parameter is about identifying the segment of all the active SKUs, it will help the leading FMCG Company understand the adequate and proper actions that are needed to be taken with the suppliers. This data was identified by comparing the sales volume of the leading FMCG Company and the end customer specifications for all the SKUs, and here the leading FMCG Company has identified it by marketing group (MG) level. Then it will be cascaded to the SKU level, and a sample of three MG is shown in Table 27.

Table 27: Service Level Segment Results After Improvement

Marketing Group	Service Level Segment
MG A A	Core (C)
MG A B	Non-Core (NC)
MG A C	Food Service (FS)

## 2- Planning Zone Segment

Since it was stated in the table of Planning Zone Segment that this parameter is about identifying the zones of all the active SKUs, it will help the leading FMCG Company understand the adequate and proper actions that are needed to be taken with the suppliers. This data was identified by comparing the sales volume of the leading FMCG Company and the end customer specifications for all the SKUs, and here the leading FMCG Company has identified it by marketing group (MG) level. Then it will be cascaded to the SKU level, and a sample of three MG is shown in Table 28.

Table 28: Planning Zone Segment Results After Improvement

Marketing Group	Planning Zone Segment
MG A A	Balanced
MG A B	Balanced
MG A C	Rigid

#### 4.7 Evaluation of Planning Zones:

The details of the Planning Zones model will be illustrated in this section. The leading FMCG Company has identified three planning zones. They are the main underlying parameter that describes and manages supply expectations related to the time factor in the overall business planning cycles, explained in Table 29 and how the data were gathered and identified.

Table 29: Planning Zones After Improvement

Planning Zones	Definition
Fixed Zone	It occurs throughout supply ordering & forecast creation, production scheduling, and any frozen period applied by source unit or driven by product nature. It is fixed behind the constrained in transit and under production supplies. This data was gathered from the agreement document.
Flexible Zone	It takes place over the longest lead time to acquire raw & packaging material. It has limited supply flexibility tolerance and is constrained to the available/allocated raw and pack material stock within the supply network. This data was gathered from the agreement document.
Open Zone	It takes place over and beyond the Fixed and Flexible Zones and is constrained only to source unit maximum allocated production capacity. This data was gathered from the agreement document.

##### 4.7.1 Results of Planning Zones:

After applying the method of the planning zones, the below will show the results for the Planning zones.

###### 1- Fixed Zone

Since it was stated in Table 29 of Planning Zones that this parameter is about the identification of the periods of supply ordering zones where it is fixed behind the constrained in transit and under production supplies for all the active SKUs, it will help the leading FMCG Company in managing the supply expectations related to the time factor in the overall business planning cycles. This data was identified from the agreement document. For all the SKUs here, the leading FMCG Company has identified it by marketing group (MG) level, and then it will be cascaded to the SKU level, and a sample of three MG is shown in Table 30.

Table 30: Fixed Zones After Improvement

Marketing Group	Firm Zone
MG A A	2 Month
MG A B	3 Month
MG A C	4 Month

###### 2- Flexible Zone



Since it was stated in Table 29 of Planning Zones that this parameter is about the identification of the zone that the supplier takes to acquire raw & packaging material over the longest lead time to supply and it is for all the active SKUs, and it will help the leading FMCG company in managing the supply expectations related to the time factor in the overall business planning cycles. Moreover, the Crop SKUs will not be added here because the Crop SKU does not have a flexible zone. This data was identified from the agreement document. For all the SKUs and here, the leading FMCG company has identified it by marketing group (MG) level, and then it will be cascaded to the SKU level, and a sample of three MG is shown in Table 31.

Table 31: Flexible Zones After Improvement

Marketing Group	Flexible Zone
MG A A	2 Month
MG A B	2 Month
MG A C	2 Month

### 3- Open Zone

Since it was stated in Table 29 of Planning Zones that this parameter is about identifying zone that takes place over and beyond the Fixed and Flexible Zones, it is for all the active SKUs. It will help the leading FMCG company manage the supply expectations related to the time factor in the overall business planning cycles. Moreover, the Crop SKUs will not be added here because the Crop SKU does not have an open zone. This data was identified from the agreement document. For all the SKUs and here, the leading FMCG company has identified it by marketing group (MG) level, and then it will be cascaded to the SKU level, and a sample of three MG is shown in Table 32.

Table 32: Open Zones After Improvement

Marketing Group	Open Zone
MG A A	4 Month
MG A B	5 Month
MG A C	5 Month

## 4.8 Evaluation of Actual Crop Calendar:

The details of the Actual Crop Calendar model will be illustrated in this section and identify all the dimensions and parameters that are part of the Crop calendar. They are the main underlying parameters that manage the expectations of the sales and marketing departments. This will help achieve maximum performance among the leading FMCG companies and provide optimal securing availability, customer service, and cost and time savings. They are explained in Table 33 and how the data were gathered and identified.

### 4.8.1 Results of Actual Crop Calendar:

After applying the method of the Crop calendar in point 4.9, the below will show the results for the Actual Crop Calendar.

#### 1- Crop Period Production Start and End Month

Since it was stated in Table 33 of Actual Crop Calendar that this parameter is about the start and end of harvesting and production of the Crop product, this data was identified from the agreement document. The communications with the suppliers for all the SKU's and here the leading FMCG Company have identified it by marketing group (MG) level. Then it will be cascaded to the SKU level, and a sample of two MG is shown in Table 34.

Table 33: Crop Calendar Definition After Improvement.

Crop Calendar	Definition
Crop Period Production Start month to date.	It is the start period of the harvesting and production of the Crop product.
Crop Period Production End month date.	It is the end period of the harvesting and production of the Crop product.
Crop Period Shipment Start month to date.	It is the start period of the shipment of the Crop product.
Crop Period Shipment End month date.	It is the end period of the shipment of the Crop product.
Crop Period Sales Start month to date.	It is the start period of the Sales of the Crop product.
Crop Period Sales End month to date.	It is the end period of the Sales of the Crop product.
Submission of FCST to Supply Team by Demand Team.	it is a fixed date that is calculated based on the actual date of the start of production of the Crop.
Calculating the volumes by Supply Team to submit to Sourcing Team.	it is a fixed date and the calculation of the needed Crop volumes to lock with the supplier, and it is based on the forecast.
Lock Final Cost and Volumes with Suppliers.	It is a fixed date, and the communications and negotiations of the needed Crop volumes are to lock with the supplier.

Table 34: Crop Period Production Start and End Month After Improvement

Marketing Group	Crop Period Production Start month to date.	Crop Period Production End month date.
MG B B	20-Aug	21-Jul
MG B C	20-Sep	21-Aug

### 2- Crop Period Shipments Start and End Month

Since it was stated in Table 33 of Actual Crop Calendar that this parameter is about the start and end of the shipments of the Crop product, this data was identified from the agreement document. The communications with the suppliers for all the SKU's and here the leading FMCG Company have identified it by marketing group (MG) level. Then it will be cascaded to the SKU level, and a sample of two MG is shown in Table 35.

Table 35: Crop Period Shipment Start and End Month After Improvement

Marketing Group	Crop Period Shipment Start month to date.	Crop Period Shipment End month date.
MG B B	20-Sep	21-Aug
MG B C	20-Oct	21-Sep

### 3- Crop Period Sales Start and End Month

Since it was stated in Table 33 of Actual Crop Calendar that this parameter is about the start and end of the Sales of the Crop product, this data was identified from the previous stages where the leading FMCG Company have agreed to standardize the sales period to be one month after the shipment month for all the SKU's. Here the leading FMCG Company has identified it by marketing group (MG) level, and then it will be cascaded to the SKU level, and a sample of two MG is shown in Table 36.

Table 36: Crop Period Sales Start and End Month After Improvement

Marketing Group	Crop Period Sales Start month to date.	Crop Period Sales End month to date.
MG B B	20-Oct	21-Sep
MG B C	20-Nov	21-Oct

#### 4- Submission of FCST to Supply Team

Since it was stated in Table 33 of Actual Crop Calendar that this parameter is about the submission of forecast to the Supply Team for all the Crop products, this data was identified from the previous stages where the leading FMCG Company have agreed to standardize the submission of the forecast period to be three months before the start of production month for all the SKU's. The leading FMCG Company has identified it by marketing group (MG) level. Then it will be cascaded to the SKU level, and a sample of two MG is shown in Table 37.

Table 37: Submission of FCST to Supply Team After Improvement

Marketing Group	Submission of FCST to Supply Team
MG B B	May'20
MG B C	Jun'20

#### 5- Calculating the Volumes by Supply Team to Submit to Sourcing Team

Since it was stated in Table 33 of Actual Crop Calendar that this parameter is about calculating the volumes and submitting it to Sourcing Team for all the Crop products, this data was identified from the previous stages where the leading FMCG Company have agreed to standardize the submission of the forecast period to be In the same month of the submission of the forecast for all the SKU's. Here the leading FMCG Company has identified it by marketing group (MG) level, and then it will be cascaded to the SKU level, and a sample of two MG is shown in Table 38.

Table 38: Calculating the Volumes by Supply Team to Submit to Sourcing Team After Improvement

Marketing Group	Calculating the volumes by Supply Team to submit to Sourcing Team
MG B B	May'20
MG B C	Jun'20

#### 6- Lock Final Cost and Volumes with Suppliers.

Since it was stated in Table 33 of Actual Crop Calendar that this parameter is about the submission of forecast to the Supply Team for all the Crop products, this data was identified from the previous stages where the leading FMCG Company have agreed to standardize the submission of the forecast period to be two months before the start of production month for all the SKU's. The leading FMCG Company has identified it by marketing group (MG) level. Then it will be cascaded to the SKU level, and a sample of two MG is shown in Table 39.

Table 39: Lock Final Cost and Volumes with Suppliers After Improvement

Marketing Group	Lock Final Cost and Volumes with Suppliers.
MG B B	Jun'20
MG B C	Jul'20

### 4.9 Results of On-Shelf Availability (OSA):

After going through the methods in this section, the below will show the results of the On-Shelf Availability (OSA) for both PA1 and PA2 Portfolios:

#### 1- PA2 Portfolio OSA:

Table 40: PA2 Portfolio OSA Results After Improvement

PA2	20-Jan	20-Feb	20-Mar	20-Apr	20-May	20-Jun	20-Jul	20-Aug	20-Sep
MG 1	55%	65%	61%	62%	65%	67%	73%	77%	82%
MG2	76%	83%	77%	84%	83%	84%	86%	87%	89%
MG 3	85%	88%	76%	65%	63%	76%	86%	84%	86%
<b>Grand Total</b>	<b>72%</b>	<b>79%</b>	<b>71%</b>	<b>70%</b>	<b>71%</b>	<b>76%</b>	<b>82%</b>	<b>83%</b>	<b>86%</b>

Table 40 shows that the OSA for PA2 Portfolio in the leading FMCG Company has increased from around 72% at the beginning of 2020 to 86% as of the last reading in September 2020.

## 2- PA1 Portfolio OSA:

Table 41 shows that the OSA for PA1 Portfolio in the leading FMCG Company has increased from around 80% at the beginning of 2020 to 90% as of the last reading in September 2020.

Table 41: PA1 Portfolio OSA Results After Improvement

PA1	20-Mar	20-Apr	20-May	20-Jun	20-Jul	20-Aug	20-Sep
MG 4	81%	82%	79%	82%	82%	90%	92%
MG 5	83%	83%	86%	81%	84%	85%	89%
MG 6	83%	85%	89%	82%	84%	91%	94%
MG 7	72%	68%	70%	72%	71%	71%	85%
<b>Grand Total</b>	<b>80%</b>	<b>79%</b>	<b>81%</b>	<b>79%</b>	<b>80%</b>	<b>84%</b>	<b>90%</b>

## V. DISCUSSION AND RECOMMENDATION

The literature review reveals that in order to have good responsiveness and agility in supply chain planning management, the leading FMCG Company has to consider all the parameters discussed previously in the analysis and results. Moreover, E2E LT, Production Capacity, SS and DOC, OTIF, Planning Segmentation, Planning Zones, and Crop Calendar are excellent approaches and methods that will lead to a strong market position and market shares the expected and unexpected future threats. All the mentioned approaches and methods are explained by their ability to:

- E2E LT will help the leading FMCG Company in managing customer expectations as well as order expectations.
- Production Capacity will help the leading FMCG Company calculate adequate and proper volumes.
- SS and DOC will help the leading FMCG Company in having adequate and proper inventory levels for all the SKU's
- OTIF will help the leading FMCG Company have a clear understanding of the reliability of all the suppliers.
- Planning Segmentation will help the leading FMCG Company better understand the adequate and proper actions needed to lock and share the needed volumes to be shared with suppliers to consider the production capacity.
- Planning Zones will help the leading FMCG Company manage the supply expectations related to the time factor in the overall business planning cycles.

- Crop Calendar will help the leading FMCG Company manage the expectations of sales and marketing departments for Crop SKUs. Moreover, it will help achieve maximum performance among the leading FMCG companies and provide optimal levels of securing availability.

After going through all the methods in this paper and the analysis and results, the leading FMCG Company had to determine that they wanted to be proactive in product availability, ensure stakeholder visibility and alignment, maintain business results, enable inventory optimization, and drive OSA Improvement.

## VI. CONCLUSION

End to end lead time (E2E LT), Production Capacity, Safety Stock (SS) and Days of Coverage (DOC), On Time in Full (OTIF), Planning Segmentation, Planning Zones, and Crop Calendar are useful approaches and methods for having clear visibility in which will lead to having a good understanding in order cycle timelines. Where it will improve the on-shelf availability of OSA. Which eventually will lead to improving the Responsiveness and Agility in Supply chain Planning Management.

The different steps of the methodology provided the leading FMCG Company with the tools and techniques required to create, evaluate, and take actions needed to protect the leading FMCG Company in the market position and market shares. The methodology simplified the actions needed by breaking them into different steps so the leading FMCG Company could implement all the active SKUs.

This paper presents the methodology of evaluating and selecting the most appropriate methods to improve the Supply chain Planning Management Responsiveness and Agility by implementing E2E LT, Production Capacity, SS and DOC, OTIF, Planning Segmentation, Planning Zones, and Crop Calendar.

By the end of this work, the leading FMCG Company had achieved the following:

- Applying the E2E LT method in real-life problem
- Applying the Production Capacity Assessment method in real-life problems.
- Applying SS and DOC method in real-life problems.
- Applying the OTIF method in real-life problems.
- Applying Planning Segmentation method in real-life problems.
- Applying Planning Zones method in real-life problems.
- Applying the Crop Calendar method in real-life problems.

**Conflict of interest:** The authors declare that they have no conflict of interest.

**Ethical statement:** The authors declare that they have followed ethical responsibilities.

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