Assessment of Jasmine Supply Chain Centered Upon Nilakotai Market

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Abstract: - **Jasmine value chain is dependent on the nature termed 'Perishability'. Perishability serves to be a predominant factor in the assessment of nature of Jasmine supply chain. In Tamil Nadu several districts provide their contribution to promote jasmine supply chain among them Nilakotai district has been chosen due the presence of perfume industries and a wide pool of farmers who are into jasmine cultivation for generations beyond. In Nilakotai district Nilakotai market serves to be the hub that facilitates material and cash flow into the Nilakotai market-based value chain. A network is framed possessing the characteristics of the jasmine value chain centered upon Nilakotai market under three layers of nodes namely suppliers, dealers, consumers respectively. The networks are framed with distance and profit as central parameters respectively. These networks are analyzed based on resilience and inferences are drawn individually for both networks based on cost and distance centered and then these individual inferences are compared and a common characteristic determined and conclusions are postulated based upon results and inferences.**

Index Terms- Cash flow,Material flow, Perishability, Resilience, Value chain.

Introduction

principle of an analyst is to create a perfect balance between cost and performance of supply chain. It is a nonvalue added entity in the entire service rendered by institutions to meet the customer demand. Institutions referred here refer to any firm that involve themselves in the service to meet customer demands like commercial organizations, business firms, service firms etc.

Supply chain principles are further centered upon two broad classifications they are value chains that involve goods of perishable category and value chains that involve goods of nonperishable category. Perishable goods include milk, curd, newspaper, butter, fruit juices, flowers etc. Nonperishable goods comprise of items such as wood sculptures, plastic toys, metal frames, laptops, computers etc.

Jasmine supply chain comprises of goods of perishable nature that make their analyses prone to the inclusion of time of transportation or time of goods in pipe line as a predominant factor that differentiated it from its counterpart nonperishable goods.

Flower distributions are in various forms. Flowers are distributed in the raw material format after collection of buds, they are woven into garlands and sold in shops and by street vendors, flowers are also acquired by perfume industries to manufacture perfumes, flowers are contracted by marriage halls or other ceremonial function coordinators to suite their decoration needs.

Among flowers jasmine takes a predominant place in the above-mentioned activities in Tamil Nadu and preparing individual supply chains involving all players is a hectic task, so all players those take part in jasmine supply network are brought into the three layers of fabric namely suppliers, dealers, consumers.

First the jasmine flowers that are harvested are brought by farmers near Nilakotai-to-Nilakotai market where they are segregated and then sold to consumers through different layers of dealers namely Export dealers, Local dealer, Perfume industry dealer. Each dealer serves different nature of consumer like Export dealers trades flowers to export agencies, Local dealer trades flowers to rural and urban people and Perfume industry dealer trades flower to perfume companies. The dealers maintain a flourishing relationship with farmers such as they help them in emergency times by giving loans in advance and support them at time of loss through aiding financial support.

When network is considered based on distance centric the material flows take place from suppliers to dealers to consumers on the contrary when network is considered on cost basis the inverse flow is noticed that flow of cash is from consumers to dealers to suppliers.

The present existing nature of Jasmine supply chain was discussed and then the chain was analyzed through resilience formula through the aid of MATLAB R2021a software and inferences are provided based upon the invoke of formula and results are postulated.

II.   LITERATURE SURVEY

'An Economic analysis of Jasmine Cultivation in Tamil Nadu' [5] it is portrayed that Horticulture has played a vital role in Indian agriculture and the sector produces more than total food grains in the country. In addition to this fact, it also conveys that the cultivation of jasmine flower generated good employment opportunities for family members, agricultural laborers and is well adopted by female workers [5]. These quotations further provide a strong base for this research article.

The flowers harvested in India are exported to neighboring countries such as Sri Lanka, Singapore, Malaysia and Middle East [6]. Fertile land for Jasmine flower is more concentrated in Tamil Nadu [6]. These findings expose the economic potential and importance to concentrate on jasmine value chain and this principle also backs up the influence of this research article in its expected influence in Jasmine value chain at Tamil Nadu.

Small and medium farmers in countries are heavily dependent on wholesale agents and traders for market information and are bound by credit facilities that inoculate them into an informal contractual relationship   [4]. This particular finding plays a vital role in determining the nature of the players of value chain of jasmine based upon Nilakotai market whether they remain static or subjected to removal and analysis in value chain network in this research article.

The essential oil of jasmine serves to be one of the most important and indispensable flower essences used in cosmetic products today [3]. This factual information encourages the inclusion of perfume dealer as one of the vital players in value chain network in this research article.

At the end of production chain, there is no way to correct production failures or upgrade the quality of final product, the low-quality products can only be sold at lower prices and the non-marketable products have to be discarded [8]. This documentation provides base for the reduction of profit cost for local dealers when compared to export and perfume dealers in the jasmine value chain network and also the principle of segregation of flowers between different dealers.

Empirical data suggest that one key risk that the supply chain of perishable goods faces-the risk of spoilage-has to be mitigated in the production process at the operational decision level [2]. This principle could be envisaged in the value chain discussed in this research article also. The segregation of flowers after an accumulation process in the market sheds light to the above-mentioned principle.

There is an increase in common change in land use from paddy field to jasmine field [7]. CO_2 and CH_4 cumulative emissions and the global warming potential (GWP) of these emissions were significantly lower in jasmine than the paddy field [7]. These research conclusions further facilitate the economic, geographical significance to consider the value chain of jasmine which is carried out in this research article.

'Assessment of pre- and post-disaster supply chain resilience based on network structural parameters with CVaR as a risk measure'[1] the authors had made attempts to assess supply chain resilience based on network structural parameters. Since resilience factor determines the nature of supply network at times when subject to risk this particular factor is considered as a predominant measure in determination of supply chain performance. The research conclusion attained in the above-mentioned paper are showcased to be true in this research article they are

1. Firms which have lowest density and centrality and the highest connectivity and network size, exhibits the highest resilience.

2. Firms which has the highest density and high centrality due to an aggression node exhibits the lowest resilience.

Further in the article 'Assessment of pre- and post-disaster supply chain resilience based on network structural parameters with CVaR as a risk measure' [1] the firms that are analyzed are industrial, business firms. The analysis of agricultural firms is not covered in the research article. This research gap is fulfilled in this paper.

III.   Methodology

In the three layers of entities namely supplier, dealer, consumer, suppliers represented as farmers hold lands suitable for jasmine cultivation and once jasmine sapling is planted the plant bore flowers for a period of 25 years therefore the production process in our current scenario the production of jasmine flowers never get stalled. When we analyze the nature of third level players of jasmine value chain based on Nilakotai market the consumers are local residents, perfume industry companies, export merchants who possess a permanent residential background hence the consumption side also remain unaffected at times of adversity.

On the other hand, when we analyze the nature of midlevel players of jasmine value chain based on Nilakotai market the dealers lie viable to impacts that occur when the market is subjected to disruptions like under the spread of COVID-19. Hence the role of each players in dealer category requires a detailed analysis to evaluate the performance of jasmine value chain based on Nilakotai market.

Here there are four parameters that are used to evaluate the resilience of jasmine supply chain based on Nilakotai market namely density, connectivity, centrality, network size which are used to determine the resilience of the value chain of jasmine based on Nilakotai market.

The network is constructed first with all its viable players

and the resilience is determined and then in order to understand the disruption caused to the value chain based on Nilakotai market the dealer nodes are removed one by one in order to determine their impact on the jasmine value chain based on Nilakotai market. When the impact is greater their importance is justified in the network constructed. The removal of each node causes a change in the above mentioned four parameters which in turn is reflected in a drop in resilience factor. The magnitude of the drop in resilience depends upon the prominence of the dealer node in the network.

The above procedure is carried on for both the graphs centered on distance and cost respectively with the inversion of the vital players which causes the graph constructed based on distance to vary with graph constructed based on cost parameters.

The inferences drawn from both the graphs are then compared to derive a common underlying principle that facilitates the decision-making process in order to safeguard both the material and cost flow in the value chain of jasmine based on Nilakotai market.

IV. CONSTRUCTION OF NETWORKS
Network- Distance centered approach

The value chain of jasmine based on Nilakotai market when drafted through MATLAB R2021a software resembled as the diagram depicted in figure-1.

- Nodes abbreviated as S_i represent farm lands referred by the name suppliers. Farmlands near Nilakotai are Sirakampati, Kavirayapuram, Mannavarathi, Karriyampati, Nariyouthu, Uthchanampati, Nilakotai.
- Nodes that are abbreviated as M_1, ED, PI_1, LD_1 represent Nilakotai market, Export dealer, Perfume industry dealer, Local dealer respectively.
- Nodes that are abbreviated as C_8-C_{12} represent consumers located in regions around Nilakotai market they are Coimbatore, Trichy, Madurai, Kerala, Palani, Coimbatore, Dindukal, Theni, Kangaeyam respectively.
- The arrows represent the flow of jasmine flowers. The arrows are given weights that are identified with distance. Hence the network is termed value chain network of jasmine based on Nilakotai market based on distance parameter.
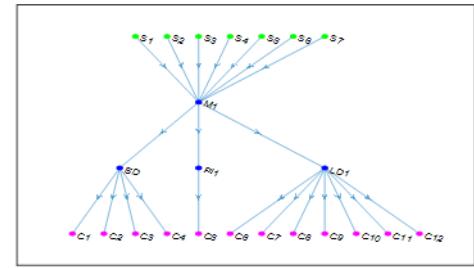

Figure-1
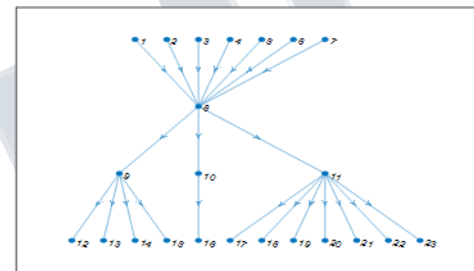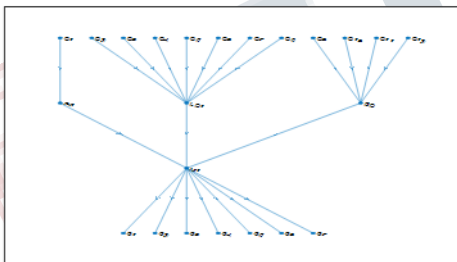**Network of entire value chain based upon distance centered approach**

Figure-1a (Simplified)
Network labels converted to numbers for convenient computation in MATLABR2021a software

Principle behind removal of nodes

Now we have second level nodes referred as dealer nodes that are subjected to disruptions. When a node is subjected to disruption the particular node is removed from the network diagram and the four parameters density, centrality, connectivity, network size is calculated individually for all the cases that include node removal. The resilience graph obtained through this process is now analysed to reveal hidden principles behind the increase or decrease in resilience.

Network- Cost centered approach

- In network centered on cost/ profit parameter the arrow direction depicts the flow of cash from consumers to dealers to market to farmers/ supply nodes.
- This flow visually is an inversion of network centered upon distance discussed before in terms of flow of material.
- An arrow from perfume manufacturing company (consumer) toward perfume dealer node depicts the profit earned by perfume industry dealer through sales of jasmine. The arrow mark from market to perfume industry dealer depict the facilitation cost

received as profit by market organizers.

- An arrow from each supplier to market node depicts the profits earned by individual farmers through their sales of jasmine in market.
- Likewise, the role of functioning hold true for all relations established in the graph centered on cost parameter.
- Material flow in this case is the flow of cash and in previous discussed network it was flow of jasmine flowers hence the edge weights given in the respective graphs varied dependent upon the parameter the network is centered upon.
- The methodology of assessment remains same for both parameters and their centered graphs. Resilience formula is computed for the disturbances caused by each node and presented in a graphic format.
- Along with resilience the other four parameters which were responsible for the changes depicted in the resilience network are also mapped for each disturbance caused by the inactiveness of nodes.

Figure-2
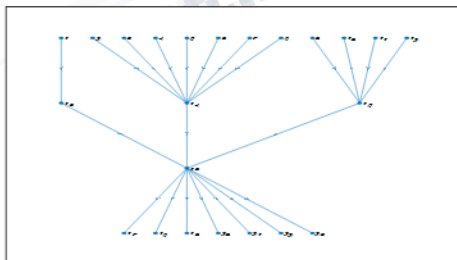**Network of entire value chain based upon cost centered approach**

Figure – 2a (Simplified)
Network labels converted to numbers for convenient computation in MATLABR2021a software

ANALYSIS OF NETWORKS
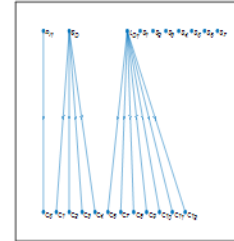### Network- Distance centered approach

Figure-3
Deletion of Market node in the Network based upon distance centered approach
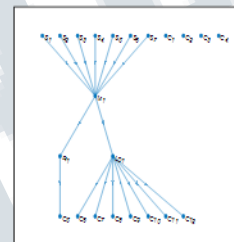

Figure-4
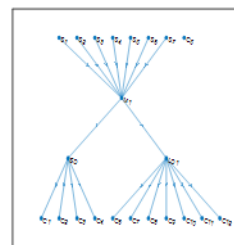**Deletion of Export dealer node in the Network based upon distance centered approach**

Figure-5
Deletion of Perfume dealer node in the Network based upon distance centered approach
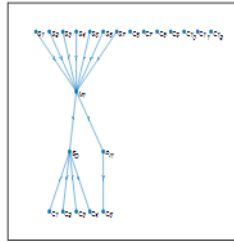
Figure-6
Deletion of local dealer node in the Network based upon distance centered approach
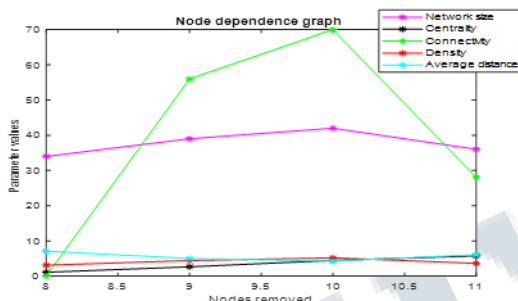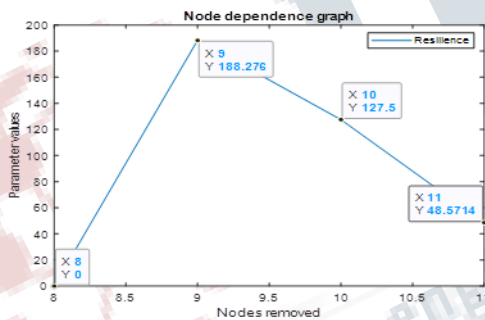

Figure-7

Figure-8
Node dependence graph – Resilience determining parameters which cause resilience fluctuation when each node removed and resilience network is demonstrated. Low resilience indicated high dependency and vice versa.

Figure-3
- The Market node is removed this indicated that a disruption had occurred and functionality of market node is affected. Though the supplier nodes remain unengaged local dealer, perfume industry dealer, export dealer remain engaged.
- This scenario may rise suspicion regarding the source of access the figure discussed elaborately. When COVID-19 spread resulted in lockdowns the sale of jasmine flower invited third party players into its supply network.
- At pre lockdown scenario the sales of jasmine

flower reached urban markets. But during COVID-19 pandemic the sales got centered among rural markets. Farmers they themselves engaged in sales of jasmine flowers to public rural masses or relied on third part unanimous players.
- This decision was mainly centered upon farmers and hence was highly uncertain hence not included in network analysis through resilience concept.
- Export dealer, perfume industry dealers, local dealers were portrayed as engaged because there were farmers who were contracted and hence had to supply to specific dealers even though market node is disrupted and in some cases perfume industries were seen collecting jasmine flowers directly from farmers and it was also recorded from farmers that perfume industries were indeterminate towards the texture, size, color, fragrance of flowers but consumed flowers at bulk.

Figure-4
- It depicts disturbances caused due to the inactiveness of export dealer node. When export dealer node was affected, its consumers were affected entirely and the imposed lockdown restrictions also added misery to ill affected export consumers.

Figure-5
- It depicts the disturbances caused due to the inactiveness of perfume dealer node. Though the perfume industries were hit by the pandemic they were able to find some farmers and collect flowers directly from farmers and as discussed earlier this process remained highly uncertain and unanimous that it cannot be graphed.

Figure-6
- It depicts the muted local dealer node. When local dealer node was affected due to strict lockdown imposition their contact with consumers was disrupted entirely and their sales went on loss. Consumers had their product purchased from nearby available street vendors or in worse cases were devoid of consumption of jasmine flowers.
- The reasons behind the inactiveness of each dealer nodes were discussed in detail now the impact of the node disturbances is showcased in resilience network diagram and the disturbances caused in each of four parameters namely density, centrality, connectivity, network size is also graphed.
- The resilience values are given by the formula

Resilience= (Connectivity×Network size) / (Density×Centrality).

Figure-7 and Figure-8
- They depict the changes caused by nodal disturbance in resilience network and the other four parameters density, centrality, connectivity, network size respectively.
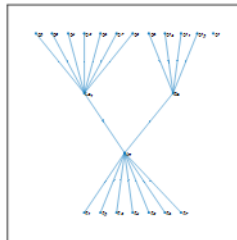
Network- Cost based approach

Figure-9
Deletion of Perfume industry node in the Network based upon cost centered approach

Figure-10
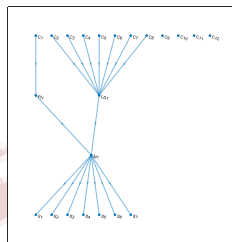**Deletion of Export dealer node in the Network based upon cost centered approach**

Figure-11
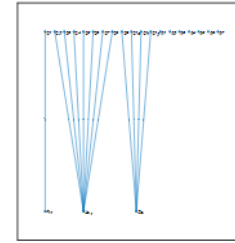**Deletion of Local dealer node in the Network based upon cost centered approach**

Figure-12
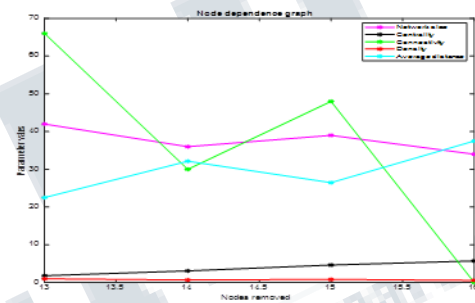**Deletion of Market node in the Network based upon cost centered approach**
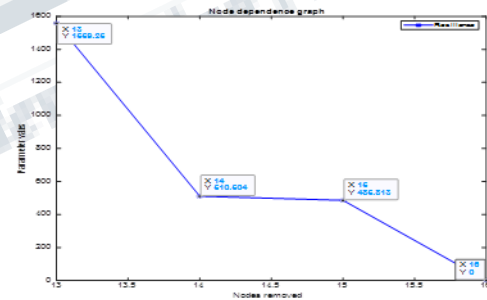

Figure-13

Figure-14
Node dependence graph – Resilience determining parameters which cause resilience fluctuation when each node removed and resilience network is demonstrated. Low resilience indicated high dependency and vice versa.

V. Common characteristic shared by both graphs.
- Node defunct is not considered in combination because their different factors responsible for the inactiveness of each dealer node take for an example when lock down was imposed export dealers were affected as the export agencies themselves found it unwise to ramp up exports when productivity of companies those export dealer were linked went low or stalled.
- It is clear to the naked eye that this scenario didn't

disturb local dealers and perfume industry dealers as they were situated across the Nilakotai hub and was able to manage within lockdown restrictions.

- In cases of some natural calamities like heavy downpour and degradation of quality of flowers local dealers get affected but not perfume industry dealer as they were ready to accept flowers of medium texture and size and at even moderate quality as flowers are crushed and their essence used in the preparation of perfumes.

- When some mishaps occur at perfume industries located across Nilakotai market then it's quite viable that their imports of material get disturbed and perfume industry dealer affected.

- These are few scenarios provided as examples provided for the strengthening of the hypothesis that dealers as a whole doesn't get affected and combination of nodal disturbances is also not a viable option to undertake in analysis of value chain of jasmine based on Nilakotai market. We also encourage further researches in this arenato further evaluate our hypothesis and promulgate the same.

VI. **Analysis of graphs and postulation of research thesis.**

- Both the graphs share in common all the characteristics excerpt the edge weights which determine whether a graph is distance centric or cost centric.

- Distance centric graph postulates the impact created by distance which serve as the most influential factor for determination of transportation costs. Since transportation cost falls proportional to distance, we feel its wise to focus upon distance as because cost of transportation not only encompasses uncertainties but also stochastic in nature.

- Distance centric graph captures the burden faced by farmers as transportation costs are born by farmers and trader especially in case of local traders.

- Profit centric graph is also not evenly concentrated as weightage varies in the hierarchy from export dealers to perfume dealers to local dealers. This hierarchy is determined based on the quality, texture, size of flowers benchmarked by each and every individual recipient taken into analysis.

- Resilience for market node disturbance project zero resilience for both graphs centered upon distance and profit which indicates both in cases of profit enjoyed by all players of value chain of jasmine and the reach capability of suppliers to reach consumers market node must remain active for value chain to

sustain disruptions and in violation of which business cease to exist.

- Perfume industry dealer node occupies high resilience in terms of cost centered graph and second highest in terms of distance centered graphs depicts that when cost is taken into account perfume industries facilitate good profit but are low in number hence the value chain was able to survive or show high resilience in spite of removal of perfume industry dealer node.

- In case of distance centered graph due to low number of perfume industries the distance taken into consideration is also low so is the case of transportation cost hence resilience remains stable in spite of its removal.

- Export dealer node deal with export agency members hence distance is of less importance on the contrary yield good profits hence play a vital role in the stability of value chain centered upon profit.

- Local dealers yield less profit per customer but customers are diversified and large in number similarly per customer distance is low but serve a pool of customers this scenario depict their corresponding position in both in distance and cost centric graphs.

Conclusion

- In this research work networks were constructed centered upon two parameters namely distance and cost-based approach.

- Among those networks certain field players were considered to be static and others dynamic a detailed explanation were provided throughout the research thesis.

- Among those dynamic players certain players enjoyed high significance in certain areas and their importance were unique in both parametric centered graphs.

- The reason for the categorization of provision of importance were also discussed in detail throughout this research project.

- The resilience graph was at brief unique in most circumstances rather than market node disturbance alone.

- This signifies that transportation cost or in other words costs borne by farmers and their profit doesn't contribute each other's significance.

- The resilience graph had played a vital role in performance measurement of jasmine value chain.

- As a concluding note we conclude that farmers must sell their products which are establishment cost

efficient and further undertake decisions regarding selection of dealers based upon their quality of production of flowers (Not based upon profits). Which when successfully acknowledged contribute in enhancing their profit and their lifestyle at large.

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