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Identifying Constraints in Decision Making in Sago Cluster in Tamil Nadu

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Entrepreneurship is critical to economic progress. Entrepreneurs act as catalysts in the industrialization and economic growth processes. The entrepreneurial achieving is characterized by high uncertainty, ambiguity, time pressure, emotional intensity, and risk, all of which can have a significant impact on how entrepreneurs evaluate specific situations and make decisions. In addition, making decisions and prioritizing them is crucial in entrepreneurial context. This study aims to identify and prioritize the potential decisions for sustainable development of sago cluster through Interpretive Structural Modelling (ISM). ISM assists in obtaining qualitative data rather than quantifiable aspects as a result of modelling. Ten drivers of decisions were finalized after expert's consultation. The interaction between drivers was developed. The study's findings will assist entrepreneurs in developing methods to promote growth of firms in Sago cluster.

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1. INTRODUCTION

Entrepreneurs play a vital part in a country's economic development. The desire to pursue entrepreneurship stems from a strong passion and certain compulsions. The entrepreneurial achieving is characterized by high uncertainty, ambiguity, time pressure, emotional intensity, and risk, all of which can have a significant impact on how entrepreneurs evaluate specific situations and make decisions [1]. Entrepreneurial decision making is critical because the decisions made by firm leaders have a significant impact on the firm's future direction and performance [2]. In addition, making decisions and prioritizing them is crucial role in entrepreneurial context. Interpretative Structural Modelling (ISM) is a multi-criteria decision making technique used to identify the critical constraints faced by the entrepreneurs in the Sago clusters. This also aid in establishing the interrelationship among the critical constraints that affect decision making.

2. LITERATURE REVIEW

According to Malone [3], ISM is considered to be a very helpful tool for people who want to approach complex situations with deliberate, logical thinking and then convey the results of that reasoning to others. According to Warfield [4] ISM is a method of interactive education. This method involves organizing a variety of aspects that are both directly and indirectly related into a thorough, systematic mode. According to Jharkharia and Shankar [5] ISM is a well-known technique for determining links between particular elements that characterize a problem or a concern. Agarwal et al., [6] described ISM begins with the identification of variables that are pertinent to the issue or problem, and it then develops with a technique for collaborative problem-solving. The choice of a contextually appropriate subordinate relation follows. Using pairwise comparison of the variables, a structural self-interaction matrix (SSIM) is created when the element set and contextual relation have been chosen. The SSIM is transformed into a reachability matrix (RM) and its transitivity is examined in the following phase. A matrix model is created following the completion of transitivity embedding. After that, the elements are divided up, and the structural model known as ISM is extracted. George and Pramod [7] have explored these three dimensions of ISM. I (interpretive) stands for the result or judgement based on expert opinions, S (structural) implies the extraction of structure among complex sets of items or variables, and M (modelling) stands for the graphical representation, i.e. diagraph, which depicts the direct and indirect correlation among factors. According to Mudgal et al., [8], the two fundamental ideas of ISM are transitivity and reachability. As a fundamental idea for simulating the structure, transitivity represents the interrelationship among three elements. In order to extract the link between a complex set of variables, Ravi and Shankar [9] established an ISM technique that consists of eight steps, beginning with the identification of variables and concluding with a check for conceptual contradiction in the ISM model.

3. METHODOLOGY

3.1 Interpretive Structural Modeling (ISM)

Structural interpretation is a powerful technique for transforming conceptual configurations into a confident, well-designed pattern [10]. The ISM is the most widely used socioeconomic evaluation tool [4]. ISM provides its customers with a structured and thorough technique for the first time incorporating group assessments in the creation of structural models. It aids in obtaining qualitative data rather than quantifiable aspects as a result of modelling [11]. The graphical presentation of results is shown by this technique [11]. The steps of ISM methodology are as follow.

Step 1: Based on expert opinion 10 major constraints were identified.

Step 2: The first round identifies contextual relationships between enablers (decisions).

Step 3: The Enabler is built with a structural self-interaction matrix (SSIM) that indicates a pair-to-pair relationship between the investigated facilitators.

Step 4: The ISM methodology emphasizes transitivity. The following formula is used, and if X=Y, Y=Z, the X=Z is inferred. The original SSIM accessibility matrix is used to check transitivity.

Step 5: The accessibility matrix is further classified into levels.

Step 6: Transitivity is eliminated by drawing a digraph. A diagram has been created based on the contextual relationship in the accessibility matrix.

Step 7: When converting diagrams to interpretive models, the final result is produced by replacing the nodes in a digital digit with assertions.

Some of the important constraints faced by the entrepreneurs of Sago cluster were selected and further analyzed using interpretive structural equational modelling to prioritize them to make up suitable measures for sustainable development of Sago cluster on a priority basis. The list of table of constraints faced by the entrepreneurs is presented in the Table 1.

4. RESULTS AND DISCUSSION

4.1 Application of ISM

4.1.1 Structural self interaction matrix (SSIM) and reachability matrix

Following the ideas of industrial experts, contextual linkages have been developed between the decision-making constants. Four symbols (V, A, X, O) were used to construct the contextual relationship that led to the formation of the SSIM matrix. Individual symbols are described in greater depth below.

V: I will assist you in obtaining j element A: j contributes to I element X: I and j elements both contribute to the achievement of O: I and j are unrelated.

Table 2 describes the four symbol relevance (V, A, X, O).

From SSIM, initial reachability matrix was constructed by converting the variables into binary from 1 and 0 by using the following rules

- When the entry (I , J) in SSIM is V, I to J transaction will be 1 and 0 for vice versa
- When the entry (I , J) in SSIM is A, I to J transaction will be 0 and 1 for vice versa
- When the entry (I , J) in SSIM is X, both I to J and J to I transaction will be 1
- When the entry (I , J) in SSIM is O, both I to J and J to I transaction will be 0

Initial reachability matrix was constructed and presented in Table 3.

Table 1. Constraints faced by the entrepreneurs of Sago cluster

S. No.	Constraints	Representation
1	Inadequate human labor	F1
2	Improper raw material management	F2
3	Non availability of raw materials round the year	F3
4	Inadequate transportation	F4
5	Inadequate electricity power	F5
6	Inability to adapt technology	F6
7	Inadequate working capital	F7
8	Lack of entrepreneur experience	F8
9	Ineffective waste management	F9
10	Poor plan layout	F10

Table 2. Self structural interaction matrix

Factors	10	9	8	7	6	5	4	3	2	1
1	V	A	O	O	O	O	V	O	V	-
2	V	X	X	A	X	A	X	A	-	
3	V	V	O	O	X	A	O	-		
4	V	A	O	O	A	A	-			
5	O	V	O	V	V	-				
6	V	X	O	O	-					
7	O	A	V	-						
8	X	V	-							
9	O	-								
10	-									

Table 3. Initial reachability matrix

Factors	1	2	3	4	5	6	7	8	9	10
1	1	1	0	1	0	0	0	0	0	1
2	0	1	0	1	0	1	0	1	1	1
3	0	1	1	0	0	1	0	0	1	1
4	0	1	0	1	0	0	0	0	0	1
5	0	1	1	1	1	1	1	0	1	0
6	0	1	1	1	0	1	0	0	1	1
7	0	1	0	0	0	0	1	1	0	0
8	0	1	0	0	0	0	0	1	1	1
9	1	1	0	1	0	1	1	0	1	0
10	0	0	0	0	0	0	0	1	0	1

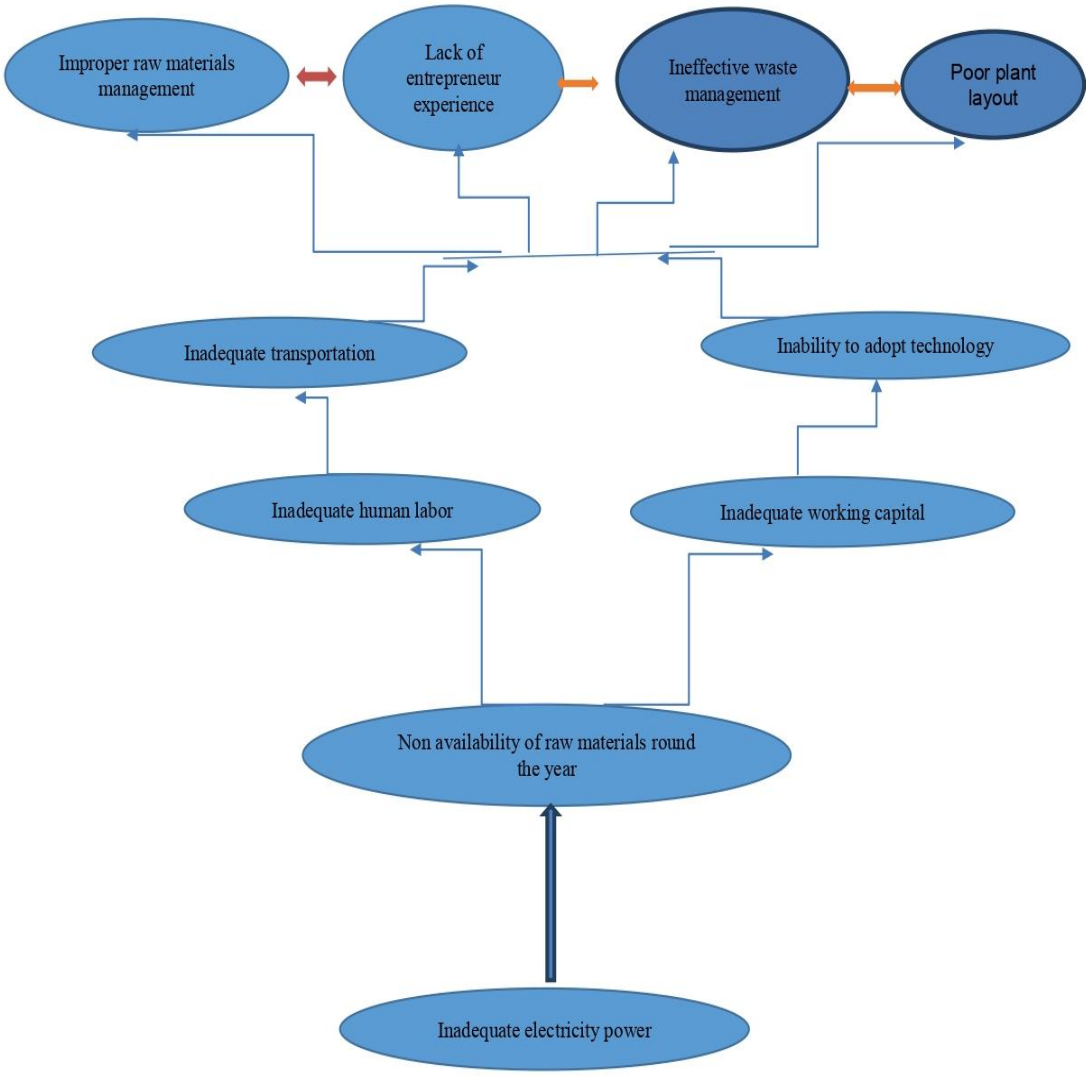

Fig. 1. ISM structure

The final reachability matrix is constructed once transitive in the initial reachability matrix is ensured. The resulting final accessibility matrix is shown in Table 4.

The driving power (A) and dependence power (B) for each constraint was calculated by summing up ones along the rows and columns respectively.

From the Table 4, it could be observed that, in accordance to driving with higher to lower driving power (A), inadequate electricity power (F5) (5), non-availability of raw materials round the year (F3) (4), decreased human labor (F1) (3), inadequate working capital (F7) (3), improper transportation (F4) (2), poor technology innovation (F6) (2), improper inventory management (F2) (1), lack of entrepreneurial activity (F8) (1), ineffective waste management (F9) (9) and poor plant layout (F10) (1). High driving power denotes the ability of the factors in influencing the other factors.

4.1.2 Level partitioning

From the final reachability matrix, reachability set, antecedent set, and interaction set for each constraint were framed.
Reachability set consist of,

- Set 1: Particular constraint
- Set 2: other constraint helped by the particular constraint, in achieving or resolving either directly or indirectly

Antecedent set consist of,

- Set 1: Particular constraint
- Set 2: Other constraint that helped to advice or receive the particular constraint either directly or indirectly

Interaction set consist of the constraints common in both reachability and antecedent set.

Level partitioning was done, when the reachability and interaction was same, the constraints was eliminated and it could be occupied the top level in ISM structure. Further iteration were made until the last constraint was eliminated and the ISM structure was complete. The level partitioning is presented in Table 5 and Table 6.

Table 4. Final reachability matrix

Factors	1	2	3	4	5	6	7	8	9	10	A
1	1	1	0	1	0	1*	0	1*	1*	1	7
2	1*	1	1*	1	0	1	1*	1	1	1	9
3	1*	1	1	1*	0	1	1*	1*	1	1	9
4	0	1	0	1	0	1*	0	1*	1*	1	6
5	1*	1	1	1	1	1	1	1*	1	1*	10
6	1*	1	1	1	0	1	1*	1*	1	1	9
7	0	1	0	1*	0	1*	1	1	1*	1*	7
8	1*	1	0	1*	0	1*	1*	1	1	1	8
9	1	1	1*	1	0	1	1	1*	1	1*	9
10	0	1*	0	0	0	0	0	1	1*	1	4
B	**7**	**10**	**5**	**9**	**1**	**9**	**7**	**10**	**10**	**10**	

Table 5. Level partitioning – Iteration 1

Factors	Reachability Set	Antecedent Set	Intersection set	Level
1	1,2,4,6,8,9,10	1,2,3,5,6,8,9	1,2,8,9	
2	1,2,3,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9,10	1,2,3,4,6,7,8,9,10	I
3	1,2,3,4,6,7,8,9,10	2,3,5,6,9	2,3,6,9	
4	2,4,6,8,9,10	1,2,3,4,5,6,7,8,9	2,4,6,8,9	
5	1,2,3,4,5,6,7,8,9,10	5	5	
6	1,2,3,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9	1,2,3,4,6,7,8,9	
7	2,4,6,7,8,9,10	2,3,5,6,7,8,9	2,6,7,8,9	
8	1,2,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9,10	1,2,4,6,7,8,9,10	I
9	1,2,3,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9,10	1,2,3,4,6,7,8,9,10	I
10	2,8,9,10	1,2,3,4,5,6,7,8,9,10	2,8,9,10	I

Table 6. Level portioning – Iteration 1 to 5

Factors	Reachability Set	Antecedent Set	Intersection set	Level
1	1,2,4,6,8,9,10	1,2,3,5,6,8,9	1,2,8,9	III
2	1,2,3,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9,10	1,2,3,4,6,7,8,9,10	I
3	1,2,3,4,6,7,8,9,10	2,3,5,6,9	2,3,6,9	IV
4	2,4,6,8,9,10	1,2,3,4,5,6,7,8,9	2,4,6,8,9	II
5	1,2,3,4,5,6,7,8,9,10	5	5	V
6	1,2,3,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9	1,2,3,4,6,7,8,9	II
7	2,4,6,7,8,9,10	2,3,5,6,7,8,9	2,6,7,8,9	III
8	1,2,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9,10	1,2,4,6,7,8,9,10	I
9	1,2,3,4,6,7,8,9,10	1,2,3,4,5,6,7,8,9,10	1,2,3,4,6,7,8,9,10	I
10	2,8,9,10	1,2,3,4,5,6,7,8,9,10	2,8,9,10	I

From the Table 6, it could be observed that improper inventory management (F2), lack of entrepreneurial activity (F8), ineffective waste management (F9) and poor plant layout (F10) formed the first level and occupied in the top level in ISM structure. Inadequate electricity power (F5) gets fifth level and occupied at the bottom and influential position in ISM structure.

4.2 ISM Structure

Based on the levels from the level partitioning, ISM structure was constructed and presented in Fig. 1. The constraint at the top level was resolved by resolving the constraint at the bottom level of the structure.

5. CONCLUSION

The primary objective of this study was to identify the inter-relationship between constrains in sago industries decision making. This study makes an attempt towards enhancement of decision making in entrepreneurs of sago industries. We used 10 constraints of decision making after recommendation of expert opinion. Further, we conducted ISM methodology to highlight and explore the inter relationship among identifies factors. Fig. 1 revealed inadequate electricity power situated at the bottom of hierarchy that depict the highest power.

Inadequate electricity power: The shortage of secure and dependable electricity power is a barrier to doing business in the sago industries. Power storage reduces possibility, quantity, and quality of production starch and sago and has a negative impact on firm total production. The impact of power on sago industries by assuring planned outages and providing access to alternate electricity supply such as generators and renewable energy.

Non availability of raw materials round the year: The importance of raw materials is obvious to upstream enterprises that refine and process goods into finished goods. Since tapioca is seasonal crop, the availability of raw materials throughout the year is critical for sago industries. The main threat to production in the sago industry is the lack of raw materials with starch content and timely availability. Creating collecting centers for raw materials and dealers throughout Tamil Nadu and keala as a distribution network would aid in recovering from raw material scarcity.

Inadequate working capital: The lead time for production of starch and Sago from tapioca were 3 to 5 days. The number of employees required for producing one batch of starch and sago were 15 to 20 employees. Casual laborers were engaged in production on daily basis for daily wage. In such constituencies working capital is required for effective production. Hence, inadequate working capital is considered as major constraints in sago industries.

Inadequate human labor: It is well acknowledged that the failure of a production unit is mostly attributable to human labor mismanagement. Many businesses, in particular, have failed to improve workers' skills and retain human capital. In sago industries, human labor is considered as important asset. Since the sago business is primarily based in rural areas, the months of August through February are when the greatest number of laborers can find work there. This is a result of the abundant tapioca supply at the time. On the other hand, they stay closed during the off-season because to a lack of raw materials. The sago units employ two different categories of laborers: permanent employees for supervisory tasks, machine operators, and accountants, and the wages they receive are based on their qualifications and experience. Casual laborers are employed on a daily wage basis to perform the actual processing; these workers can be classified as skilled or unskilled; the majority of these workers are women who are responsible for washing, peeling, and carrying the tubers to the crushing point. The wage paid to women workers is based on the number of roots peeled. Hence, human capital for sago industries is important.

Inability to adopt technology: The process of accepting, integrating and using new technology in sago industries is a constraint due to high cost. However, implementation of new technologies would make production faster and reduce labor requirement significantly.

Improper transportation: Because roots deteriorate quickly owing to microbial attack, most starch companies use standard procedures to process given roots within 1-2 days and avoid storing perishable fresh roots. In such conditions effective transportation would aid better quality production and thus increases firm effectiveness.

Improper Raw materials management: Poor inventory management causes overstocking and understocking, both of which have an impact on cost and quality, among other things. About 200kg of sago is produced from one tone of tapioca tuber. Since the output of sago to input tapioca tuber intake for production is very less, proper management of raw material is required for firm effective production.

Lack of entrepreneur experience: Every activity in any business is the responsibility of the entrepreneur. It aids in the creation of business structures and numerous decision-making processes that are required for the efficient production of starch and sago in the Sago cluster. About more than 50% of entrepreneurs in sago industries were following their family business entities, the experience in production of starch and sago is lesser than the firm's age.

Ineffective waste management: Ineffective waste management can lead to a slew of negative environmental consequences, ranging from water and soil pollution to dwindling natural resources. Sago pith still has a high starch content. Sago pith includes 65.7% starch, 19.8% crude fiber, 1% crude protein, 4.1% ash, and 59.1% moisture. The use of this material as a biomass resource could result in new products rather than waste treatment.

Poor plant layout: A poor plant layout causes waste in transportation, handling, and movement between work stations, as well as delays and extra processing in the event of an overly sophisticated storage system. In sago industries, the processing of tapioca involves various processing stage. They are washing tubers, peeling, rasping, screening, dewatering, pulverization, globulation, grading, roasting, drying and packing. Hence for the above processing stage the firm should have adequate plant layout for better production.

Therefore, inadequate electricity can be termed as "base key factor" as well remaining factor directly or indirectly associated with it. It also witnessed that improper inventory management, ineffective waste management, poor plant layout and lack of entrepreneurial activity depend on high driving power factors. The findings of this study may limit to developing sago industries only, as expert consultation only sago industry experts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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