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RESEARCH ARTICLE :

An assessment of lean wastes generated in paddy processing units – A case of Madurai cluster

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SUMMARY : The study involved in identifying the occurrence of wastes throughout the paddy process processing. The paddy processing units in Southern Tamil Nadu produced single boiled rice for the consumers of Tamil Nadu. Paddy was processed either by the conventional or modern technology. The data was collected from the paddy processing chain were analysed using percentage analysis. The results showed that identified wastes generated within the paddy processing industry were unutilized capacity, unnecessary waiting time for paddy and rice, paddy and rice inventory, inappropriate processing, defects (black rice / brokens / discoloured rice). An overall analysis indicated that the modern paddy processing units in Southern Tamil Nadu were more efficient resulting in lesser wastages compared to the conventional units.

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KEY WORDS :
Lean, Paddy, Processing, Wastes

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BACKGROUND AND OBJECTIVES

Indian rice industry constitutes two forms of rice, basmati and non-basmati. The non - basmati rice production is miles ahead of basmati rice in terms of size of production. The basmati rice production of India constituted less than one per cent of the total rice produced in India. This makes the basmati sector saturated offering hardly any scope for expansion whereas the non-basmati sector constituting approximately 99 per cent of the total rice produced, which gives ample opportunity for major rice processors to thrive in domestic and international markets.Lean Manufacturing, which is often referred to as Lean, is a philosophy of manufacturing process improvement through elimination of waste. The paddy processing units in Tamil Nadu are moving towards newer technologies wherein the lean thinking is visible in the processing of paddy rather in conducting their business. The entrepreneurs were not aware of lean practices but they do adopt waste minimization activities so as to improve their efficiency. The assessment of lean wastes in Paddy Processing Units during the processes in important sector of the economy is a prerequisite for not only effective evolution of policy measures for implementation but also to help the existing industry to be more competitive and sustainable in the long run.

Sori *et al.* (2014) conducted the study to know about the constraints in production,

marketing and processing of paddy in Mahasamund district of Chattisgarh. Eighty one processors were randomly selected and they were asked to rank the constraints in rice processing. They found that among six major problems related to processing of paddy, electricity problem ranked first by sampled paddy processors with average score of 90.21 while efficiency ranked second. According to Singha (2012), the conversion ratio of rice was found to be 63 per cent and 58.7 per cent by the modern and traditional mills respectively. The net profit accrued by the modern mills was found to be lesser than the traditional mills on the grounds of economies of scale and quality of production. Mezgebe *et al*. (2013) described waste as an uneconomical use of resources and it included materials, machines, labour, time and revenue, resulting in a supply of products in an unwanted quantity (over and above, less and below). Kato (2005) felt that over-production of information (duplication), waiting of people, transportation of information, over-processing, motion of people, rework, defective of information, re-invention and hand-offs were the important product development wastes. Bauch (2004) identified ten wastes (over-production or unsynchronized process, waiting, transport or hand-off, over-processing, inventory, movement, defects, re-invention, lack of system discipline, limited IT resource) during production.

RESOURCES AND METHODS

The major paddy processing clusters in Tamil Nadu based on the concentration of paddy processing units are Alankulam, Dhalavaipuram, Pudhuvayal, Kangeyam, Madurai, Thiruvarur and Villupuram. Madurai district was purposively selected as it has equal proportion of both conventional and modern paddy processing units (PPUs). Fifteen conventional and Fifteen modern PPUs were randomly selected from the list given by the Madurai Rice Millers Association. For collection of primary data, a well-structured interview schedule was prepared and the data required for the study was gathered through personal interview method from the owners of selected paddy processing units. The lean wastes generated within the Paddy Processing Units were analyzed for the sample PPUs using percentage analysis and the results are discussed.

OBSERVATIONS AND ANALYSIS

An attempt was made to estimate the lean wastes generated within the paddy processing units. The factors governing such wastes were more internal and are amenable for better control and elimination mechanisms through suitable changes that could be introduced at the unit level for reduction in process wastes.

The identified wastes generated in paddy processing industry were;

- Unutilized capacity
- Unnecessary waiting time for paddy and rice
- Paddy and rice inventory
- Inappropriate processing
- Defects (Black rice / brokens / discoloured rice)

Unutilized capacity in conventional PPUs :

The capacity of a processing facility is one of the strategic decisions made at the time of establishing the business. The modern PPUs had greater processing capacity when compared to the conventional PPUs. Most of the modern PPUs had upgraded their facility in a phased manner based on the changes in the business environment. Hence, they expanded their processing capacity that required huge investments. The modern PPUs which had established recently had initially created a greater capacity as it would become highly capital intensive to expand the capacity at later stages. The modern PPUs tried to utilize their capacity to maximum possible extent so as to reach the economies of scale. It was very difficult for any firm to operate at its fullest capacity throughout the year. The duration of working of the conventional units was restricted to seven to eight months in a year which resulted in idle / unutilized capacity.

Non-availability of labour, longer process time, unexpected break downs were some of the other factors that lead to idle capacity. The unused capacity was categorized under waste since the PPUs did not utilize the resources efficiently. Unutilized capacity was very high in modern PPUs compared to conventional PPUs. The total installed capacity and the capacity utilized throughout the year was calculated for every PPU.

The percentage of unutilized capacity was determined by the formula

Unutilized capacity / day= Total installed capacity / day – Capacity utilized / day

The extent of unutilized capacity was identified for conventional and modern PPUs and the conventional and modern PPUs were categorized based on the unutilized

capacity and the results are presented in Table 1.

It could be inferred from Table 1 that, majority of the conventional firms (40.00 %) had unutilized capacity between 31 to 40 per cent. A similar trend was observed in Modern PPUs too. Most of the units (53.33 %) faced the problem of idle capacity that ranged between 31 to 40 per cent.

Table 1 : Unutilized capacity in PPUs (Number of units)

Sr. No.	Unutilized capacity (%)	Conventional PPUs	Modern PPUs	Total
1.	11 - 20	4 (26.67)	2 (13.33)	6 (20.00)
2.	21 - 30	5 (33.33)	4 (26.67)	9 (30.00)
3.	31 - 40	6 (40.00)	8 (53.33)	14 (46.67)
4.	41-50	-	1 (06.67)	1 (03.33)
	Total	15 (100.00)	15 (100.00)	30 (100.00)

Figures in parentheses indicate percentage to total

Unnecessary waiting :

Waiting is another productivity killer and is a major source of frustration for the producers. Waiting should be eliminated for improving the efficiency. During the study, it was observed and understood that the major sources of waiting time were unloading time, storage of paddy before processing and the rice waiting to be packed in gunny bags. Hence, an attempt was made to quantify these aspects of waiting for understanding the influence of these factors on generation of wastes in the PPUs of Madurai Cluster.

The details pertaining to the waiting time of the paddy to be processed in conventional and modern PPUs are furnished in Table 2. PPUs procured paddy and stored for longer periods due to the fear of non-availability of raw materials all-round the year. Prolonged storage of the raw materials at right moisture content increased the quality of rice and decreased the percentage of the brokens, another form of process waste.

Table 2 : Waiting time for stored paddy to be processed in PPUs (Number of units)

Sr. No.	Waiting time (months)	Conventional PPUs	Modern PPUs	Total
1.	More than12 – Less than 18	-	4 (26.67)	4 (13.33)
2.	More than 6–Less than 12	-	6 (40.00)	6 (20.00)
3.	Less than 6	6 (40.00)	5 (33.33)	11 (36.67)
4.	More than 2 - Less than 4	6 (40.00)	-	6 (20.00)
5.	Less than 2	3 (20.00)	-	3 (10.00)
	Total	15 (100.00)	15(100.00)	30 (100.00)

Figures in parentheses indicate percentage to total

It could be observed from Table 2 that 80 per cent of the conventional PPUs stored the paddy for more than two but less than four months. The procured paddy was then processed into rice. It could also be noted that the waiting time for most (40 %) of the modern PPUs was in the range of 6 - 12 months. About 27 per cent of the processing units in Madurai cluster stored for 18 months and then processed it.

Waiting time for paddy to be unloaded in PPUs:

The raw material was procured either in local market or outside the state. Procured paddy arriving at the PPUwas unloaded and stacked in storage godowns for further processing.

Waiting time for paddy to be unloaded varied among the PPUs according to the circumstances. Average waiting time was calculated and categorized into three categories (less than 2 hours, 2 – 3 hours, more than 3 hours). The details regarding waiting time of paddy to be unloaded in both conventional and modern PPUs are presented in Table 3. As there was no difference in waiting time among both the types of processing units, it was taken together for discussion.

Table 3 : Waiting time for paddy to be unloaded in the PPUs (Number of units)

Sr. No.	Waiting time (hours)	No. of PPUs	Percentage
1.	More than 3.00	9	30.00
2.	2.00–3.00	8	26.67
3.	Less than2.00	13	43.33
	Total	30	100.00

It could be observed from Table 3 that for most of the PPUs (43.33 %) the average waiting time for paddy to be unloaded was less than 2.00 hours. Checking the quality of paddy by palm crushing the grains, ensuring weight and counting of bags, insufficient space for goods to be unloaded, non-availability of labour were the reasons for delay in unloading.

Waiting time for processed rice :

Paddy underwent sequence of processing steps to get converted into rice. The rice was finally collected in bins in case of modern PPUs and it was made to flow in a room in the conventional units. Such rice remained waiting till it was packed and stacked. Packing was done either manually or using automated (semi / full) machines. The waiting time for one ton of rice to be packed was

worked out and the details are presented in the Table 4.

It could be inferred from Table 4 that, in most of the PPUs (36.67 %) processed rice in both conventional and modern PPUs waited for more than 4.00 hours before process of packing started. Entire batch was processed and packed in a single lot to avoid admixture of other batches.

Table 4 : Waiting time for processed rice to be packed in the PPUs (Number of units)

Sr. No.	Waiting time (hours)	No. of units	Percentage
1.	More than 4.00	11	36.67
2.	2.00 – 4.00	9	30.00
3.	Less than 2.00	10	33.33
	Total	30	100.00

Inventory :

Apart from raw materials, there are different forms of inventory maintained at the PPUs such as rice, brokens, chaffs, packing materials, firewood for the parboiling operations, and rice husk ash. As the value of the finished good inventory was very high compared to the other forms of inventory, the analysis was confined to rice.

Finished goods (Rice) inventory :

The level of inventory maintained was not static as all firms purchased the good quality paddy as and when it arrived at the market. The PPUs processed paddy and sold their products (rice) in local state market. All the PPUs bought paddy by cash and carry method and distributed the processed rice to retailers in credit. Quality of paddy improved when stored for longer time but the quality gets deteriorated for rice when stored for longer periods. Thus proportion of quantity of paddy stored was higher when compared to final product. Details regarding finished goods inventory maintained in conventional and modern PPUs are given in Table 5.

It could be concluded from Table 5 that majority of conventional PPUs (46.67 %) stored their final product for less than 15 days. However rice was pushed into market and period of storage varied according to market conditions and also varieties processed. All PPUs processed raw rice, steam rice, single and double boiled rice.

Table 5 : Rice inventory in PPUs (Number of units)

Sr. No.	Rice inventory (days of storage)	Conventional PPUs	Modern PPUs	Total
1.	1 - 15	10 (66.67)	4 (26.67)	14 (46.67)
2.	16 - 30	5 (33.33)	5 (33.33)	10 (33.33)
3.	31 - 45	-	6 (40.00)	6 (20.00)
	Total	15 (100.00)	15 (100.00)	30 (100.00)

Figures in parentheses indicate percentage to total

Overprocessing :

The activities such as reprocessing returns from the market, processing of chaffs along with paddy if not properly removed, increased boiling time of paddy, number of whiteners and polishers used while processing paddy were categorized as wasteful activities. PPUs decided the number of whiteners and polishers to be used while processing paddy. When the market demanded fine polished grains, the processing undergoes maximum of two whiteners and three silky polishers in modern units. Conventional PPUs had lesser number of whiteners and majority of the units does not own silky polishers. The slender / fine rice fetched higher market price but because of the numerous polishing and whitening processes, the nutritional value was reduced. The nutritional layers were removed when the grain underwent various polishing stages. Based on the number of the polishers during processing PPUs were classified into three categories and details are presented in Table 6.

Table 6 : Number of polishers in PPUs (Number of units)

Sr. No.	No. of polishers	Conventional PPUs	Modern PPUs	Total
1.	Cone polisher + Silky	3 (20.00)	-	3 (10.00)
2.	2 Whiteners + Silky	5 (33.33)	2 (13.33)	7 (23.33)
3.	Cone Polisher alone	7 (46.67)	-	7 (23.33)
4.	2 whiteners + 3 Silky	-	9 (60.00)	9 (30.00)
5.	3 whiteners + 2 silky	-	4 (26.67)	4 (13.34)
	Total	15 (100.00)	15 (100.00)	30(100.00)

Figures in parentheses indicate percentage to total

It could be concluded from Table 6 that majority of conventional PPUs (46.67 %) had two stage polishing (whitener and silky) and 60 per cent of PPUs used only polishers during processing. Majority of modern PPUs (60 %) had two whiteners and three silky polishers.

Defects :

The economic output of paddy processing is head rice. Other products such as coarse brokens, fine brokens, discoloured paddy, black rice were categorized as defects.

The reason for such defects may be poor quality of paddy, prolonged soaking of paddy, mixtures of immature grains during boiling operations, processing technologies, sudden breakdowns and wear and tear of machineries. Quantity of defects varied with varieties processed among the batches of the same variety due to improper processing of grains, forms of rice produced and moisture content of the raw material. The percentage of such defects per batch was calculated and details are presented in Table 7.

Table 7 : Quantity of process defects in PPUs (Number of units)

Sr. No.	Percentage of defects	Conventional PPUs	Modern PPUs	Total
1.	Less than 6.00	-	10.00 (66.67)	10 (33.33)
2.	6.00 – 10.00	4 (26.67)	5 (33.33)	9 (30.00)
3.	More than 12.00 – 14.00	8 (53.33)	-	8 (26.67)
4.	More than 14.00	3 (20.00)	-	3 (10.00)
	Total	15 (100.00)	15 (100.00)	30 (100.00)

(Figures in parentheses indicate percentage to total)

It can be observed from Table 7 that 53.33 per cent of conventional units had defective percentage that ranged between 12.00 to 14.00. Majority of the sample conventional units (73.33 %) were inefficient since the percentage of defective materials were more than 12 per cent. About 66.67 per cent of the sample modern PPUs had defective percentage that ranged between 4.10 and 6.00.

Conclusion :

In summary of the analysis of wastes generated within the sample paddy processing units in the selected clusters, the following results emerged.

Some of the modern units had expanded their capacity during the phase of upgradation that resulted in higher costs when compared to the cost of establishment of new units. The problem of excess capacity was higher in the modern PPUs when compared to the conventional units.

On comparison between the conventional and modern PPUs, it could be understood that the waiting time was significantly higher in the modern PPUs compared to the conventional units. Delay in unloading caused time wastage, quality loss and reduction in grain weight. Waiting time for rice to be packed and stored was also similar in both conventional and modern paddy processing units. As the demand for each of forms of processed rice varieties varied from one market to another. The shelf life of these varieties differed based on the processing technology used. The average shelf life of rice was better with conventional units compared to modern units. Modern PPUs stored rice for longer duration compared to conventional units. Majority of PPUs (40 %) stored rice between 31 – 45 days. The demand for each of forms of processed rice varieties varied from one market to another. The shelf life of these varieties differed based on the processing technology used. The average shelf life of rice was better with conventional units compared to modern units. Modern PPUs stored rice for longer duration compared to conventional units. Majority of PPUs (40 %) stored rice between 31 – 45 days.

The analysis of factors that resulted in internal waste generation in the PPUs logically lead to much more intensive evaluation of performance of the modern PPUs. Such evaluation helped to understand the performance gap in terms of waste generation between the best performing and least performing units. To analyze the performance gap benchmarking technique that is widely adopted in the management studies was used.

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