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Critical Investigation of Farm Mechanization Gap in Major Agro-climatic Zones of Tamil Nadu

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A B S T R A C T

An exploratory research study was carried out to find mechanization gaps, need for equipment refinement and potential demand of farm equipment for the major field of Tamil Nadu. The study covered all the seven agro-climatic zones. Data were collected from twenty four subject matter specialists working in farm mechanization and allied disciplines in 22 KVKs of the state. Four major crops of the state namely paddy, sugarcane, groundnut, and cotton. The present study revealed that operation-wise level of mechanization varies from western zone (42.0%) to north eastern zone (26.0%). It was also evident that paddy crop stood first (53.0%) in status of mechanization in the state while the status of mechanization with respect to remaining major crops was on par and below the state average of 37.4%. Among the field operations seed-bed preparation and tillage stood first in the status of mechanization while status of mechanization with respect to other operations expect post-harvest and value-addition were on par and below the state average (36.2%). All the crops had good scope for mechanization in the areas of post-harvesting and value addition in the state since only 7.9% of operations were mechanized presently. Cotton and groundnut registered lowest percentage (1.3 and 2.5) of mechanization level in harvesting operation which needs more attention. According to Garratt ranking analysis, it could be found that post-harvest mechanization was the highest operation followed by cotton harvester and power weeder. Harvester for groundnut and sugarcane was the next priority followed planter for cotton and sugarcane, as well as rice transplanter.

Introduction

Agricultural scenario in Tamil Nadu

Tamil Nadu occupies seven per cent of the Nation's population, four per cent of the land area and three per cent of the water resources at all India level. Hence, the productivity has to be increased by adopting scientific water management, farm mechanization and focus on technologies that will enhance the farm income. The labour and hard work of the farming community should be rewarded with matching income. Farm centric projects have to be taken up to achieve success. Presently 56% of population is dependent on agriculture

in Tamil Nadu and State Agriculture income accounts for 13% of the Net Domestic Product of the State.

Total land holding is 8.193 million numbers in which 91% of the total holdings are with marginal and small farmers. The gross area cultivable area is 5.572 million-ha and eventually net area sown 4.892 million- ha. About 58% of cultivated area is irrigated and 42% rainfed. (Season and Crop Report, 2011: Department of Economics and Statistics, Tamil Nadu).

Last many decades mechanization in agriculture has enhanced production and productivity of agricultural products through timeliness of operation, efficient management of inputs and reduction of post-harvest losses in Tamil Nadu. But the level of adoption of mechanized intervention is varies widely across different climatic regions in this state. One of the reasons may be attributed to the variation in farm power availability for agricultural operations among different states.

The level of adoption of mechanized agricultural practices varies with the cropping pattern followed, agro-climatic, soil conditions and socio-economic status of the farming community. Though these mechanized farming practices are being followed by the farmers at different places in the state the adoption rate of mechanized farm operations is still far from satisfactory and a huge mechanization gap exists resulting into delaying in critical/timely farm operations under acute scarcity of natural and manmade resources and subsequent yield losses. Therefore, it is imminent to assess the level of mechanization for different agricultural practices in different agro-climatic regions and identify the existing mechanization gap so that new technologies and implements can be identified for refinement to bridge this gap.

Materials and Methods

Methodology

To determine mechanization gap for the major field crops grown in all seven agro-climatic zones of Tamil Nadu, the data were collected from the twenty four subject matter specialists 22 KVKs. These are Coimbatore, Erode, Madurai, Kanyakumari, Nilgiris, Cuddalore, Thiruvallur, Villupuram, Vellore, Puducherry, Dharmapuri, Salem, Namakkal , Trichy, Tiruvarur, Karur, Perambalaur, Dindukal, Theni, Ramnad, Sivagangai and Virudhunagar Among the 22 SMSs, 17 are agricultural graduates while five are agricultural engineering graduates. Eighteen are male and four are female specialists.

Exploratory Research design has been employed to obtain the existing status and gap in mechanization. During the brain storming session, seven groups were formed based on climatic zones and pre-structured questionnaires were issued to all the respondents for entry of the primary data on operation wise availability of machinery, crop wise level of mechanization, trends on agricultural mechanization, gap in mechanization, need for equipment refinement and potential demand.

Considering the area of extent of cultivation in Tamil Nadu, four major crops studied were paddy, sugarcane, groundnut, and cotton. The seven agro-climatic zones of the state were i) Cauvery delta zone (CDZ), ii) Southern zone (SZ), iii) Western zone (WZ), iv) High rainfall zone (HRZ), v) Hilly zone (HZ), vi) North Eastern zone (NEZ), and vii) North Western zone (NWZ). Among the above cited seven agro-climatic zones, high rainfall zone and hilly zone falls under each district with different cropping pattern and mechanization adoption.

Prioritization of mechanized operations

In Garrett ranking method, the percent positions estimated were converted into scores by referring to Garrett's table. Then for each factor, the scores of each individual were added and then mean value was calculated. The means were arranged in descending order. The operation having the highest mean value score was considered to be most important and high priority. The identified operations were administered to the respondents and they were asked to give their ranks in the order of merit. The order of merit given by the respondents for the different operations was converted into ranks by using the following formula.

Per cent position = $(100 (R_{ij}-0.5))/N$ …. (1)

where, R= Rank assigned for i^{th} factor by j^{th} individual and N= Number of factors ranked by j^{th} individual.

The percent positions estimated were converted into scores by referring to Garrett's table. Then for each factor, the scores of each individual were added and then mean value was calculated. The means were arranged in descending order. The operation having the highest mean value score was considered to be most important and high priority.

Results and Discussion

The data collected from the subject matter specialists of 22 KVKs of Tamil Nadu are presented in the following tables (Tables 1–7). Among the seven agro-climatic zones, high rainfall zone and hilly zone falls under each district with different cropping pattern and mechanization adoption (Fig. 1–3).

Level of farm mechanization

i) Paddy: It was evident from Table 1 that SZ showed highest mechanization (96.0%) in case of seed bed preparation/tillage in paddy crop where CDZ had lowest (85.0%) level of adoption of machinery. For sowing/ planting/ transplanting operation, highest (70.0%) lies with SZ and CDZ and lowest (20.0%) in NWZ. Mechanization in weeding and intercultural operation was highest (80.0%) in NEZ where WZ had lowest (20.0%) in this category. In case of harvesting and threshing, NEZ and CDZ had highest (95.0%) and NWZ had (70.0%) lowest among other zones. Similarly, WZ had majority (60.0%) of post-harvest operations and NWZ and NEZ possessed no post-harvest/processing in paddy crop. It was also noted from the analysis that SZ ranked first in mean mechanization (61.0%) followed by WZ and CDZ (60.0% each). In the state, 56.4% of operations for paddy crop were mechanized which denoted the crop need attention in mechanization especially in the area of weeding and inter-cultivation.

ii) Sugarcane: It was evident from Table 2 that SZ showed highest mechanization (95.0%) in case of seed bed preparation/tillage in sugarcane crop where NEZ had lowest (20.0%) level of adoption. For sowing/planting/transplanting operation, highest (45.0%) lies with CDZ and no mechanization intervention in NEZ and SZ. Weeding and intercultural operation mechanization is high (65.0%) in WZ where SZ had lowest (25.0%) in this category. In case of harvesting and threshing, NEZ had highest (95.0%) and NWZ had no intervention among other zones. Similarly, WZ had majority (60.0%) of post-harvest operations and other zones possessed no post-harvest/processing in sugarcane crop. It was also noted from the analysis that NWZ ranked first in mean mechanization (55.0%) followed by NEZ (51.7%). In the state, 32.4% of operations for sugarcane crop were mechanized which denoted the crop need lots of attention in mechanization in the areas of

planting, harvesting, and post-harvest operations.

iii) Groundnut: The SZ showed highest mechanization (95.0%) in case of seed bed preparation/tillage in Groundnut crop where NEZ, NWZ and WZ had equal (90.0%) level of adoption (Table 3). For sowing/planting/transplanting operation, highest (80.0%) lies with NWZ and WZ and lowest (15.0%) in SZ. Weeding and intercultural category, WZ alone (15.0%) showed the mechanization intervention. In case of harvesting and threshing, NEZ and WZ had the mechanization (05.0%) of pod shelling and others among other zones. Similarly, WZ had majority (30.0%) of post-harvest operations and other zones possess no intervention in post-harvest/processing in groundnut crop. It was also noted from the analysis that NWZ ranked first in mean mechanization (85.0%) followed by SZ (55.0%). In Tamil Nadu, only 32.8% of operations for groundnut crop were mechanized which denoted the crop need lots of attention in mechanization in the areas of weeding, harvesting, and post-harvest operations and value addition.

iv) Cotton: In the cotton crop, SZ showed highest mechanization (95.0%) in case of seed bed preparation/Tillage in cotton crop where WZ had lowest (75.0%) level of adoption. For sowing/planting/transplanting operation, WZ (20.0%) alone showed the mechanization intervention. In case of weeding and Intercultural operation mechanization is high (55.0%) in CDZ where SZ had lowest (5.0%) in this category. In case of harvesting and threshing, CDZ alone showed intervention among other zones. Finally, no intervention is being carried out in post-harvest/processing in cotton crops. It was also noted from the analysis that NWZ ranked first in mean mechanization (60.0%) followed by SZ (50.0%). In Tamil Nadu, only 31.3% of operations for cotton crop were mechanized which denoted the crop need lots of attention in mechanization in the areas of sowing as well as harvesting (Table 4).

Identification of mechanization gap

From Table 6 it was evident that, paddy crops had highest level of mechanization at 56%. Among the field operations seed-bed preparation and tillage stood first in the status of mechanization while status of mechanization with respect to other operations expect post-harvest and value-addition were on par and below the state average (36.2%). All the crops had good scope in the areas of post-harvesting and value addition for mechanization in the state since only 7.9% of operations on post-harvesting and value addition were mechanized presently. Cotton and groundnut registered lowest percentage (1.3 and 2.5) of mechanization level in harvesting operation which needed lots of attention.

Prioritization of mechanized operations

In Garrett ranking method, the percent positions estimated were converted into scores by referring to Garrett's table. Then for each factor, the scores of each individual were added and then mean value was calculated. The means were arranged in descending order. The operation having the highest mean value score was considered to be most important and high priority.

According to the ranking as shown in Table 7, it is found that post-harvest mechanization was the requiring highest prior operation followed by cotton harvester. Power weeder was another major issue as could be seen from the analysis followed by harvester for groundnut and sugarcane as well as planter for cotton and sugarcane.

Table.1 Adoption of farm mechanization in paddy crop

S. No	Field operations	Agro-climatic zone (%)					Pooled (%)
		WZ	NWZ	NEZ	CDZ	SZ	
1	Seed bed preparation / tillage	95.0	80.0	90.0	85.0	96.0	89.2
2	Sowing/ planting/ transplanting	35.0	20.0	30.0	70.0	70.0	45.0
3	Weeding and Inter-culture	20.0	40.0	80.0	45.0	50.0	47.0
4	Harvesting and threshing	90.0	70.0	95.0	95.0	88.0	87.6
5	Post-harvest and value addition	60.0	0	0	05.0	01.0	13.2
	Mean	60.0	42.0	59.0	60.0	61.0	56.4

Table.2 Adoption of farm mechanization in sugarcane crop

Sl. No	Field operations	Agro-climatic zone (%)					Pooled (%)
		WZ	NWZ	NEZ	CDZ	SZ	
1	Seed bed preparation / tillage	80.0	90.0	20.0	75.0	95.0	72.0
2	Sowing/ planting/ transplanting	05.0	35.0	-	45.0	-	17.0
3	Weeding and Inter-culture	65.0	40.0	40.0	55.0	25.0	45.0
4	Harvesting and threshing	20.0	-	95.0	10.0	01.0	25.2
5	Post-harvest and value addition	15.0	-	-	-	-	03.0
	Mean	37.0	33.0	31.0	37.0	25.2	32.4

Table.3 Adoption of farm mechanization in Groundnut crop

Sl. No	Field operations	Agro-climatic zone (%)				Pooled (%)
		NWZ	NEZ	WZ	SZ	
1	Seed bed preparation / tillage	90.0	90.0	90.0	95.0	91.3
2	Sowing/ planting/ transplanting	80.0	60.0	80.0	15.0	58.8
3	Weeding and Inter-culture	-	-	15.0	-	3.8
4	Harvesting and threshing	-	05.0	05.0	-	2.5
5	Post-harvest and value addition	-	-	30.0	-	7.5
	Mean	34.0	31.0	44.0	22.0	32.8

Table.4 Adoption of farm mechanization in Cotton crop

Sl. No	Field operations	Agro-climatic zone (%)				Pooled (%)
		NWZ	CDZ	WZ	SZ	
1	Seed bed preparation / tillage	90.0	85.0	75.0	95.0	86.3
2	Sowing/ planting/ transplanting	-	-	20.0	-	5.0
3	Weeding and Inter-culture	30.0	55.0	40.0	05.0	32.5
4	Harvesting and threshing	-	05.0	-	-	1.3
5	Post-harvest and value addition	-	-	-	-	-
	Mean	24.0	29.0	27.0	20.0	25.2

Table.5 Operation wise overall status of farm mechanization in Tamil Nadu

Sl. No	Operations	Crop (%)				Mean (%)
		Paddy	Sugarcane	Groundnut	Cotton	
1	Seed bed preparation / tillage	72.2	72.0	91.3	86.3	80.5
2	Sowing/ planting/ transplanting	45.0	17.0	58.8	5.0	31.5
3	Weeding and inter-culture	47.0	45.0	3.8	32.5	32.0
4	Harvesting and threshing	87.6	25.2	2.5	1.3	29.2
5	Post-harvest and value addition	13.2	3.0	7.5	-	7.9
	Mean	53.0	32.4	32.8	31.3	37.4

Table.6 Identification of mechanization gap

Crop	Operation	Existing practice	Gap identified	Requirements
Paddy	Tillage	Tractor operated plough/puddler	Nil	Nil
	Planting	Manual	Mechanical transplanter	Self-propelled transplanter
	Inter-culture	Cono-weeder, manual weeding	Long handled tool	Improved weeder
	Harvesting	Combine, Manual harvest	Nil	Nil
	Post-harvest	Manual	Suitable technology	Suitable technology
Sugarcane	Tillage	Tractor operated plough/ridger	Nil	Nil
	Planting	Manual	Mechanical planters	Sett-cutter planter, budchip settling planter
	Inter-culture	Manual	Weeder / earthing up equipment	Small tractor-mounted equipment
	Harvesting	Combine, Manual	Sugarcane Harvester	Sugarcane Harvester
	Post-harvest	Manual	Suitable technology	Suitable technology
Groundnut	Tillage	Tractor operated plough	Nil	Nil
	Sowing	Seed-drill, manual dropping behind plough	Manual& mechanical dibbler	Manual & mechanical dibbler
	Inter-culture	Weeding by hand hoe	Long handled tool	Improved weeder
	Harvesting	Manual harvesting	Mechanical harvester	Tractor-operated harvester
	Post-harvest	Manual	Suitable technology	Suitable technology
Cotton	Tillage	Tractor operated plough	Nil	Nil
	Sowing	Manual dropping behind plough	Mechanical seeder	Seed drill
	Inter-culture	Manual weeding	Power weeder	Power weeder
	Harvesting	Manual picking	Mechanical harvester	Cotton picker
	Post-harvest	Manual	Suitable technology	Suitable technology

Table.7 Priority of farm operations for mechanization

(n=24)

S. No.	Problems	Total score	Mean score	Rank
1	Post-harvest machinery	2750	86.7	I
2	Cotton harvester	2500	85.2	II
3	Power weeder for row crops	2350	76.1	III
4	Groundnut harvester	2025	62.9	IV
5	Sugarcane harvester	1925	59.0	V
6	Planter for cotton and sugarcane	1450	47.4	VI
7	Rice transplanter	1350	39.5	VII

Fig.1 Agro climatic zones of Tamil Nadu

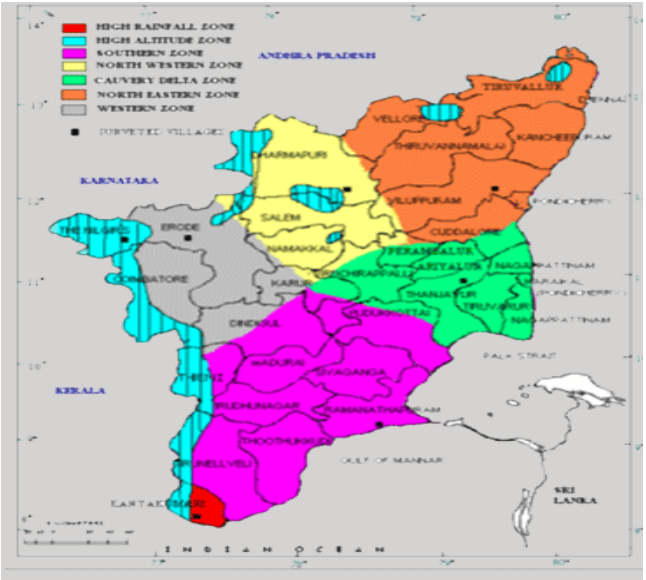


Fig.2 Major crop wise proportion of mechanization in Tamil Nadu

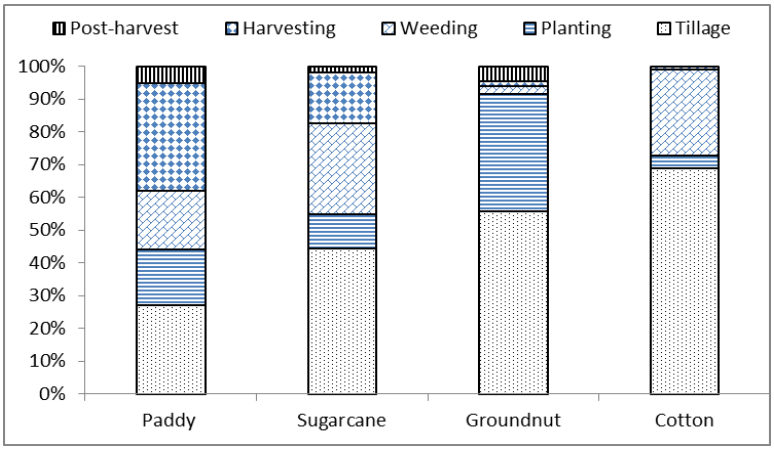
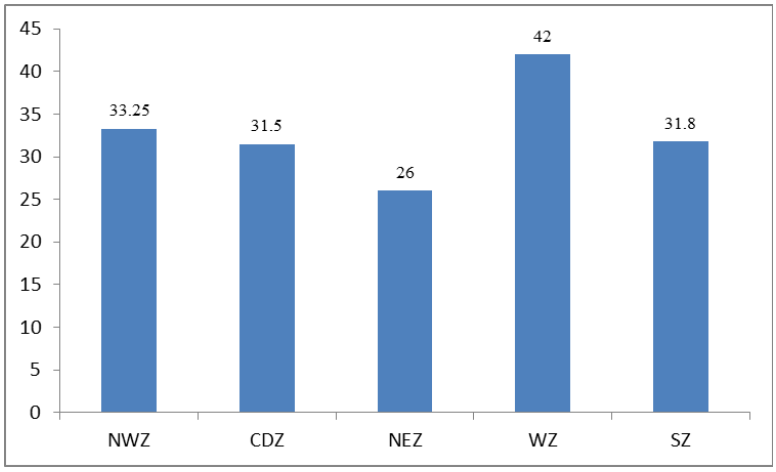


Fig.3 Agro climatic zone-wise mechanization status



Rice transplanter ranked last in the study. Due to urbanization the labourers move from rural areas to urban areas for employment, there is shortage of labour force in all farm operation year round. Since the farm operations were mainly carried out timely, it was felt that easy to use farm equipment and tools according to requirement could be introduced in Tamil Nadu farms.

Conclusions of the study are as follows:

The operation-wise level of mechanization varies from western zone (42.0%) to north eastern zone (26.0%). Paddy stood first (53.0%) in status of mechanization in the state while the status of mechanization with respect to remaining major crops was on par and below the state average of 37.4%. Among the field operations seed-bed preparation and tillage stood first in the status of mechanization while status of mechanization with respect to other operations expect post-harvest and value-addition were on par and below the state average (36.2%).

All the crops had good scope for mechanization in the areas of post-harvesting and value addition in the state since only 7.9% of operations were mechanized presently. Cotton and groundnut registered lowest percentage (1.3 and 2.5) of mechanization level in harvesting operation which needed lots of attention.

According to Garratt ranking, post-harvest mechanization was the highest operation followed by cotton harvester and power weeder. Harvester for groundnut and sugarcane was the next priority followed planter for cotton and sugarcane, as well as rice transplanter. Since the farm operations were mainly carried out timely, it was felt that easy to use farm equipment and tools according to requirement could be introduced in Tamil Nadu farms.

References

1. Anonymous, 2004. Annual Report of Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India.
2. Dixon, R.B. (1982), "Women in Agriculture: Counting the labour force in developing countries". Population and Development Review, 8: 539.
3. Nawab Ali, 2005. Role of agricultural engineering towards food, nutritional and environmental security in India, Agricultural Engineering Today, 29 (5-6): 1-11.

4. Nag, P.K., Chatterjee, S.K. 1981. Physiological reactions of agricultural workers in Indian agricultural work. Human Factors, 23, 607-614.
5. Singh Gyanendra. 2000. Growth pattern and performance characteristics of tractors used in India. Journal of Institution of Agricultural Engineers (UK), Landwards, Spring, pp 17-25.
6. Thakur, S. (1994), 'Indigenous and scientific post-harvest technology exposure and media impact on farm women'. M.Sc. Dissertation submitted to CCS Haryana Agrl. University, Hisar.
7. Webster, C. C. and Wilson, 1966. Agriculture in the tropics. Longman, London, UK.

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