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Assessment of Farm Mechanization Level for Groundnut Crop in Junagadh District, Gujarat, India

Monika Verma [a++*], R. K. Kathiria [b#], Nakka Leelavathi [a++], M. S. Dulawat [c†] and S. K. Gadhe [d‡]

[a] Department of Farm Machinery and Power Engineering, CAET, India.
[b] Director of Research, JAU, India.
[c] Department of Renewable Energy Engineering, CAET, India.
[d] Department of Farm Machinery and Power Engineering, CAET, Junagadh Agricultural University, Junagadh-362001(Gujarat), India.

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

Groundnut (*Arachis hypogaea* L.) is a major leguminous crop grown in the tropical and subtropical regions of the world. This survey work was done in the Junagadh district of Gujarat state. Total 45 villages from 9 talukas were selected randomly. A total of 450 farmers were selected for survey with

[++] M. Tech Scholar;
[#] Associate Research Scientist;
[†] Professor and Head;
[‡] Senior Research Assistant;
**Corresponding author: E-mail: vermamonika18890@gmail.com;*

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10 farmers chosen from each village. Data were collected personally by interviewing the respondents with the help of well-structured interview schedule, and it was statistically analyzed. It was observed from the findings that 57 % of the respondents belonged to middle age group, 27 % of the respondents were educated up to medium school level, 72 % of the respondents had medium size of family, 41 % of the respondents had medium sized land holdings, 36 % of the respondents had well source of irrigation, 79 % of the respondents had electric pump and 31 percent of the respondents had tractor. Of those interviewed, 70% used a tractor-drawn cultivator for the preparation of a seed bed, a blade harrow, and a planker. In case of sowing, tractor drawn auto-seed cum fertilizer drill (after monsoon) was used by 46% of the respondents. Mini tractor drawn multi-purpose implement for interculturing was used by 66% of the respondents. About 98% of the respondents used battery sprayer for plant protection. Tractor drawn blade harrow was used for harvesting purpose by 67% of the respondents. At the time of threshing, 99.56% of the respondents used electric or oil engine operated thresher in Junagadh district. Mechanical energy for different operations like seedbed preparations, sowing, interculturing, plant protection, harvesting and threshing was found to be 4419.5, 1543.20, 348.49, 131.98, 1072.33 and 658.62 MJ/ha respectively in Junagadh district. Survey represent that the mean farm power is 45.05 hp and farm mechanization level is 13.92 hp/ha in Junagadh district. Keywords: Groundnut, Farm machinery, Mechanical energy, Farm power, Farm mechanization level.

Keywords: Farm mechanization; groundnut; farmers; leguminous crop.

1. INTRODUCTION

Groundnut commonly known as Arachis hypogaea L., also referred to as earthnut, monkey nut, pinda, manillanut, and goobers are obtained from Woodroof [1]. India is the second largest producer of groundnuts in the world. Globally groundnut ranks 4th in importance as an edible oil source and 3rd in vegetable protein sources according to Harisudhan and Subrahmaniam, [2]. Groundnut kernel contains 43 to 49 % of oil, 28 to 30 % of proteins which is 1.3 times higher than meat, 2.5 times higher than eggs and 8 times higher than fruit and 16 to 24 % of carbohydrates. They are rich source of vitamins A, B1, B2 and E (Lakhani and Vagadia, [3], Sinhar and Gajjar, [4]). Gujarat, being a prominent state, accounts for 37 % of the total production in India [5]. Within Gujarat, Junagadh district is the leading producer of peanuts, with a production of 0.45 million tonnes and an 11 % share, second only to Rajkot (12 %, 0.49 MT) during the Kharif season of 2020-21 [6]. The area under groundnut cultivation in Gujarat is 19.09 lakh hectares with annual production of 3.85 MT with productivity of 2020 kg/ha [7].

Farm mechanization implies the use of various power sources and improved farm tools and equipment, with a view to reduce the drudgery of the human beings and draught animals, enhance the cropping intensity, precision and timelines of efficiency of utilization of various crop inputs and reduce the losses at different stages of crop production. Therefore, there is more need to adopt new farm machinery or improvement in the existing farm machinery in groundnut cultivation [8].

This study would finally give insight into the prevailing scenario of farm mechanization status in the groundnut crop and analyzed the extent of awareness, knowledge and its adoption of different farm implements by the groundnut grower.

Keeping this in view, the present study was conducted with the following objectives:

1. Study of the groundnut grower profile and machinery used by them for various groundnut crop operations

2. To assess mechanical energy used in different farm operations of groundnut crop

2. METHODOLOGY

The present study was undertaken in Junagadh district of Gujarat state. It extends between latitudes 20.47°N to 21.45°N and longituds 70.15°E to 70.55°E that covers a total land area of 8,831 km^2. Total 45 villages from 9 talukas were selected randomly. A total of 450 farmers were selected for survey and 10 farmers chosen from each village. The data, from the respondents in person, was collected through an interview with a pre-structured interview schedule. A comprehensive interview schedule

was prepared to collect data on personal characteristics of farmers, adoption of farm machinery, time and fuel consumption, and constraints faced by farmers. The data thus collected was analyzed to work out mechanical energy, level of farm mechanization, and to identify the constraints faced by farmers. The data obtained in the study is subjected to statistical analysis using tools such as percentage, frequency, and arithmetic mean.

3. RESULTS AND DISCUSSION

3.1 Profile of Groundnut Growers

The distribution of the farmers according to their respective groundnut grower profiles, in the order below, can be seen from Table 1. Accordingly, 57 %, 11 % and 32 % of the respondents were in middle age, young and old age groups; 27 %, 15 %, 21 %, 19 %, 11 % and 7 % were middle education, college/ post-graduation, higher education, primary education, illiterate and functionally literate respectively; 72%, 14% and 14 % of the respondents were of medium size, small size and large size of family members; 40 %, 2 %, 8 %, 19 % and 31 % of the respondents were of medium size, big size, marginal size, small size and semi medium size of land holding respectively; 36 %, 28 %, 0.44 % and 36 % of the respondents belongs to wells, bores, no facility and well or bore (both) source of irrigation respectively; 79 %, 10 %, 11 % and 0.22 % of the respondents were availing electrical pump, submersible pump, Electric & Submersible pump and no facility of irrigation power respectively. Likewise 29 %, 31 %, 22 % and 18 % of the respondents were using mini tractor, 35 hp tractor, 45 hp tractor and more than 45 hp tractor respectively. These findings are in tune with findings of Zala et al. [9], Rathod et al. [10] and Zala et al. [11].

3.2 Adoption Pattern of Farm Machinery by the Groundnut Grower

The distribution of farmers regarding the adoption pattern of farm machinery was spiked from Table 2, presented accordingly in the following order. The tractor drawn M.B plough 46 %, cultivator 70 %, blade harrow 70 %, planker 70 % and rotavator 34 % carry out preparation of seed bed. Mini tractor drawn cultivator 27 %, blade harrow 25 % and planker 22 % were adopted by the few farmers. Under bullock drawn implements the great majority of farmers used cultivator 11 %, blade harrow 15 % and planker 16 %. Tractor drawn seed cum fertilizer drill (before monsoon) 46%, tractor drawn seed cum fertilizer drill (after monsoon) 16%, mini tractor drawn seed cum fertilizer drill (after monsoon) 15% and bullock drawn auto seed cum fertilizer drill (after monsoon) 13% were the important sowing appliances followed by the groundnut growers. Interculturing purpose: The great majority of farmers are used manually 100 %, mini tractor drawn multipurpose implement 66 % and few farmers used bullock drawn multipurpose implement 22% for groundnut crop. Majority of farmers used battery sprayer 98 %, a few farmers are used knapsack sprayer 2 % and tractor drawn power sprayer 10 % for plant protection. The majority of farmers are used manually 100 %, tractor drawn blade harrow 67 %, mini tractor drawn Blade harrow 20 % in harvesting groundnut crop. The majority of farmers are used electric or oil engine operated thresher 99.56 % for groundnut crop. Raval et al. [12] also reported similar finding.

3.3 Mechanical Energy

Mechanical energy on various farm operations through the use of different power sources: tractors, bullocks, and human power.

Fig. 1 the highest mechanical energy consumption by M. B. plough operation of 979.62MJ/ha in vanthali taluka and lowest of 865.83 MJ/ha in mendarda taluka. The mechanical energy consumption for a cultivator is ranged from a maximum of 357.15 MJ/ha in the vanthali taluka to the minimum of 331.15 MJ/ha in manavadar taluka, whereas in the case of a blade harrow, the energy consumed was estimated to be a maximum of 402.55 MJ/ha in vanthali taluka to the minimum of 366.76 MJ/ha in keshod taluka. Planker saw the highest mechanical energy consumption of 272.20 MJ/ha in bhesan taluka and the lowest was 241.57 MJ/ha in manavadar taluka. Similarly, in the case of rotavator, the maximum energy consumed was found in vanthali taluka as 990.34 MJ/ha, whereas minimum energy consumed was worked out in maliya hatina taluka as 904.50 MJ/ha.

Table 1. Distribution of respondents according to groundnut grower profile (n=450)

	Parameter	Percentage (%)	Frequency
Age	Young (up to 35 years)	11	49
	Middle (36 to 50 years)	57	256
	Old age (above 50 years)	32	145
Education	Illiterate	11	51
	Functionally literate	7	31
	Primary school	19	85
	Middle school	27	122
	High school	21	92
	College/ Post graduation	15	69
Family Size	Small (up to 3)	14	61
	Medium (4 to 6)	72	324
	Large (above 6)	14	65
Land Holding (ha)	Big size (above 10 ha)	2	7
	Medium size (4.01 to 10 ha)	40	181
	Semi medium size (2.01 to 4 ha)	31	140
	Small size (1.01 to 2 ha)	19	86
	Marginal size (0.01 to 1 ha)	8	36
Source of Irrigation	No facility	0	2
	Well	36	164
	Bore	28	124
	Well & Bore (both)	36	160
Irrigation Power	No facility	0	1
	Diesel engine pump	0	1
	Electric pump	79	356
	Submersible pump	9	40
	Electric pump & Submersible pump (both)	12	52
Tractor available	Mini tractor	29	129
	Up to 35 hp	31	141
	Up to 45 hp	22	97
	More than 45 hp	18	82

According to Fig. 2. During operation, the highest mechanical energy input in bhesan taluka is 549.93 MJ/ha and lowest in manavadar taluka is 518.94 MJ/ha. The highest mechanical energy input with respect to other farm operations used for a blade harrow is 576.26 MJ/ha in the keshod taluka and the minimum energy requirement is 544.43 MJ/ha in the mendarda taluka. The minimum mechanical energy consumption as reported by planker is 275.27 MJ/ha for maliya hatina taluka and the highest for vanthali taluka, which was 288.58 MJ/ha.

As shown in Fig. 3, during cultivator operation, the highest mechanical energy requirement is in bhesan taluka, which was 75.38 MJ/ha, while the minimum required for the land was mendarda taluka, which stood at 52.78 MJ/ha. The maximum mechanical energy utilized for a blade harrow in keshod taluka is 65.84 MJ/ha while in mangrol taluka this implement is not used. Similarly, planker minimum mechanical energy was utilize in mendarda taluka is 57.28MJ/ha while the maximum is 75.38 MJ/ha in mangrol taluka.

Fig. 4 this represents the tractor drown seed cum fertilizer drill operation (before monsoon) at maximum mechanical energy of 341.72 MJ/ha in visavadar taluka and minimum is in Junagadh rural taluka in which the mechanical energy was 324.62 MJ/ha. The consumption of mechanical energy by other tractor-drawn seed-cum-fertilizer drills is maximum in mendarda taluka, which is followed by 387.05 MJ/ha and minimum in the bhesan taluka, which was 322.50 MJ/ha. The tractor-drawn seed drill consumes a maximum before the monsoon season in the visavadar taluka, which was 380.58 MJ/ha while in vanthali, manavadar, mendarda, bhesan, and keshod taluka, the same tool is not utilized. The tractor-drawn seed drill (after monsoon), the maximum mechanical energy, is 337.84 MJ/ha in the Keshod Taluka, while the minimum of 317.09

MJ/ha is in Maliya Hatina Taluka. Mini tractor-drawn seed cum fertilizer drill (after monsoon); in Junagadh rural taluka, the recorded maximum was 282.54 MJ/ha, while Mendarda Taluka had a minimum of 270.31 MJ/ha. Bullock drawn auto seed cum fertilizer drill (After monsoon)the maximum mechanical energy is 89.16 MJ/ha in keshod taluka and the minimum mechanical energy is 85.81 MJ/ha in mangrol taluka and bullock drawn hand metering seed drill (after monsoon) the maximum mechanical energy is 87.94 MJ/ha in keshod taluka while in vanthali, manavadar, mangrol, bhesan, maliya hatina, visavadar and keshod taluka, it is not utilized.

Table 2. Distribution of respondents according to adoption pattern of farm machinery (n=450)

Sr. No.	Adoption pattern	Percentage (%)	Frequency
1.	**Seed bed preparation**		
	A. Tractor drawn		
	1. M. B. Plough	46	206
	2. Cultivator	70	317
	3. Blade harrow	70	317
	4. Planker	70	313
	5. Rotavator	34	155
	B. Mini tractor drawn		
	1. Cultivator	27	122
	2. Blade harrow	25	111
	3. Planker	22	99
	C. Bullock drawn		
	1. Cultivator	11	51
	2. Blade harrow	15	69
	3. Planker	16	70
2.	**Sowing**		
	1. Tractor drawn seed cum fertilizer drill (after monsoon)	16	73
	2. Tractor drawn seed cum fertilizer drill (before monsoon)	46	209
	3. Tractor drawn seed drill (after monsoon)	7	32
	4. Tractor drawn seed drill (before monsoon)	1	5
	5. Mini tractor drawn seed cum fertilizer drill (after monsoon)	15	69
	6. Bullock drawn auto seed cum fertilizer drill (after monsoon)	13	57
	7. Bullock drawn hand metering seed drill (after monsoon)	1	5
3.	**Inter-culturing**		
	1. Mini tractor drawn multipurpose implement	66	295
	2. Bullock drawn multipurpose implement	22	100
	3. Manually	100	450
4.	**Plant protection**		
	1. Tractor Drawn Power Sprayer	10	46
	2. Knapsack Sprayer	2	7
	3. Battery Sprayer	98	443
5.	**Harvesting**		
	1. Tractor drawn groundnut digger-shaker	0	2
	2. Tractor drawn blade harrow	67	301
	3. Mini tractor drawn Blade harrow	20	88
	4. Manually	100	450
6.	**Threshing**		
	1. 1. Tractor operated thresher	0.45	2
	2. 2. Electric or oil engine operated thresher	99.55	448

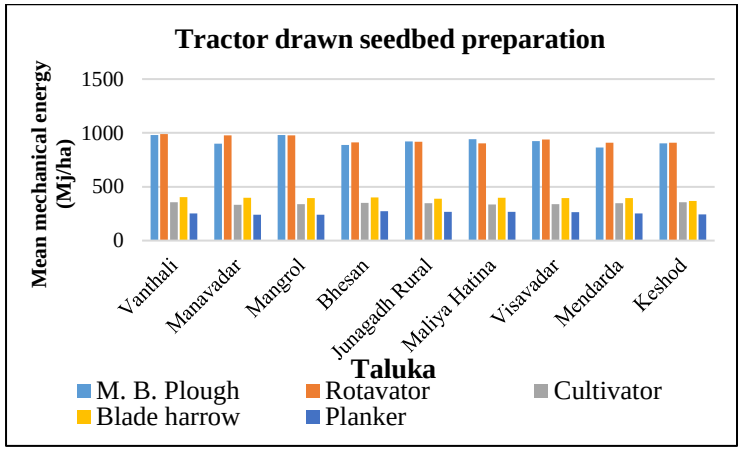

Fig. 1. Mechanical energy of tractor drawn implements used for seedbed preparation by 450 farmers in Junagadh district

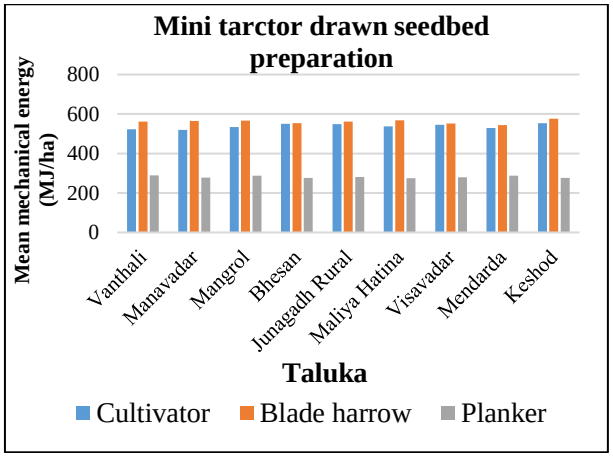

Fig. 2. Mechanical energy of mini tractor drawn implements used for seedbed preparation by 450 farmers in Junagadh district

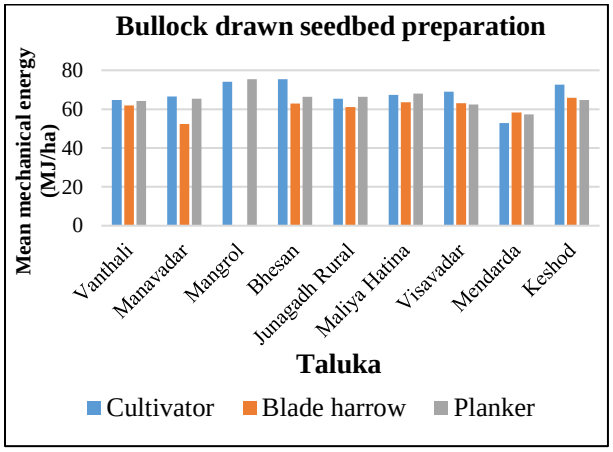

Fig. 3. Mechanical energy of bullock drawn implements used for seedbed preparation by 450 farmers in Junagadh district

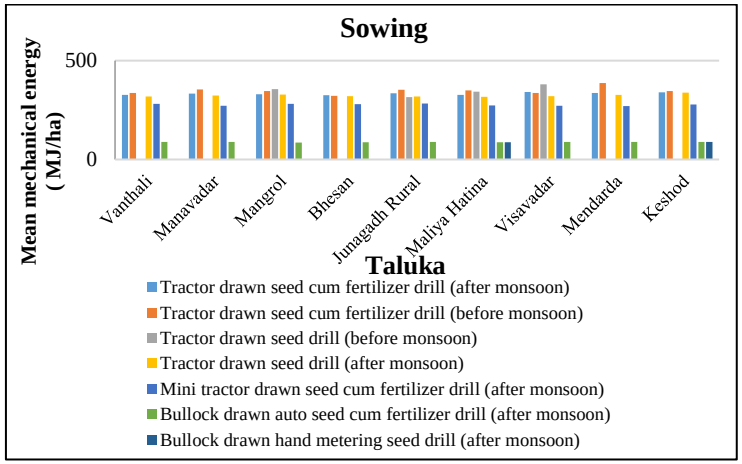

Fig. 4. Mechanical energy of implements used for sowing by 450 farmers in Junagadh district

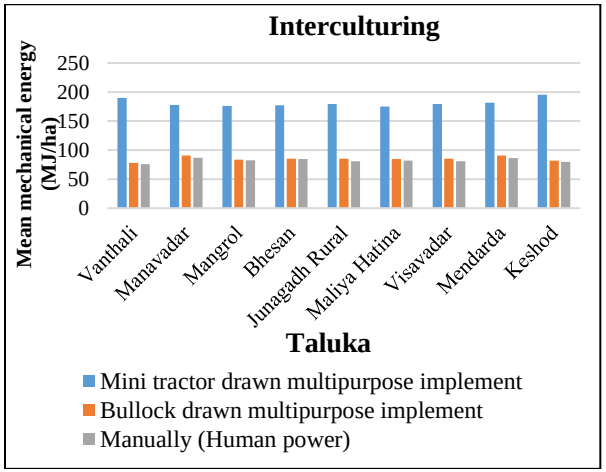

Fig. 5. Mechanical energy of implements used for interculturing by 450 farmers in Junagadh district

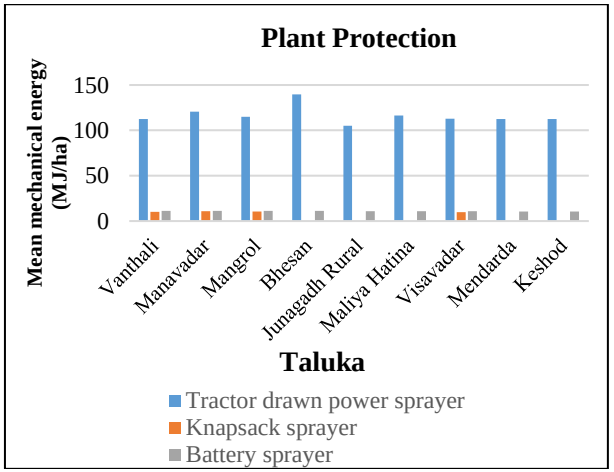

Fig. 6. Mechanical energy of implements used for plant protection by 450 farmers in Junagadh district

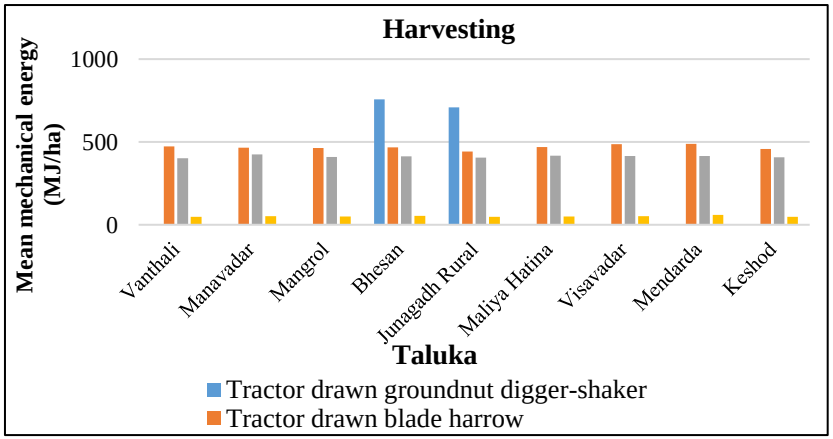

Fig. 7. Mechanical energy of implements used for harvesting by 450 farmers in Junagadh district

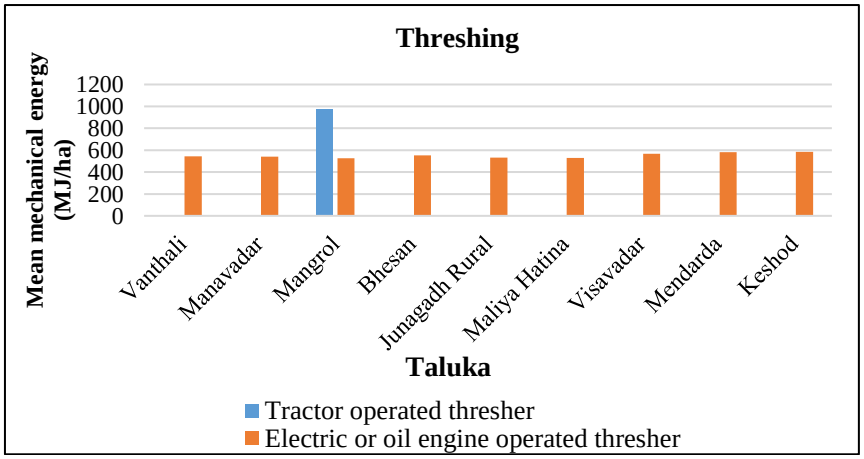

Fig. 8. Mechanical energy of implements used for threshing by 450 farmers in Junagadh district

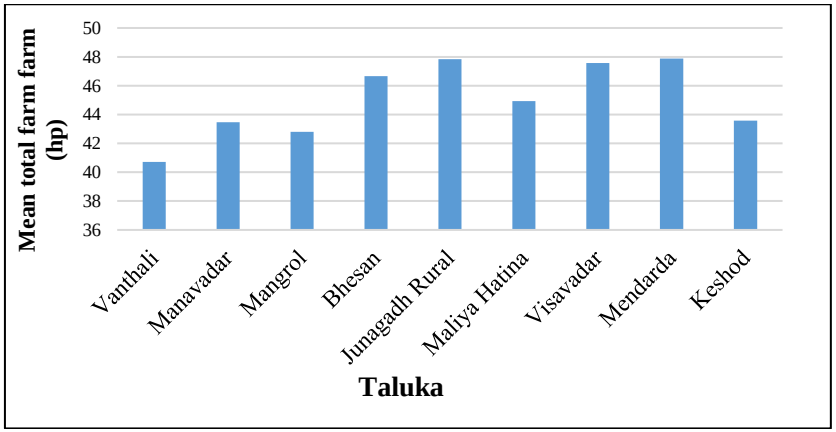

Fig. 9. Total farm power of 450 farmers in Junagadh district

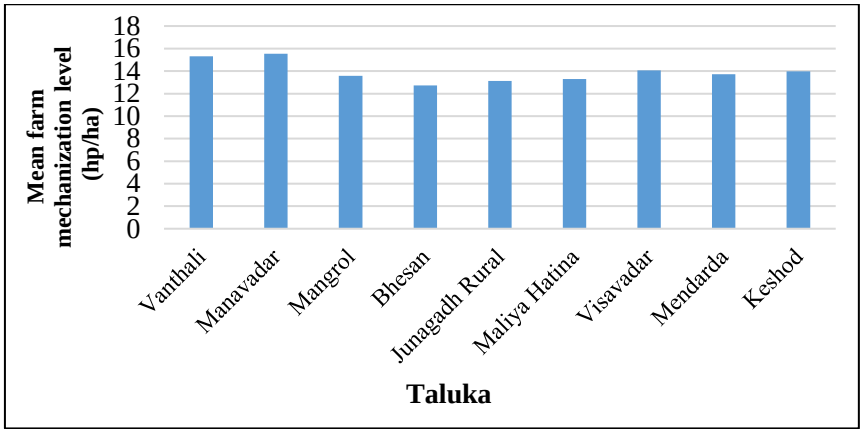

Fig. 10. Farm mechanization level of 450 farmers in Junagadh district

Fig. 5 Maximum and minimum mechanical energy in Keshod and Maliya Hatina taluka was 195.24 and 174.86 MJ/ha during mini tractor-drawn multipurpose implement. The maximum mechanical energy consumed for other bullock drawn multi-purpose implement in manavadar taluka is 90.03 MJ/ha, whereas minimum mechanical energy is in vanthali taluka, which is 78.70MJ/ha. Maximum mechanical energy consumed manually is 86.94 MJ/ha in manavadar taluka and minimum energy is in Vanthali Taluka with 76.06 MJ/ha, whereas tractor-drawn multi-purpose implement is not used in any taluka.

Fig. 6 in tractor-drawn power sprayer, the maximum mechanical energy is consumed by bhesan taluka showing 139.75 MJ/ ha and the minimum energy is consumed by Junagadh rural taluka showing 105.06 MJ/ha. Maximum mechanical energy is used by knapsack sprayers in different parts in manavadar taluka showing the value of 11.03 MJ/ha while this energy is not used in the other talukas like bhesan, Junagadh rural, maliya hatina, mendarda, and keshod taluka. The maximum mechanical energy recorded in manavadar taluka is 11.36 MJ/ha whereas minimum mechanical energy for keshod taluka accounts about 10.54 MJ/ha.

Fig. 7 as the maximum and minimum mechanical energy of the tractor-drawn blade harrow in the Mendarda taluka and Junagadh rural taluka as 487.53MJ/ha and 441.64 MJ/ha respectively. Another mini-tractor-drawn blade harrow has a maximum of 424.32MJ/ha mechanical energy in Manavadar Taluka and minimum in Vanthali Taluka as 401.17MJ/ha. Manually, mendarda taluka has the maximum mechanical energy is 58.85 MJ/ha., while vanthali taluka has the minimum mechanical energy is 47.22 MJ/ha. The tractor drawn groundnut digger-shaker has a maximum mechanical energy of 757.33 MJ/ha in the bhesan taluka and is not utilized in the vanthali, manavadar, mangrol, maliya hatina, visavadar, mendardar and keshod taluka.

Fig. 8 represents the mechanical energy of electric or oil engine operated thresher at maximum mechanical energy of 583.42 MJ/ha in Keshod taluka and minimum mechanical of 524.78 MJ/ha in Mangrol taluka. Maximum mechanical energy of tractor-operated thresher is 972.28 MJ/ha in Mangrol taluka, it is not utilized in vanthali, manavadar, bhesan, junagadh rural, maliya hatina, visavadar, mendarda, and keshod taluka.

3.4 Farm Mechanization Level Considering Tractor Power, Animal Power and Human Power

There is huge role of tractor for improvement of farm mechanization level as tractor allow farmers to do heavy duty works easily and time consuming. According to Figs. 9 and 10, the maximum mean farm mechanization level in manavadar taluka is 15.55 hp/ha whereas maximum mean farm power in mendarda taluka is 47.87 hp. As per Figs. 9 and 10, it may be stated that the minimum mean farm mechanization level in bhesan taluka is 12.72 hp/ha and minimum mean farm power in vanthali taluka is 40.69 hp. In this district, Junagadh district comprising 450 farmers has reported the mean farm power of 45.05 hp and farm mechanization level, 13.92 hp/ha.

4. CONCLUSION

The finding showed that middle age group consisted of 57 % respondents, 27 % of the respondents were educated up to medium school level, 72 % of respondents had a medium size of family, 40 % of the respondents had Medium sized land holdings, 36 % of the respondents had well source of irrigation, 79 % of the respondents had electric pump and 31 % of the respondents had tractor. A tractor-drawn cultivator was used for seedbed preparation by the majority of the respondents representing 70%, while 70% also reported using a blade harrow and planker. Regarding sowing, 46% of the respondents used tractor-drawn auto-seed cum fertilizer drill (before monsoon); about interculturing, 66% of the respondents used mini tractor-drawn multipurpose implement; regarding plant protection, 98% of the respondents used battery sprayer; 67% of the respondents used tractor-drawn blade harrow for harvesting in the Junagadh district; and 99.56% of the respondents used electric or oil engine-operated thresher for threshing. Mean mechanical energy for different operations such as seedbed preparations, sowing, interculturing, plant protection, harvesting and threshing was found to be 4419.5, 1543.20, 348.49, 131.98, 1072.33 and 658.62 MJ/ha respectively in Junagadh district. The survey represented that the mean farm power is 45.05 hp and farm mechanization level is 13.92 hp/ha in Junagadh district.

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Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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