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Cost Effective Implements for Small Wheat Farmers in Bhal Region of Gujarat

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ABSTRACT: The crop cultivation in Bhal & Coastal Agro-climatic zone in Gujarat is relatively difficult and risky which depends mainly on intensity and frequency of rainfall. The kharif crops generally suffer due to inundation of water or otherwise shortage of moisture. The sowing time of Rabi crops is largely governed by the soil moisture conditions rather than temperature. Rainfed wheat, the durum or macroni wheat is the most important Rabi (post monsoon) crop of the region. It occupies an area of about 1.0 lakh hectares with an average productivity of 544 kg/ha. As per the reports of the Times of India e-Newspaper (February 22, 2019), small farmers are continuously increasing day by day in all over the country. In Gujarat, there are 53.19 lakh registered farmers and among 16.15 lakh farmers are small, 20.17 lakh are marginal and only 39893 are large farmers. The changing socio-psychologic and economic condition of the region are affecting the use of farm machinery also. As a result, even a large land holding farmers of this region are facing economic crisis and poor socio-economic condition and the condition of the small farmers is very critical and worse than marginal and large farmers of the region. For sustainable development of Agriculture and survival of small farmers particularly of the region, study is conducted to access the different tools, implements and machines for wheat crop cultivation as per RNAM test code at Agricultural Research Station and Krishi Vigyan Kendra, Anand Agricultural University, Arnej (Dist: Ahmedabad) during 2020-21 to guide the extension worker for proper selection of tools and machinery by small farmers of the region.

Keywords: Durum wheat, Bhal region, farm Implements, dryland agriculture, conserved moisture condition.

INTRODUCTION

Bhal and Coastal Agro-climatic zone in Gujarat has a geographical area of approximate 12 lakh hectare having medium to heavy black soil and is spread over five districts namely Ahmedabad (Dholka, Bavala, Dhandhuka, Barvala and Ranpur taluka), Bhavnagar (Bhavnagar and Vallabhipur taluka), Bharuch (Vagra and Jambusar taluka), Kheda (Matar and Kheda taluka),Anand (Khambhat and Tarapur taluka), Surendranagar (Limbdi and Chuda taluka) adjoining to Gulf of Khambhat. Bhal zone comprises about 7.4 lakh hectare cropped area, which is mostly rain-fed. Cotton & fodder sorghum are predominant *Kharif* crops of this region. Wheat and Gram are major *Rabi* crops. Average rainfall of this zone varies from 550-750 mm. The infiltration capacity of the soil is very poor (0.04 cm/h to 0.19 cm/h) and topography is flat, with poor drainage. As the area is largely rain-fed, it is also desirable to conserve and store the runoff water for later use (Anonymous, 2015; Anonymous, 2019).

The crop cultivation in the region is relatively difficult and risky which depends mainly on intensity and frequency of rainfall. The *kharif* crops generally suffer due to inundation of water or otherwise shortage of moisture. The sowing time of *Rabi* crops is largely governed by the soil moisture conditions rather than temperature. Further, the *Rabi* crops experience moisture stress during later stage and results in poor productivity. Saline sodic soil, poor drainage and brackish ground water are some of the important crop productions related constrains of this zone.

The durum or macroni wheat cultivation in India is considered to be very old. It is the best wheat for drought conditions or under restricted irrigated conditions of Punjab, M.P., Karnataka, Tamil Nadu, Gujarat, West Bengal and H.P. It is best known for its use for semolina (suji) preparation and also known as Daudkhani wheat or Chasia wheat or Bhalia wheat or Safed wheat. Durum wheat is locally consumed in the form of Bhakhari which is common preparation for dinner and breakfast Ladu and pasta. Farmers are encouraged to grow this crop because of its higher price, least problems of plant protection and use of straw as feed for livestock.

In Gujarat, durum wheat is grown in about 2.5 lakh hectares which accounts 26% of total area under wheat in Gujarat. Rainfed wheat is the most important *Rabi* (post monsoon) crop of Bhal and Coastal Agro-climatic

Zone of Gujarat. In the zone, it occupies an area of about 1.0 lakh hectares with an average productivity of 544 kg/ha (Anonymous, 2015, Anonymous, 2020). According to Indian Express report the registered farmers in Gujarat are 53.19 lakh. Among 53.19 lakh farmers, 16.15 lakh farmers are small, 20.17 lakh are marginal and only 39893 are large farmers. As per the reports of the Times of India e-Newspaper (February 22, 2019), small farmers are continuously increasing day by day in all over the country due to fragmented family size of our social system. Now a days, People prefer to live in small family rather than large and combined family.

Besides many other things, the changing socio-psychologic and economic condition of the region is greatly affecting the use of farm machinery by small and marginal farmers also. As a result, even the large land holding farmers of this region are facing economic crisis and poor socio-economic condition. The small farmers of the region are facing severe socio-economic condition. They are continuously struggling for good return with minimum cost of crop production in the pace of increased mechanization. The tools, implements and machines developed in the rest of the country and accepted by large and economically sound farmers cannot be directly adoptable and beneficial to small farmers of the region. Hence, tools, implements and machines used for wheat crop by small farmers of this region needs to be accessed.

MATERIAL AND METHODS

The tools, implements and machines used for wheat crop cultivation was accessed at Agricultural Research Station, Anand Agricultural University, Arnej(Gujarat) and Krishi Vigyan Kendra, Anand Agricultural University, Arnej (Gujarat) during 2020 to 2021.

All the tools and implements for tillage operation, sowing operation, weeding and interculturing, harvesting and threshing operation were tested as per RNAM test code (Anonymous, 1985).

RESULTS AND DISCUSSION

Tillage Operation. Tillage operation is defined as mechanical manipulation of soil. It is performed to achieve a desired seedbed to get optimum environment for proper plant growth. Seedbed preparation is done through primary and secondary tillage operation. In Bhal region, after cessation of monsoon, when the field gets proper condition (Vapsa condition), it should be harrowed either by bullock drawn or tractor drawn heavy blade harrow, which is popularly known as 'Bhal Kaliyu'. While harrowing the land, depth of operation should be maintained up to 7.5 cm. This operation is to be repeated 2-3 days before sowing to form a friable dry soil layer locally known as 'Panh' which acts as a soil mulch and helps to conserve moisture in subsurface layer wherein the seeds are to be placed (Anonymous, 2020). If the duration between first harrowing and sowing is prolonged one more intermediate operation is done to check evaporation of conserved moisture.

Bhal Kaliyu: Bhal Kaliyu (Fig. 1a) is a very popular implement used for land preparation. It developed by local manufacturer and largely accepted among farmers of this region. Bhal Kaliyu is available for two types of power sources, Animal drawn and Tractor operated. Due to higher maintenance cost of bullock and other socio-economic reasons, farmers mostly prefer tractor operated Bhal kaliyu. It is a tractor-mounted implement and consists of mainframe made of heavy weight galvanized round pipe, rigid tines and straight blade. The clamping of tines makes possible to adjust the distance between them according to crop rows. The heavy straight blade is mounted on the tynes with fasteners. The depth of operation is controlled by the hydraulic system of the tractor. General specification and field performance of the tractor operated Bhal Kaliyuis given in Table 1.

Fig. 1a. Tractor operated blade harrow (Bhal Kaliyu).

Fig. 1b. Trcator operated Rotavator.

Table 1: General specification and field performance of tractor operated Bhal Kaliyu.

Length(cm)	80
Width(cm)	200
Height(cm)	90
Weight(kg)	230
Field capacity, ha/h	0.4
Depth of operation, cm	Adjustable
Field efficiency, %	80
Soil pulverization, MMD	11.50 – 12
Cost of operation, Rs/ha	900

Now a day, due to increased mechanization in the region, some farmers are using rotavator for seedbed preparation for wheat cultivation in the region. For qualitative assessment and performance evaluation of seedbed preparation implements for wheat crop in Bhal agro climatic condition, a study was conducted by Krishi Vigyan Kendra, Anand Agricultural University, Arnej from 2018-19 to 2020-21. On the basis of the result of the study rotavator (Fig. 1b) found best implement for seedbed preparation for marginal and large farmers (Anonymous, 2020). But considering socio-economic point of view and farmer's constraints particularly of small farmers, Bhal Kaliyu is more advisable to use for seedbed preparation in the region.

Rotavator: It consists of a steel frame, a rotary shaft on which blades are mounted, power transmission system, and gear box. The blades are of L-type, made from medium carbon steel or alloy steel. The PTO of tractor drives the rotavator. Rotary motion of the PTO is transmitted to the shaft carrying the blades through gearbox and transmission system. A good seedbed and pulverization of the soil is achieved in a single pass of the rotavator.

Table 2: General specification and field performance of tractor operated Rotavator.

Length (cm)	165
Width (cm)	100
Height (cm)	111
Weight (kg)	350
Shape of blade	L shape
Orientation of blade (degrees)	45-47
Total number of flanges	6
Number of blades per flange	6
Diameter of rotor shaft (cm)	8
Field capacity, ha/h	0.4
Depth of operation, cm	Adjustable
Field efficiency, %	85
Soil pulverization, mm	12
Cost of operation, Rs/ha	1200

Sowing: The best sowing time for rainfed wheat in the region is from last week of October to first week of November depending upon the moisture content and prevailing temperatures. The main objective of sowing is to put the seeds in rows at desired depth. Farmers' uses animal drawn seed drill for centuries. Animal drawn seed drill and tractor operated seed drills both are commercially available in the region. But, due to precision in sowing of seeds at proper depth and less time consumption with compared to animal drawn seed drill, farmers prefer tractor operated heavy seed drill to sow the wheat seeds. Tractor drown automatic seed drill can also be used for uniform seeding at even depth. Seeds should be drilled 7.5 cm deep in the sub surface moist layer (Dhada).The spacing is 30 cm between rows is maintained by seed drills. Farmers' uses animal drawn seed drill for centuries. It is not possible to maintain uniformity in distribution of wheat seeds in animal drawn seed drills. Now a days, automatic seed drills are largely used by the farmers and they are easily commercially available in the region.

Tractor drawn seed drill: Tractor drown automatic seed drill (Fig. 2) is used for uniform seeding at even depth. Seeds should be drilled at 7.5 cm deep in the sub surface moist layer (Dhada). The spacing is 30 cm between rows is maintained by seed drills. it consists main components as (i) Frame which is usually made of angle iron with suitable braces and brackets. It is strong enough to withstand all types of loads in working condition (ii) Seed box which is made of mild steel sheet or galvanized iron with a suitable cover. Small agitator is provided to prevent clogging of seeds. (iii) Covering device which is used to refill a furrow after the seed has been placed in it. Covering the seeds are usually done by patta, chains, drags, packers, rollers or press wheels. (iv) Furrow openers is provided in a seed drill for opening a furrow. The seed tube conducts the seed from the feed mechanism into the boot from where they fall into the furrows. (v) Seed metering mechanism which is used to deliver seeds or fertilizers from the hopper at selected rates according to types of crops (vi). There are two transport wheels fitted on the main axle; wheels have suitable attachments to transmit power to operate seed dropping mechanism (Afzalinia *et al.*, 2006).

Fig. 2. Animal drawn drill and tractor operated seed drill.

Table 3: General specification and field performance of animal drawn and tractor operated seed drill.

Parameters	Animal drawn Seed drill	Tractor operated Seed drill
Length(cm)	105	230
Width(cm)	60	145
Height(cm)	900	135
Weight(kg)	125	385
Row spacing	Adjustable	Adjustable
Furrow opener type	Shovel	Shoe or shovel
Metering mechanism	Fluted roller	Fluted roller
Power transmission	Chain and sprocket	Chain sprocket
Field capacity, ha/h	0.1 - 0.15	0.5- 0.6

Weeding and Inter culturing: Lano (*Suaeda maritima* (L.) Dum), Nali/Hirankhuri (Convolvulus arvensis), Camel thorn - Alhagi pseudalhagi (M.Bieb.)Desv.) and Hathizad/ Okharad (Chrozophorarottleri (Geis) Juss.) are major weeds found in the field of wheat. Weeds can be effectively controlled by hand weeding or manually operated wheel hoe. For this purpose, two hand weeding or one weeding with manual weeder are required. Manual weeder does interculturing operations maximum six times commencing from just before initialization of cracking (45 DAS) at an interval of 8-10 days helps to increase the yield by checking the moisture evaporation losses due to soil mulch development and keeping the crop field weed free**.**

Twin wheel hoe: It is widely accepted weeding tool. It has a long and adjustable handle and operated one person with push and pull action, frame and wheel. The number of wheels varies from one to two and diameter depends on local requirements. The frame has the provision to attach different type of soil working tools such as straight blades, sweeps, V-blade, tine cultivator (Fig. 3). General features and performance results of the twin wheel hoe is presented in Table 4.

Fig. 3. Manually Operated Twin wheel hoe.

Table 4: Specification and field performance of Manually operated twin wheel hoe.

Overall length, cm	140
Overall width, cm	45
Overall height, cm	80
Width of blade, cm	20
Wheel diameter, cm	30
Depth of working, cm	6
Weight, kg	8-10
Cost, Rs	2500 - 3500
Field capacity, ha/h	0.01- 0.013

Plant protection equipment: Grass hopper known as horned grass hopper cause a severe damage to seedlings of wheat crop. Once the crop is destroyed, resowing is required. The pest is confined to wheat growing areas of Dhandhuka taluka of Bhal region. The pest appears as swarms and attack on newly emerged seedlings by cutting the plants at ground level. The damage is done within short time of its field entry and remains there feeding on debris/grass and moving slowly to another field for attack. Farmers need to apply insecticides and pesticides for controlling the damage in the form of spray dust or mist. Duster and sprayer are generally used for application of the chemicals. Farmers prefers dusting of powder chemical with gloved hands and a sprayer for liquid chemicals. Different types of sprayers have been developed for different types of application and field and crop condition. Farmers of the region prefers Knapsack Sprayer for spray application in the wheat crop. Knapsack sprayers are very common and largely used by small and marginal farmers across the country (Singh, 2016). These are manually operated and mounted on the back of the operator and commercially available. It suitable for all the crops having standing height up to 1 m. it saves 78 % labour and 55 % cost over the manual spreading of chemicals (Fig. 4)

Fig. 4. Manually Operated Knapsack sprayer.

Table 5: General specification and field performance of the Knapsack sprayer

Dimension (l × b × h), cm	50 × 25 × 60
Tank capacity, litre	10
Weight of the sprayer, kg	4 kg
Nozzle type	hollow cone
Operating pressure, kg/cm^2	1.7
Cost, Rs	3000 – 5000
Field capacity, ha/h	0.08

Harvesting: Harvesting is generally performed by hand sickles when crop attains maturity. Generally, plain and serrated sickles are used by the farmers for manual harvesting in the region. Different types of sickles are commercially available in the region. But, among these sickles, modified serrated sickle by local manufacturer gives very good results and beneficial to the farmers of the region.

Serrated sickle: It has a serrated and curved blade with wooden handle. Serrated sickle cut the crop by friction. The crop is held in one hand and the sickle is pulled for cutting the crop (Fig. 5).

Fig. 5. Serrated blade sickle.

Table 6: General specification and field performance of the serrated blade sickle.

Dimension (l × b × h), cm	28 × 12 × 4
Length of cutting edge, cm	22
Width of cutting edge, cm	2.5
Weight, kg	0.15
Field capacity, ha/h	0.018
Labour requirement, man-h/ha	70-100
Cost, Rs	250 – 350
Cost of operation, Rs/ha	900 – 1300

The average field capacity for different crops is 0.015 ha/h to 0.019 ha/h. The field capacity of serrated sickle for wheat crop is observed 0.018 ha/h, which is about 60 % more than traditional plain bladed sickles. Its weight is 150 gm, which is much less than traditional sickles and hence reduce muscular stress of the labour. It is made of spring steel and does not require frequent sharpening of the blade, which results in more economic benefits than traditional sickles (Anusha and Mehta 2021).

Vertical conveyor reaper and combine harvester is more suitable for timely harvesting to achieve better quality and higher yield of the crop. Shortage of labour during harvesting time is a great problem faced by farmers. However, shattering loss of grains during harvesting of wheat crop by reaper and combine is observed very high (10-15 %) compared to hand harvesting (1.5 to 2 %) in this region. The wheat crop is grown on conserved moisture condition with limited irrigation hence height of the wheat crop plants remains very less and found higher shattering loss of the grain as compared to wheat grown in other areas and harvested by reaper or combine harvester like other mechanical means which are considered as higher level of mechanization. So, particularly for small farmers of the region, manual harvesting by serrated sickle is the best one option rather than any other mechanical harvesting means.

Threshing: Threshing is the process of detaching grains from the ear heads. In thresher, after harvesting, crop bundles are passed through the passage between concave and rotating drum. The grains are separated from ear heads due to the factor like impact of beaters mounted on periphery of rotating drum and wearing or rubbing action. Generally separating of grain from ear heads depends up on type of crop, variety of crop, ripening phase of grain and moisture content of grin. Wheat is traditionally threshed by bullock trampling or even by running a tractor over harvested crop spread on threshing yard. Bullock trampling and running tractor are traditional practices of threshing, which is a slow and labor-intensive process (Singh, 2016). The loss of grains and brokage percentage are very high in these practices. So, farmers prefer to use threshers for wheat crop threshing. Now a days, with the increase of mechanization, different types of power operated threshers have been developed and multi crop power operated threshers are easily and commercially available. Farmers can use these threshers on hire (rent) basis without investing more money to purchase it.

Tractor operated multi crop thresher: It consists of spike tooth cylinder, aspirator type blower and sieve shaker. Adjustment for cylinder and blower speed, concave clearance is provided to make suitable for various crops. It is suitable for threshing of wheat, maize, sorghum, gram, pigeon pea, mustard, sunflower, safflower, linseed crops (Fig. 6).

Table 7: General specification and Field performance of tractor operated multi crop thresher.

Dimension (l × b × h), m	1.90 × 1.60 × 1.40
Weight, kg	400 – 450
Broken grain, %	0.35
Total grain loss, %	0.82
Output capacity, kg/h	400 – 500
Threshing efficiency, %	96 -98
Cleaning efficiency, %	95 – 97
Labour requirement. Man-h/q	1-2

Fig. 6. Power operated multi crop thresher.

CONCLUSIONS

Improved and efficient tools, small implements and machines plays an important role in the sustainable development of the agriculture. Extension worker has to keep in mind that of helping the farmers to make proper selection of tools and implements according to the requirement and constraints of the farmers. All types of the farmers will not require the same tools or machine. The socio-economic capacity of farmers to buy the tools and machines is also very important. As the most of the farmers of the region are small and marginal, they will be mostly dependent on the manually operated tools and implements and sometime the wok capacity of farmers is not matching with their operational requirements. Hence, selection of scientifically designed, tested and useful tools and implements with farmer's socioeconomic condition should be given due consideration in order to achieve sustainable agricultural development in the Bhal region of Gujarat.

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Conflict of Interest. None.

REFERENCES

Afzalinia, S., Shaker, M. and Zare, E. (2006). Performance evaluation of common grain drills in Iran. *Canadian Biosystems Engineering, 48*(2), 39-43.

Anonymous (1985). RNAM test codes and procedure for farm machinery, Technical series No.12. Economic and Social Commission for Asia and the Pacific Regional Network for Agricultural Mechanization, Bangkok, Thailand.

Anonymous (2015). Package of *Rabi* crop practices of Bhal region in Gujarat 2015, Anand Agricultural University, Arnej (Gujarat), pp.1-25.

Anonymous (2019). On farm testing on Assessment of Farm Implements in wheat harvesting, Annual Progress Report, Krishi Vigyan Kendra, Anand Agricultural University, Arnej Dist: Ahmedabad (Gujarat).

Anonymous (2020). Report presented during 17th AGGRESCO Sub-Committee of Agricultural Engineering and Agricultural Information Technology. Pg: 2-23.

Anusha, M. and Mehta, A. K. (2021). Drudgery Reduction through Ergonomic Evaluation of Women Farm Workers using Local Sickle and Serrated Sickle During Harvesting in Wheat Crop of Udaipur District. *Int. J. Curr. Microbiol. App. Sci., 10*(01), 1075-1084.

Singh, S. (2016). Data book on Agricultural Mechanization in India. Agricultural Machinery Manufacturers Association, India.

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