

Case Study

Status of Farm Machinery Manufacturing in Madhya Pradesh: A Case study

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ABSTRACT

The objective of this paper was to assess the current status of farm machinery manufacturers in Madhya Pradesh along with farm machinery market size, production potential and demand of farm machinery using primary data. To achieve the goal, primary data were collected through pre-tested and well-structured proforma in 2017-18 adopting post-stratified random sampling technique. The market size of farm machinery manufacturing sector was estimated to be INR 7.56 (± 0.21) Billion. There were 53% manufacturers with an annual turnover less than INR 10 Million and only 3% manufactures had annual turnover more than INR 150 Million. High coefficient of variation for advance tools like vertical milling centre (660%) and CNC (Computer numeric control) machine (358%) indicated non uniform utilization of advance tools which affects the quality of manufactured farm implements. The survey conducted in the study region had manufactures producing around 45 different farm implements for agriculture. Investigation revealed that the production of the implements like rotavator, laser land leveler, reaper, combine harvester, chaff cutter and spray were less than its demand, which prompted the users to import these implements from neighboring States like Gujarat, Rajasthan and Punjab. The study showed that 43% of the total manufacturers were integrated with Madhya Pradesh Government subsidy scheme. The manufactures of Madhya Pradesh also exported farm implements like reversible Mould Board plough to South Asian country and other developing country.

HIGHLIGHTS

- ① Status of farm machinery manufacturing in Madhya Pradesh has been assessed using statistical techniques by surveying 225 manufactures.
- ② There were around 45 different types of farm implements were being manufactured in the study region with estimated market size 7.56 (± 0.21) billion.
- ③ The production potential of the implements like rotavator, laser leveler, reaper, combine harvester, chaff cutter and spray pump can be predicted.
- ④ In addition, it is recommended that tool room facility should be developed in each manufacturing hubs by Government agency to help manufacturers in producing quality implement.

Keywords: Farm machinery manufacturers, farm implements, production potential and demand

Indian agriculture has marked its presence at the global level. In spite of this, there are two important bottlenecks like stagnant productivity and shortage of agricultural labour. It is estimated that percentage of agricultural workers total works would drop to 25.7% by 2050 from 58.2% in 2001 (Anonymous, 2018). The declining trend in availability of agricultural workers and pressure to feed ever

growing population of the country has compelled the government to shift towards farm mechanization (Oteng and Kumi 2012; Singh 1993). These footsteps will lead to enhancement crop productivity of

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agricultural production system. Establishment of custom hiring centres, hi-tech hubs, and farm machinery banks at village level are strides of mechanization. At present, more than 2500 custom hiring centres are working in Madhya Pradesh. This has ensured availability of modern agricultural machines to small and marginal farmers. It has been estimated that use of improved implements can increase the productivity by up to 30 % and reduce the cost of cultivation up to 20 %. To enhance the agricultural productivity by mechanization, the role of farm machinery manufacturers is of utmost importance. There are almost 400 registered farm machinery manufacturers all over the country listed by Directorate of Agricultural Engineering, Farmer's Welfare and Agriculture Department, Madhya Pradesh. In India, there are 250 medium and large scale manufacturers, 2500 small scale industries and around 15000 tiny industries (Mehta *et al.* 2019). The Indian agricultural equipment market was worth INR 908 billion in 2018 and it is expected to grow at a CAGR (compound annual growth rate) of 6% during 2019-2024. The market is further projected to reach a value of INR 1289 billion by 2024 (Anonymous, 2019). The market size of farm machinery in Madhya Pradesh is estimated of INR 7.56 billion, which is 0.83% of country market share. Hand tools and small agricultural implements are being manufactured by marginal and medium level manufacturers. In order to meet the future demand, there is a need to study their status regarding market size, product mix and production potential. Few researchers have studied the status of farm machinery manufacturing sector in Madhya Pradesh state as well as in the country. Singh *et al.* (2009) assessed the status of farm machinery manufacturers in Madhya Pradesh. They observed that majority of the manufacturers were of small (46.6%) scale. Most of the manufacturers were making tractor operated cultivators (88.14%), seed-drills (77.9%), trolleys (73.7%), and threshers (72.0%). Kumar *et al.* (2016) quantified the agricultural mechanization in soybean- wheat cropping pattern for Bhopal region of Madhya Pradesh but they did not give emphasis on farm machinery manufacturing sector. Economic Evaluation and Mechanization Index of Selected Cropping Pattern in Madhya Pradesh has been analyzed by Singh and Kumar (2017). They estimated average power availability (1.80 kW/ha)

and observed that farmers are getting better net return from wheat (INR 19,591/ha) followed by gram (INR 18,695/ha) production with a BCR (benefit cost ratio) of 1.71 & 1.86 respectively. They classified the industries in India on the basis of total capital investment i.e. village craftsmen, cottage industries, tiny industries, small scale industries, medium scale industries and large scale industries. Alam *et al.* (2017) assessed market potential, importers, traders/wholesalers and retailers of agricultural machinery manufacturers in Bangladesh and identified the bottlenecks. Kumar *et al.* (2021) measured technical efficiency of farm machinery manufacturers in Central India and they find that out of the total variation in manufacturing system, 69% was due to technical inefficiency, whereas 31% was due to stochastic errors.

In the present paper, current scenario of farm machinery manufacturing of Madhya Pradesh has been studied aiming to estimate production potential and demand of different farm implements. This study will aid promotion of agricultural mechanization through government initiated programs.

MATERIALS AND METHODS

The status of farm machinery manufacturing in Madhya Pradesh has been studied through conducting survey using cluster sampling and estimating the parameters using post-stratified sampling technique. The information has been collected from 87 (sample size-n) manufactures covering 24 manufacturing hubs located in different districts of Madhya Pradesh. Data collection was followed with stratification based on annual turnover (ATO). Kumar *et al.* (2019) listed around 225 farm machinery manufacturers in Madhya Pradesh. Thus, population size (N) has been considered as 225. The farm machinery manufacturers were stratified into 4 strata on the basis of ATO (less than 10 million, 10-50 million, 50-150 million and more than 150 million). The parameter estimates were evaluated as follows. The prior information about the population size of h^{th} strata (N_h) is estimated as,

$$\hat{N}_h = N \frac{n_h}{n} \quad \dots(1)$$

The estimate of population mean and population

total is estimated as follows with their estimate of variances.

$$\hat{y}_{st} = \sum_{h=1}^H W_h \bar{y}_h, \hat{Y}_{total} = N \bar{y}_{st} \quad \dots(2)$$

$$\hat{v}(\bar{y}_{st}) = \sum_{h=1}^H W_h^2 \left(\frac{1}{n_h} - \frac{1}{N_h} \right) S_h^2$$

$$\hat{v}(Y_{total}) = N^2 \sum_{h=1}^H W_h^2 \left(\frac{1}{n_h} - \frac{1}{N_h} \right) S_h^2$$

$$S_h^2 = \frac{1}{N_h - 1} \sum_{i=1}^{N_h} (y_{hi} - \bar{y}_h)^2$$

The 95% confidence interval (CI) of population mean and population total were evaluated as;

$$CI = \hat{y}_{st} \pm t_{n-1, 0.05} \sqrt{\hat{v}(\bar{y}_{st})} \quad \dots(3)$$

$$CI = \hat{Y}_{total} \pm t_{n-1, 0.05} \sqrt{\hat{v}(Y_{total})}$$

where,

$$W_h = \frac{N_h}{N}, \sum_{h=1}^H N_h = N, \sum_{h=1}^H n_h = n$$

N_h = Population size of h^{th} strata, n_h = Sample size of h^{th} strata, n = Sample size, N = Population size, S_h = Heterogeneity of h^{th} strata, H = Number of strata.

Goodness of fit test has been used to judge whether a variable was following a particular probability distribution or not. Here, probability distribution function like normal, lognormal, exponential and beta were fitted and best fit distribution were used in predicting the proportion of manufacturers. The goodness of fit test was performed using three different tests like Kolmogorov-Smirnov, Cramer-von Mises and Anderson-Darling test.

RESULTS AND DISCUSSION

Type of farm machinery in major hubs

The major farm machinery manufacturing hubs located in different districts of Madhya Pradesh are Bhopal, Bina, Khurai, Dewas, Kheda, Babai, Itarsi, Rau, Sanver, Indore, Bari-Bareli, Sehore,

Maksi, Badnagar, Vidisha, Dalauda, Pipaliya Mandi, Nimach, Dabra and Morar. Sehore is a manufacturing hub of Grader and most of the manufacturers have expertise in manufacturing Grader. Among different types of Grader, Spiral grader is being manufactured in large quantity. Vidisha is the manufacturing hub for Grader, Winnower and Loader. Bari-Bareli in raisen district is one of the manufacturing hubs of Balram hal, Leveller, and Cage wheel. The implements like Balram hal, Leveller and Cage wheel are used in rice cultivation. Some of the manufacturers in Badnagar, Ujjain are still manufacturing bullock drawn implements that are being used by the farmers of Chindwara district. Bullock drawn implements are also sold in Rajasthan by some manufactures. But a decreasing trend in demand of bullock drawn implements has been observed since last decade. In Ujjain, the area under potato, onion and garlic has increased. Thus, there is increasing trend in the sale of automatic potato planter and garlic planter. The farmers of Ujjain and Shajapur district have started the cultivation of maize, which has resulted in demand of maize planter and maize seller. This indicates change in cropping pattern and some other crops are being replaced by maize crop in recent years. In Itarsi, Disc harrows are very popular and are being manufactured by almost all the manufacturers. Balram hal is also gaining popularity in this region due to its use in rice cultivation. An increasing trend was observed in the sale of this implement since last decade which indicate that area under rice cultivation is increasing in this region. The farmers of this region are shifting partially from soybean cultivation to rice cultivation due to failure of soybean crop due to biotic and abiotic stress. Khurai is manufacturing hub of seed drills, cultivators and threshers. The Seed drills of Khurai are very popular among the farmers. More than 15000 seed drills have been sold every year. Around 25% of the total sale of seed drills has been sold in other states like Andhra Pradesh, Uttar Pradesh, Bihar and Chattisgarh. Budha, Mandsaur is the major manufacturing hub of mould board plough and reversible mould board plough. 3500 units of mould board and 4000 units of reversible mould board plough have been sold in the year 2017. Even, some of the manufacturers of Budha have exported mould board plough and reversible

mould board plough to South Asian country and other developing country.

Market size of farm machinery manufacturing

The selected farm machinery manufacturers were stratified in to 4 strata on the basis of annual turnover (ATO). Out of 87 manufacturers, the number of manufacturers with annual turnover less than 10 million, between 10-50 million, 50-150 million and more than 150 million were found to be 39, 33, 12 and 3 respectively. The farm machinery manufacturers were engaged in manufacturing and sale of more than 45 different farm implements. The market size of farm implements with 95% confidence interval was estimated to be 7.56 (±0.21) billion using stratified sampling technique. There were 53% manufacturers that had ATO less than INR 10 million. The percentage of manufacturer that had ATO between 10 and 50 million was found to be 30%. There were 14% manufacturers having ATO between 50 and 150 million and only 3 % manufactures had ATO greater than 150 million.

Many distributions were fitted to predict the proportion of manufacturers for a particular parameter. No evidence was found to reject the null hypothesis at 5% level of significance that annual turnover of industries follow lognormal distribution in all three tests Kolmogorov-Smirnov ($p = 0.08$), Cramer-von Mises ($p = 0.12$) and Anderson-Darling ($p = 0.082$). Thus, it was concluded that annual turnover and area of industries follow lognormal distribution. The p values under above test for area of industries were found to be 0.15, 0.16, and 0.13 respectively. Thus, it was concluded that annual turnover and area of industries follow lognormal distribution. Using lognormal distribution, the percentage of manufacturers on the basis of area under industries, numbers of technician and helpers have been predicted. There were 10 % manufacturers whose area of industries were less than or equal to 1422 square feet. There were 25 % manufacturers who have two or less than two technicians and there were 50 % manufacturers who have seven or less than seven helpers.

Manpower and available tools used in manufacturing

The parameter estimates for infrastructure facilities utilized in manufacturing farm implements are

presented in table 1. High coefficient of variation (CV) for advanced tools like VMC (vertical milling centre), CNC (computer numerical control) and gear cutting machine was observed. Very less manufacturers had these tools and in majority of the cases, no such tools were found, thus high CV was observed for these tools. Almost every manufactures had Spray/painting tools, thus very less CV was observed for this tool. Also, majority of manufacturers had Lathe machine, Drill machine, Sheet Cutter, welding tools, Power press and Grinder machine.

Table 1: Estimates of infrastructure parameters

Particulars	Average*/Median	Maximum	CV
Area(square feet)	27387.750*	350000	167
Area(Acre)	0.628*	8.034	167
Technician	4	25	93
Helpers	7	250	196
Sales man	1	4	78
Service after sale	1	5	113
Office staff	2	10	78
CNC (computer numerical control)	0	5	358
VMC (vertical milling centre)	0	1	660
Lathe machine	1	15	139
Drill machine	2	20	94
Hand drill machine	2	7	80
Sheet Cutter	1	6	85
Gas welding	1	10	118
Arc welding	2	30	126
Bench vice	1	15	114
Spray/paint	1	5	66
Gear cutting machine	0	2	569
Power press	1	15	116
Grinding machine	1	10	86
Hand grinder	2	15	98
Crane(tractor)	0	3	117
Crane (hydraulic)	0	1	342
EOT Crane	0	3	221
Power hammer	0	1	211
Shaper	0	3	211
Bending Machine	0	4	132

Types of Farm implements

The collected information on 45 farm implements analyzed. Majority of the manufactures were

making cultivator, seed drill, seed cum fertilizer drill and trailer. The percentage of manufacturers engaged in producing different farm implements has been presented in Table 2. There were around 85%, 78%, 65% and 56% manufacturers that are engaged in manufacturing cultivator, seed drill, trailer and seed-cum-fertilizer drill. There was no any manufacture that was manufacturing combine harvester and laser leveler, thus, these machines were being imported from Punjab.

Although, each manufacture was manufacturing many implements but they had expertise or popularity in manufacturing a specific farm implements. There were 29 % manufacturers that had expertise in manufacturing tractor trailer. Likewise, around 16 % manufacturers had expertise in manufacturing seed-cum-fertilizer drill. There were very few manufacturers that had expertise in manufacturing advance and improved implements like reaper (1.23%), maize planter (0.64%) and potato planter (0.60). The reasons that very few manufactures had capability to manufacture advance implements are that most of the manufactures did not have modern tools for manufacturing and also they had shortage of skilled manpower. Very few manufactures had advance tools like plasma cutter, CNC, VMC etc. that help in making good quality implements.

Table 2: Farm implements and their manufactures in percentage

Sl. No.	Implements	% of FMM	Sl. No.	Implements	% of FMM
1	Cultivator	85.39	24	Balram hal	6.74
2	Seed drill	77.53	25	Ditcher	6.74
3	Trailer	65.17	26	Garlic planter	6.74
4	Seed cum fertilizer drill	53.93	27	Disc harrow	5.62
5	Reversible M B plough	42.7	28	Post hole digger	5.62
6	Duck foot cultivator	37.08	29	Potato digger	5.62
7	Leveller	31.46	30	Spray pump	5.62
8	Multi-crop thresher	29.21	31	Maize Sheller	5.62
9	Rotavator	23.6	32	Potato planter	4.49
10	Grader	14.61	33	Blade Harrow	3.37
11	Dozer	12.36	34	Cage wheel	3.37
12	Hadamba thresher	12.36	35	Maize planter	3.37

13	Spiral grader	12.36	36	Bhusa pump	3.37
14	Bund former	11.24	37	Mulcher cum shredder	2.25
15	Raised bed planter	11.24	38	Combine harvester	0.00
16	Cleaner	11.24	39	Seed drill*	2.25
17	Water tanker	11.24	40	Bakhar*	2.25
18	Reaper	10.11	41	Laser leveler	0.00
19	Chaff Cutter	10.11	42	Water pump	1.12
20	Potato planter (auto.)	8.99	43	Onion planter	1.12
21	Paddy thresher	8.99	44	Blade harrow*	1.12
22	M B plough	7.87	45	Bund former*	1.12
23	Loader	7.87			

Note: FMM: Farm machinery manufacturers, '*': indicates animal operated implements

Production potential and demand of farm implements

The production potential and demand of 45 farm implements were estimated for the year 2017-18 and it has been presented in Table 3. It was observed that production potential of the implements like Rotavator, laser leveler, reaper, combine harvester, chaff cutter and spray pump were less than its demand. Due to this, these implements were being imported from Gujarat, Rajasthan and Punjab.

Table 3: Production potential and demand of farm implements

Sl. No.	Implements	Potential	Demand
1	M B Plough	4901	1818
2	Reversible M B Plough	48509	26051
3	Cultivator	75966	38631
4	Duck Foot Cultivator	24844	10327
5	Balram Hal	1491	1094
6	Disc Harrow	1080	398
7	Post Hole Digger	966	625
8	Ditcher	2273	1463
9	Rotavator	3693	6605
10	laser leveller	0	14
11	Blade Harrow	1179	1023
12	Leveller	15554	8418
13	Cage Wheel	1293	1193
14	Dozers	8111	4588
15	Water Pump	170	142
16	Bund Former	5597	3026

17	Seed Drill	121435	72060
18	Seed cum Fertilizer Drill	75426	39446
19	Maize Planter	1207	710
20	Raised Bed Planter	9773	4043
21	Potato Digger	1847	1236
22	Potato Digger (automatic)	1960	1395
23	Potato Digger (plane)	455	219
24	Onion Planter	142	57
25	Garlic Planter	2784	2165
26	Spray Pump	526	1009
27	Mulcher cum shredder	426	213
28	Reaper	682	2065
29	Combine Harvester	0	994
30	Paddy Thresher	4233	2628
31	Maize Sheller	4545	2955
32	Bhusa Pump	128	85
33	Hadamba Thresher	11847	12188
34	Multi-Crop Thresher	30781	24429
35	Spiral Grader	69759	29889
36	Grader	69972	29989
37	Cleaner	2472	1412
38	Trailer	27642	12531
39	Water Tanker	3224	2088
40	Chaff Cutter	30114	31080
41	Loader	767	463
42	Seed Drill (animal operated)	9943	909
43	Bakhar (animal operated)	1420	57
44	Blade Harrow (animal operated)	2841	43
45	Bund Former (animal operated)	2841	43

Selling of farm implements

Around 43 % of the total manufacturers were integrated with Madhya Pradesh Government subsidy scheme and they were selling farm implements under different subsidy scheme. The percentage of manufacturer that was selling different farm implements under subsidy scheme has been presented in Table 4. Only 9 % manufacturer of total manufacturer that were manufacturing M B plough had sold this implement under subsidy scheme. Similarly, 28 % manufacturer of total manufacturer that were manufacturing Reversible M B plough had sold under subsidy.

Table 4: Percentage of manufacturer associated with subsidy scheme

Implements	% of FMM
M B plough	9
Reversible M B plough	28
Cultivator	8
Rotavator	16
Seed drill	20
Seed-cum-fertilizer drill	28
Multi-crop thresher	26
Cleaner/grader	7
Trailer	10
Raised bed planter	18

Recommendations for Government, institutions and manufacturers

A tool room facility should be developed by Government agency in manufacturing hubs to help manufacturers to produce quality implements by using this facility. Also there is a scarcity of skilled manpower. A concept of using standard part components should be developed by research institutes to simplify and maintain the quality manufacturing of similar implements. There is no concept of using standard part components in any particular implement and hence every manufacturer has its own design of each implement, hence they are not able to maintain quality manufacturing. There are very few manufacturers who are developing their workshops with modern workshop facility like plasma cutting but still, most of the manufacturers do not have this modern workshop facility and also using traditional designs of implements for manufacturing. This affects the quality of manufactured implements.

CONCLUSION

Stratified sampling technique has been used to assess the status of farm machinery manufacturing in Madhya Pradesh. For this purpose, out of 225 manufacturers, data from 87 manufactures were collected. The result indicates that the total market size of farm implements in Madhya Pradesh was around 7.56 (± 0.21) billion. It was found that there were 53% manufacturers that had annual turnover less than INR 10 million and only 3 % manufactures had annual turnover greater than INR 150 million.

It was investigated that there were high coefficient of variation (CV) for advance tools like vertical milling centre (660%) and CNC (358%). Lowest CV was found for spray-painting because almost all the manufacturers had this facility. There were around 45 different types of farm implements were being manufactured in the study region. The percentage of manufacturer that had expertise in manufacturing a specific farm implement was evaluated. It was observed that production potential of the implements like rotavator, laser leveler, reaper, combine harvester, chaff cutter and spray pump were less than its demand. Due to this, these implements were being imported from Gujarat, Rajasthan and Punjab. It was concluded that around 43 % of the total manufacturers were registered with Madhya Pradesh Government subsidy schemes and they were selling farm implements under different subsidy schemes. Based on this study, it is recommended that tool room facility should be developed in each manufacturing hubs by Government agency to help manufacturers. Also, a concept of standard part components must be given so that every manufacturer can use this to maintain quality and standard of implements instead of using their own design which leads to variability in standard part component of same implement. This create problem for end users at the time of repairing and maintenance.

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