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Farm mechanization: Its status in the state of Odisha, India

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Abstract

Farm mechanization is a vital component in agriculture to increase the production and productivity of crops due to the achievement of timeliness in farm operations, reduction in drudgery of labour and saving time and cost of cultivation. This paper discusses the trends of mechanization in agriculture in the state of Odisha, India. It is found that there is a large scope for mechanization in agriculture in the coming years, as there is a minimal share of the machine labour in the total costs of cultivating the principal crops. Farmers of the state are also gradually switching from traditional system to the mechanized methods of crop cultivation. It is therefore indispensable to take extensive programme, either at the Govt. or non-Govt. level to enhance the agricultural mechanization to a greater height. There is the high need of adaption of suitable machines of small capacity and low cost, especially in tillage, transplanting, weeding, harvesting and threshing operations. Massive awareness programme need to be carried out among the farmers of Odisha for popularizing the need based and crop specific machinery, available at the various research organizations of the state and the country for enhancing mechanization.

Keywords: Farm mechanization, farm power and rice mechanization

Introduction

Farm mechanization is an important element of modernization of agriculture. Agricultural mechanization and availability of adequate farm power are crucial for timely farm operations, handling the crop produce, increasing production and productivity and reducing post-harvest losses. With the increase in cropping intensity, the time gap between two successive crops has been drastically reduced resulting into the demands of the use of improved machines and availability of adequate power for timeliness of farm operations so that land can be made ready for the next crop. Similarly, for precision farming, increasing area under irrigation, conservation tillage, straw management and diversification of agriculture, water lifting and precision placement/application of agricultural inputs such as seed, fertilizer, irrigation water, plant protection chemicals etc., suitable equipment and more power are required for increasing farm mechanization. Greater degree of farm mechanization can also address the issues of scarcity of farm labour during peak agricultural seasons like sowing and harvesting particularly for rice cultivation.

About 70 per cent population of Odisha is directly or indirectly engaged in agriculture. Agriculture not only provides food to its population but also provides employment opportunities to about 60% of the total workforce of the State. This sector suffers from frequent natural calamities like cyclones, drought and floods and even animal menace, localized adverse weather events etc. Odisha has a geographical area of 1,55,707 sq. kms. and is divided into ten agro climatic zones depending upon the soil types, topography, rainfall and cropping pattern (Odisha Agricultural Statistics, 2018) ^[1]. The total cultivated land of the State is 61.80 lakh ha, out of which, 29.14 lakh ha (47%), 17.55 lakh ha (28%) and 15.11 lakh ha (25%) are of high, medium and low land respectively. About 38 % of cultivated land is irrigated. Majority of the farmers is of small and marginal categories and have limited access to resources. As per Agricultural Census-2010-11, the number of operational holdings of the State is 46.67 lakh with operational area 48.52 lakh ha ^[2]. The state has witnessed a decline in operational area from 50.81 lakh ha in 2000-01 to 48.52 lakh ha in 2010-11 due to urbanization and more of land has been put to non-agricultural use. Accordingly, the average size of land holding among the farmers of the state too has declined to 1.04 ha. The marginal and small farmers constitute about 76 percent of the cultivated land holdings. The farmers with 2-5 ha land holding constitute 20 per cent of the holdings and farmers having 5 ha or more land holding comprise 4 per cent of the holding.

The net sown area and gross cropped area during the year 2013-14 were 54.24 lakh ha and 90.54 lakh ha respectively. The cropping intensity for 2013-14 was 167%. Increase in the agricultural production and farm productivity are essential for providing food security to the vast majority of the population and achieving significant growth in the income levels of the people. The State Agriculture Policy 2016 has been implemented to have a reliable growth in agriculture sector of the State by providing enhanced assistance to the farming community and other stakeholders. Government has also intensified the efforts to improve production and productivity with sustainable agricultural practices to strengthen agricultural economy and income of the farmers with higher investment, efficient production technology, post-harvest solutions, effective value addition and remunerative market options. Cluster demonstration programme are also being conducted by the Government in the farmers' field under line transplanting/line sowing/SRI method of paddy cultivation.

Subsidy assistance for farm mechanization has as well been extended by the Government in the state.

Workforce

Due to acute shortage of work force (Agricultural labour) in rural areas, many farmers are facing a lot of difficulties in completing their agricultural operation in time. Many agricultural workers are now a days shifting to urban areas in search of better jobs. As per 2011 census, agriculture labourers in Odisha (male & female) constitute 62.93% which has been declined to 52.9% in 2015. Women agricultural labourers in rural area has been declined from 84.5% in 1999-2000 to 74.5% in 2011-12. Human labour and animal power are the main source of energy for the farmers of the state. To tackle the situation of acute shortage of labour, particularly during the peak period of cultivation, it is high time to mechanize all the activities of agricultural operations to make the agriculture profitable. The percentage distribution of input costs of the prevailing crops in Odisha has been presented in Table 1.

Table 1: Percentage distribution of input costs based on sample village survey in selected districts- Puri and Khurdha in Odisha during 2015-2019

Crop	Seed Total	Irrigation	Manure	Organic	Fertilizer	Hired labour			Hired machinery costs			Pesticides/Weedicides
						Bullock	Manual	Total	Tractor	Combine	Total	
More mechanized district												
Paddy	3.37	4.18	5.70	15.43	2.17	28.40	30.56	31.66	6.23	37.89	2.85	100.00
Moong	22.44	0.00	5.06	14.18	7.10	28.98	36.08	18.25	0.00	18.25	4.00	100.00
Less mechanized district												
Paddy	3.12	1.58	4.44	8.50	4.03	57.59	61.63	14.70	3.39	18.09	2.64	100.00
Moong	19.21	0.00	4.33	9.64	12.19	43.64	55.83	9.29	0.00	9.29	1.70	100.00

Source: Field survey, 2019

The input costs of the selected sample villages are presented in Table 1 in between more mechanized district (MMD)-Khurdha and low mechanized district (LMD)-Puri during 2015-19. Out of all the costs, hired machinery costs stood at the highest i.e. 38% followed by hired labour costs (30%) for paddy. Among other costs, fertilizer cost is reported to be 15% and it was higher than any other input cost of paddy crop. The lowest cost appeared for pesticides/weedicides with 3%. Moong crop did not show much input costs compared to paddy. In the cultivation of moong, hired labour cost is reported to be the maximum cost out of all input costs in MMD. The LMD showed opposite picture compared to its counterpart. In LMD, the cost of hired labour is reported to be highest i.e. 62% and less costs under hired machinery cost i.e. 18%. This appears that machinery need to be introduced more in low mechanized area in order to decrease the cost of cultivation resulting into increasing productivity and deriving more profit in crop cultivation.

Status of farm mechanization

Farm Mechanization in India is still in its early stages with an overall mechanization level of 40-45%. The level of mechanization in India is much lower than United State (95%), Western Europe (95%), Russia (80%), Brazil (75%) and China (57%)^[3]. Steady growth was observed in tractor and power tiller operated implements and machines, power equipment (engine and motor operated) and some manually operated tools including sprayers in India. After liberalization, manufacturing of agricultural equipment got a big boost particularly in Haryana, Punjab, Rajasthan, Madhya Pradesh, Gujarat and Uttar Pradesh in India. Due to rapid growth and scope for mechanization in Odisha, recently a good numbers of manufacturers have come forward for manufacturing

agricultural equipment in the state. The Indian agricultural equipment market is experiencing a rapid growth with expected strong potential for future growth as well. The demand for agricultural machinery in Asia-Pacific region was more than twice than in any other region. The tractors, power tillers, combine harvesters, rotavators, threshers and rice transplanters are some of the equipment for which a potential demand has been witnessed over the past few years.

The tractor manufacturing industry in India not only fulfills the country's demand for agricultural tractors but also exports around 65,000 tractors per annum to South African countries and other developed countries. The sale of tractors in India has grown from 217,456 in 2001-02 to 661,431 in 2012-13 during the last 11 years. The Indian tractor market has traditionally been dominated by 23-30 kW tractor segment. The sale of more than 37 kW tractors has been increased from 7.3% to 13.8% during the last thirteen years (2000-2013). Similarly, the sale of tractors in the range of 31-37 kW has been increased from 14.1 to 36.4% during the same period. It indicates that requirement of higher power category tractors in India is increasing for using higher capacity machines on custom hiring basis. During the same period, the sale of medium power tractors (23-30 kW) has been decreased from 55 to 40.4% and low power tractors (15-22 kW) from 23 to 6.3%. The sale of less than 15 kW tractors was only 3.13% during 2012-13. The state of Haryana in India has the highest tractor density of 84 tractors per thousand hectare of net sown area and is followed by Punjab (76), Uttar Pradesh (51), Bihar (44), and Tamil Nadu (43). Overall tractor density per thousand hectare of net sown area in India is 33 in 2012-13 while it has been increased to 37 in 2013-14. The lowest tractor density is in Kerala (4) followed by Assam (9) and West Bengal (17) among the states of India (Mehta *et al.*, 2014). In Odisha, there are only 5 tractors per

thousand hectares which is second lowest in India till 2015-16. TAFE, Mahindra, John Deere, New Holland, Swaraj, Sonalika etc. have the major share of tractor market in India. The current market for power tillers in India is estimated at 56,000 numbers during 2013-14. The market for power tillers in India is mainly concentrated in the eastern and southern parts of the country owing to the small size of land holdings of farmers in these regions and higher are under rice cultivation. On an average, the power tiller density in India is 2.21 per thousand hectare of net sown area. The power tillers market in Odisha is dominated by two manufacturers from south India viz. VST Tillers Tractors Ltd., Bangalore (Karnataka) and Kerala Agro Machinery Corporation Ltd. (KAMCO), Athani (Kerala). The combine harvesters market in India is estimated at 4,000-5,000 units annually. The tractor mounted combine harvesters occupy around 60% of the total combine harvesters market in

India and is mainly concentrated in southern states viz. Tamil Nadu, Kerala, Andhra Pradesh and Karnataka of the country on custom hiring. This is followed by self-propelled combine harvesters which represent 40% of the market. Tractor operated combine harvester, costing about 60-70% of the self-propelled combine are owned individually by farmers with large size farms (> 4 ha). The self-propelled combines are largely owned by custom-hiring contractors. Manufacturers such as CLAAS India Ltd., Preet Agro Industries Pvt. Ltd, Balkar Combines, Vishal Combines, Standard Combines, Kartar Agro Industries Pvt. Ltd, Panesar Agriculture Industries, Hira Agro Industries, John Deere India Pvt. Ltd, Action Construction Equipment Ltd, Dashmesh Mechanical Works Pvt. Ltd etc. are some of the manufacturers in India that have a major share in the combine harvester market in Odisha. The annual demand of some other agricultural machinery is presented in Table 2.

Table 2: Annual market of some implements/machines

S. N.	Name of machinery	Annual market demand in India (2013-14)*	Annual market demand in Odisha, (2015-16)**
1	Tractor	6,00,000	2829
2	Mini Tractor	-	566
3	Power tiller	56,000	4921
4	Combine harvester	4000-5000	2323
5	Thresher	1,00,000	2234 (Axial flow thresher), 3266 (Power thresher)
6	Rotavator	60,000-80,000	4716
7	Rice transplanter	1500-1600	2800
8	Reaper	4000-5000	654
9	Zero till drill	25000-30000	-
10	Multi crop planter	1000-2000	2253
11	Laser guided land leveller	3000-4000	1293
12	Power weeder	25000	12118

Mehta *et al.* (2014)^[4], ** Calculated assuming 50% mechanization level to achieve in Odisha in coming 10 years.

The overall mechanization level in India is only 40-45% even though 90% of the total farm power is contributed by mechanical and electrical power sources. However, all operations are not uniformly mechanized. Operation-wise level of mechanization varies from 42% for soil working and seed bed preparation, 29% for seeding and planting, 34% for plant protection and 37% for irrigation. In case of harvesting and threshing, the level of mechanization is 60-70% for wheat and rice and less than five per cent for other crops. The overall

mechanization in Odisha is found to be only 35-36% with major improvement in land preparation (74.85%). The operation wise mechanization for harvesting and seeding are top priority for the farmers in India for cereals crops. But mechanization of above operations is not up to the level of farmers' expectations till date. The level of mechanization in India and Odisha (as calculated) for some major operations is given in Table 3.

Table 3: Level of mechanization in some major field operation in India and Odisha

Sl. No.	Farm operation	Mechanization level in India (2013-14)*, %	Mechanization level in Odisha, (2015-16)**, %
1	Land preparation/seed bed preparation	42	74.85
2	Seeding and planting	29	8.65
3	Harvesting	60-70	14.99
4	Threshing & winnowing		42.74
Average		43.66	35.31

* Mehta *et al.* (2014)^[4], ** Calculated

In Odisha we have achieved the highest mechanization level in land preparation followed by 43% in threshing and winnowing while the lowest of 8.65% in seeding and planting operation. It is highly essential to increase the level of mechanization in seeding/planting as well as in harvesting operations in Odisha.

The subsidy is being released to the farmers on purchase of farm implements/equipment. The sale of tractor and power tiller and combine harvester under subsidy programme in the state during last 10 years in Odisha is given in Figs. 1 and 2 respectively.

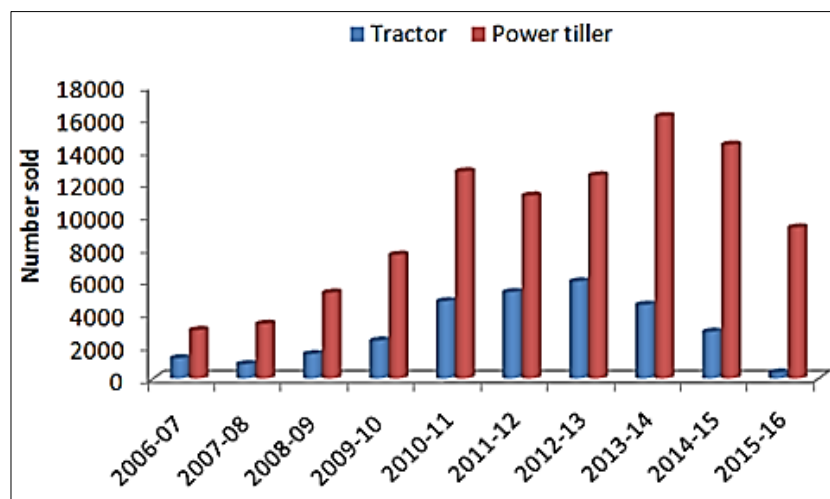


Fig 1: Sale of tractor and power tillers in Odisha

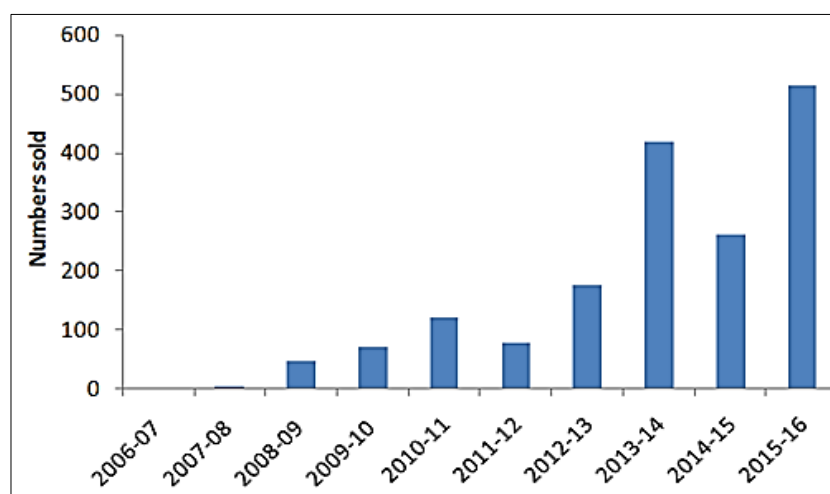


Fig 2: Sale of combine harvesters in Odisha

Sale of other implements in Odisha for the last 10 years from 2006-07 to 2015-16 is presented in Table 4.

Table 4: Sale of agricultural implements and machines in Odisha from 2006-07 to 2015-16

Year	Tractor	Power tiller	Pump set	Paddy reaper	Tractor drawn rotavator	Self-propelled transplanter	Power thresher	Axial flow thresher/ other thresher	Combine harvester	Seed cum fertilizer drill
2006-07	1247	2974	118988	94	48	8	205	123	0	
2007-08	705	3362	139143	110	67	13	253	227	4	
2008-09	1500	5280	169190	290	47	47	831	405	49	
2009-10	486	7615	223843	479	46	30	1412	502	72	
2010-11	4750	12742	292550	869	311	42	2437	805	123	
2011-12	5317	11257	300000	696	250	45	2380	535	78	
2012-13	5977	12503	31000	1069	469	166	4972	1028	178	40
2013-14	4534	16144	34000	614	4700	619	6100	2472	420	176
2014-15	2875	14388	29992	360	4531	521	5270	3354	264	3419
2015-16	378	9436	33878	697	5359	817	2500	3731	528	1156
Total	27769	95701	1372584	5278	15828	2308	26360	13182	1716	4791

Sale of implements has increased in many fold in recent years due to Govt. incentives and it is expected to increase further in coming years.

Farm power availability

Agricultural workers, draught animals, tractors, power tillers, diesel engines, electric motors are used as sources of farm power in Indian agriculture. The key challenges faced by the farm mechanization in India are as follows:

The average farm size in India is small i.e. less than 2 ha. Due to small size of land holdings in India, it is difficult for the farmers to own machinery. As a result, the benefits of

mechanization are enjoyed by only a section of the farmers who have large farm holdings. The cropping intensity in Indian agriculture is increased with the increase in power availability. It was 120% with power availability of 0.36 kW/ha during 1975-76 and increased to 141% with increase in power availability to 2.02 kW/ha during 2013-14. Net sown area per tractor shows the reverse trend during the same period, which was 487 ha/tractor in 1975-76 and reduced to 27 ha/tractor in 2013-14. Over the years, the shift has been towards the use of mechanical and electrical sources of power, while in 1960-61, about 92.30% farm power was fulfilled from animate sources.

In 2013-14 the contribution of animate sources of power reduced to about 11.80% and that of mechanical and electrical sources of power was increased from 7.70% in 1960-61 to about 88.20% [4].

The farm power availability of the state has been increased to 1.52 kW/ha during 2014-15 which was only 0.69 kW/ha during 2004-05. The power availability of Odisha since last 10 years is shown in Fig.3. The cropping intensity and power availability in Odisha farms are shown in Table 5. The cropping intensity has been increased with increase in power availability from 2004-05 to 2013-14 while the net sown area per tractor has decreased from 1434 ha per tractor during 2004-05 to 185 ha per tractor in 2013-14.

Farm power availability and food grain productivity relations: Food grains productivity in India has been increased from 0.710 t/ha in 1960-61 to 2.11 t/ha in 2013-14, while farm

power availability has been increased from 0.296 kW/ha to 2.02 kW/ha during the same period. Thus, food grains productivity is positively associated with unit power availability in Indian agriculture. The relationship between food grains productivity and unit farm power availability in India for the period 1960-61 to 2013-14 were estimated by linear function as given below in Fig. 3(4).

$$Y_{\text{fgs}} = 0.766x + 0.554; R^2 = 0.961 \quad (1)$$

Where, Y_{fgs} = food grains productivity, t/ha, and x = power availability, kW/ha

This indicates that productivity and unit power availability is associated linearly in India. It is also evident that farm power input has to be increased further to achieve higher food grains production.

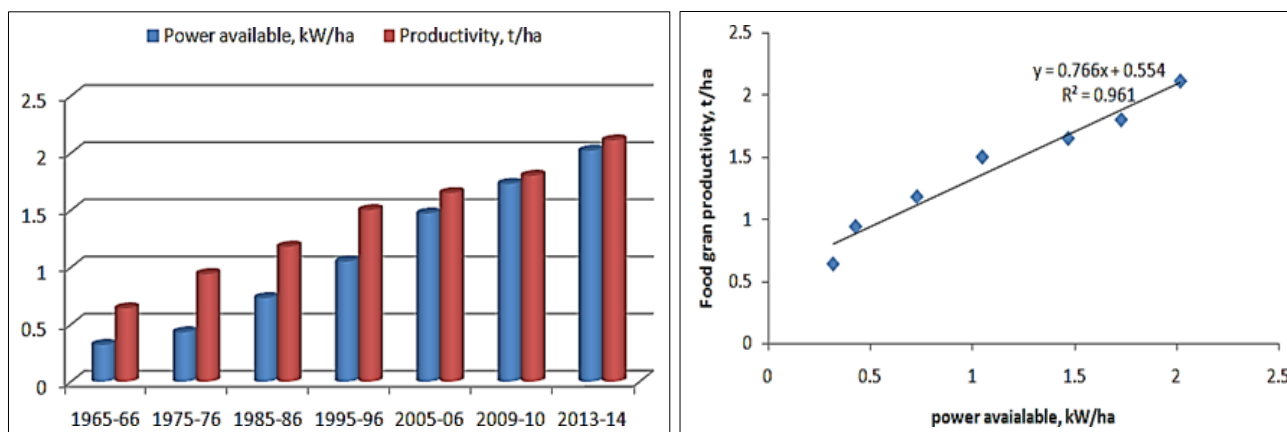


Fig 3: Power availability versus food grains productivity in India

The relationship between food grains productivity and unit farm power availability in Odisha for the period 2004-05 to 2013-14 were estimated by linear function as given below.

$$Y_{\text{fgs}} = 0.398x + 0.906; R^2 = 0.317 \quad (2)$$

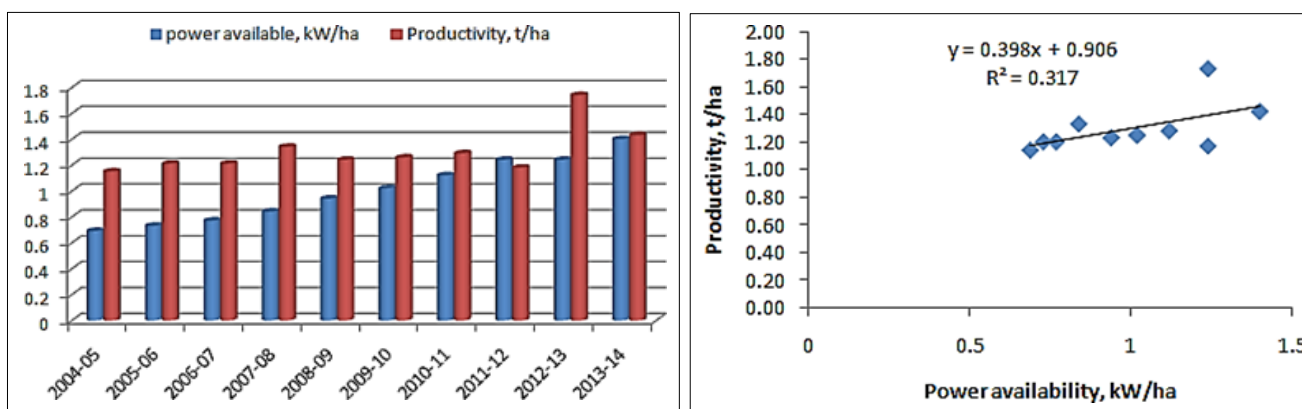


Fig 4: Power availability versus food grains productivity in Odisha

Productivity and power availability in Odisha farms do not exhibit a progressive trend (Table 5) and this may be due to the erratic climatic conditions and susceptibility of the State to natural calamities like frequent flood, drought and hence the

food grains production generally fluctuates from year to year. The food grain production was 83.60 lakh tones in 2013-14 as compared to 102.10 lakh tones in 2012-13 and 63.16 lakh tones in 2011-12.

Table 5: Cropping intensity and power availability in Odisha farms

Year	Cropping intensity, %	Productivity t/ha	Power available, kW/ha	Power per unit production, kW/t	Net sown area, '000ha	Net sown area per tractor, ha
2004-05	152	1.15	0.69	0.60	5739	1434
2005-06	157	1.21	0.73	0.60	5691	1185
2006-07	149	1.21	0.77	0.64	5654	935
2007-08	160	1.34	0.84	0.63	5624	833
2008-09	162	1.24	0.94	0.76	5604	679
2009-10	163	1.26	1.02	0.81	5574	638
2010-11	167	1.29	1.12	0.87	5407	401
2011-12	166	1.18	1.24	1.06	5292	281
2012-13	167	1.74	1.24	0.71	5331	215
2013-14	167	1.43	1.40	0.98	5424	185

As power input in farms are increasing over the years due to increase in number of power operated agricultural machinery in the state, programme such as demonstrations, field day etc. may be organized in different farmers' field across the state to create awareness about the machinery available in the state, their availability, cost and benefit over the traditional practices.

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