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# Improved farm implements used in rice growing area of Madhya Pradesh

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**Abstract**
Rice is the major crop in most of the district of Mahakoushal region of Madhya Pradesh i.e. Balaghat, Seoni, Dindori, Mandla and Jabalpur District. It is very labour intensive crop as compared to other crop grown in the region. Farm machinery plays an important role in rice production. A study was conducted with 13 farmers using improved farm implements and machines i.e. M. B. Plough, Cultivator, Rotavator, Leveller, Sprayers, Reaper and Thresher in the field. Field capacity of all farm implements and economical study were carried out for the year 2017, 2018 and 2019. It was found that average productivity was 3.62 t $ha^{-1}$ as compared to District average productivity of 2.25 t $ha^{-1}$. Average input cost of cultivation was 0.38 lakh $ha^{-1}$ and Gross income 0.72 was lakh $ha^{-1}$ and benefit cost ratio was 1.91.

**Keywords:** Farm machinery, rice productivity, economics and field capacity

## Introduction
In rice grown area improved farm implements are widely used from field preparation to crop harvesting and threshing. Due to unavailability of labour and time farm machinery plays an important role. Similarly, the System of Rice Intensification (SRI) demonstrated that by changing the soil water and nutrient management the yield in rice can be increased by about 50% or more, while reducing water requirements by an equivalent percent. This gives farmers incentives to experiment with SRI method, which also reduces the cost of production and increases their net income per ha by even more than yield. This benefit to the farmer is more than the contribution of increased yields (Satyanarayana, *et al.* 2006) [9]. In the SRI method, it is to understand that it is merely a set of changes in managing paddy plants, soil, water and nutrients that can help increase the productivity. This change by using small farm implements and in the management of plants, soil, water and nutrients contribute to both healthier soil and plant supported by greater root growth and the nurturing of soil microbial abundance and diversity. It is based on a number of agro-ecological principles with good scientific foundations. Little capital is needed since SRI does not require purchasing new seeds or agrochemical inputs, only a line marker (for marking lines at well puddle field) and a Weeder which makes weeding more effective, as it contributes to soil aeration as well as the removal of weeds (Chaturvedi, *et al.* 2006) [1].

## Experimental site
The proposed study was conducted at different blocks of Balaghat District of MP. Field experimental surveys were conducted to study of different farm machinery and implements at farmers filed.

## Climatic condition
An area comes under the Chhattisgarh-Plains agro-climatic zone. Average rainfall was 1301.90 mm. Maximum rainfall was received in the month of July. During *rabi* season, rain was received in the 1st week of January, February and March. The maximum temp of 43.40°C was observed in the month of May. Whereas, minimum temp of 2 °C was observed in the month of December. The study area (Balaghat district) is spread between latitude - 21º34'56" N to 22º11'00" N and longitude-79º47'31" E to 80º32'34" E.

**Soil type**

The soils of the Balaghat district were reported as mixed red and black soil. Thus, the deficiency of Micronutrients and sulphur were observed as Zn: 46.5%, Fe: 2.0% Mn & Cu: 0.5% and S: 9.0% as the major disorders in mixed red and black soils of Balaghat district of Madhya Pradesh, India.

**Table 1:** Major Soils of Balaghat

| Major Soils | Area ('000 ha) | Percent (%) of total |
|---|---|---|
| Deep black soils | 577.6 | 62.6 |
| Medium sandy clay loam soils | 166.0 | 18.05 |
| Shallow sandy soils | 177.0 | 19.2 |

***Source*:** NBSS & LUP, Nagpur

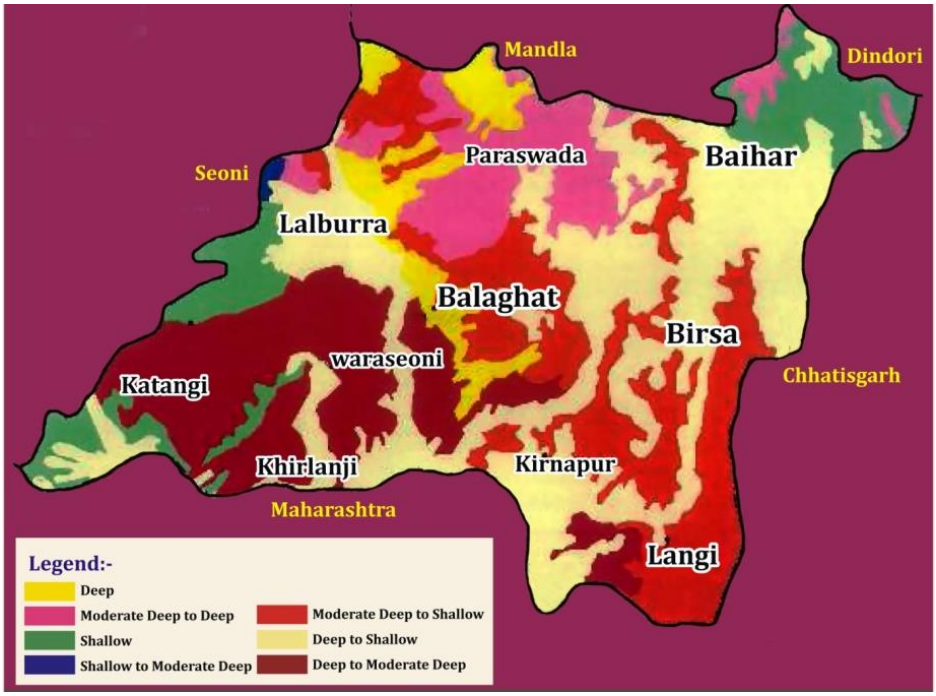


**Fig 1:** Soil Map of Balaghat

## Materials and Methods

**Scenario of farm machineries used in rice cultivation in the district**

At present around 2.70 lakhs ha area under rice cultivation in the Balaghat district of Madhya Pradesh. Most of the farmer of the area in the district using improved farm implements for rice cultivation. Due to absence of improved farm implements timely operations of farm will not be performs properly, causes poor yield and other losses. Application of Farm implements in rice cultivation starts from land preparation to threshing. Field capacity and economical study were conducted of major farm implements as mentioned in study. More than 13 farmers were selected for the study those were adopting improved farm machineries and equipments since last four to five years back. In the study area all selected farmers not having all mentioned farm implement by own purchased but they are hiring machine time to time on custom hiring basis. Field capacity and performance of machine were calculated as per guidelines of mechanization manual.

**Major farm machinery used for rice cultivation**

**M B Plough**

As we know that M B Plough is a primary tillage farm implement used in rice field after every 4 to 5 years interval for summer deep ploughing. Earlier days Deshi Ploughs were used for deep ploughing but now reversible M B Plough are available by custom hiring centres for summer deep ploughing in the district. It requires more than 45 hp tractors for proper functioning and draft. It pulverized 25 to 30 cm soil and destroyed most of the unwanted plants and weeds and insects during summer season. Its field capacity is calculated by using this formula: Field Capacity (FC) ha $hr^{-1}$ = (Area ploughed by M B Plough, ha)/ (Time required, hr)

**Cultivator**

Cultivator is a secondary tillage farm implement used in rice field after every crop to crop interval. Earlier days *Deshi* Ploughs are used for cultivating the field but now seven to 11 tynes cultivators are available by custom hiring centres for cultivating the field. It requires more than 25 hp tractors for proper functioning and draft. It makes better soil bed and breaks the big soil clods into small fine seed bed. In rice cultivation use of cultivator depends on soil type, soil moisture and earlier crop resides. Its field capacity is calculated by using this formula:

Field Capacity (FC) ha $hr^{-1}$ = (Area cultivated by cultivator, ha)/ (Time required, hr)

**Rotavator (Rotary Tiller)**

Rotavator is a secondary tillage implement used for puddling in rice growing area. Fuel expenses saving can be of 15% TO 35%. It can immediately prepare the soil; the soil moisture of previous crop does not go waste. Pudding in wet fields is done smoothly, quickly and efficiently. It is Suitable to use in dry as well as wet land cultivation. Rotavator is suitable for light and medium soil conditions. It is used for loosening and aerating soil up to depth of 125 mm- 1500 mm. Prepares seed bed quickly and economically.

Field Capacity (FC) ha $hr^{-1}$ = (Area puddle by Rotavator, ha)/ (Time required, hr)

**Leveller *(Datari)***

Leveller is a secondary tillage implement used for levelling in rice growing area. It can immediately prepare the soil well

levelled after puddling; the soil moisture of previous crop does not go waste. It restricts deep percolation of water.

Field Capacity (FC) ha $hr^{-1}$ = (Area levelled by leveller, ha)/ (Time required, hr)

**Vertical Conveyer Self Propelled Reaper**

At present self propelled reaper is mostly used for rice crop harvesting. It less time consuming device and easy to operate. It is an engine operated, walk behind type harvester suitable for harvesting and windrowing cereals and oilseed crops. The reaper consists of engine, power transmission box, pneumatic wheels, cutter bar, crop row dividers, conveyor belts with lugs, star wheels, operating controls and a sturdy frame. The engine power is transmitted to cutter bar and conveyor belts through belt pulleys. During forward motion of the reaper, crop row dividers divide the crop, which come in contact with cutter bar, where shearing of crop stems takes place. The cut crop is conveyed to one side of the machine by the conveyor belt fitted with lugs and is windrowed in the field. The crop is bundled manually and transported to threshing yard. There are no shattering losses due to vertical conveying of the crop.

Field Capacity (FC) ha $hr^{-1}$ = (Area harvested by reaper, ha)/ (Time required, hr)

**Multi crop Thresher**

Multi crop threshers are widely used for threshing in the area. The thresher consists of frame, threshing cylinder, cylinder casing, concave, oscillating sieves, pulley, belts, four wheels, aspirator blower, winnowing and cleaning attachment. The threshing cylinder is fitted with peg- tooth beaters fitted on the cast iron rings. The main shaft on which threshing cylinder is fixed is supported at two ends by heavy pedal bearings. Various pulleys of different sizes are fitted on this shaft to transmit power to the winnowing and fan attachment. Adjustments for cylinder and blower speeds and concave clearance are provided to make the machine suitable for threshing various crops. For threshing paddy, soybean, maize, sorghum etc., the crop moves axially and is threshed due to impact and rubbing action and the straw is blown away. While threshing wheat, the crop is not allowed to move axially. It is threshed due to impact and rubbing action between cylinder and concave and the straw is broken into small pieces. The grain falls through the concave onto the sieves where it is cleaned, collected and bagged.

Field Capacity (FC) kg $hr^{-1}$ = (Grain collected, Kg)/ (Time required, hr)

**Results and Discussion**

**Table 2:** Farmer wise data of farm machinery used in rice crop with yield

| S. No. | Farmer Name | Field Capacity of machines and yield (pooled data of three years) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | M Plough $hahr^{-1}$ | Cultivator $hahr^{-1}$ | Rotavator $hahr^{-1}$ | Leveler $hahr^{-1}$ | Reaper $hahr^{-1}$ | Thresher $kghr^{-1}$ | Yield $t.ha^{-1}$ |
| 1 | F1 | 0.21 | 0.41 | 0.22 | 1.2 | 0.45 | 1.2 | 3.55 |
| 2 | F2 | 0.22 | 0.4 | 0.22 | 1.3 | 0.46 | 1.35 | 3.65 |
| 3 | F3 | 0.22 | 0.4 | 0.22 | 1.2 | 0.44 | 1.25 | 3.65 |
| 4 | F4 | 0.21 | 0.4 | 0.21 | 0.3 | 0.43 | 1.15 | 3.75 |
| 5 | F5 | 0.2 | 0.4 | 0.2 | 1.1 | 0.43 | 1.25 | 3.65 |
| 6 | F6 | 0.19 | 0.42 | 0.19 | 0.9 | 0.44 | 1.15 | 3.65 |
| 7 | F7 | 0.19 | 0.41 | 0.19 | 1.1 | 0.41 | 1.25 | 3.55 |
| 8 | F8 | 0.19 | 0.39 | 0.2 | 1.2 | 0.41 | 1.15 | 3.59 |
| 9 | F9 | 0.19 | 0.39 | 0.19 | 1.3 | 0.4 | 1.15 | 3.55 |
| 10 | F10 | 0.18 | 0.38 | 0.2 | 1.1 | 0.4 | 1.25 | 3.35 |
| 11 | F11 | 0.2 | 0.41 | 0.2 | 1 | 0.42 | 1.25 | 3.75 |
| 12 | F12 | 0.21 | 0.41 | 0.2 | 1 | 0.39 | 1.32 | 3.65 |
| 13 | F13 | 0.21 | 0.42 | 0.2 | 1.1 | 0.44 | 1.25 | 3.72 |
| A.M. | | 0.20 | 0.40 | 0.20 | 1.06 | 0.42 | 1.23 | 3.62 |
| S.D. | | 0.013 | 0.012 | 0.011 | 0.257 | 0.021 | 0.065 | 0.107 |
| Min. | | 0.18 | 0.38 | 0.19 | 0.3 | 0.39 | 1.15 | 3.35 |
| Max | | 0.22 | 0.42 | 0.22 | 1.3 | 0.46 | 1.35 | 3.75 |
| *C.V.* | | *6.36* | *2.93* | *5.46* | *24.18* | *5.05* | *5.33* | *2.95* |

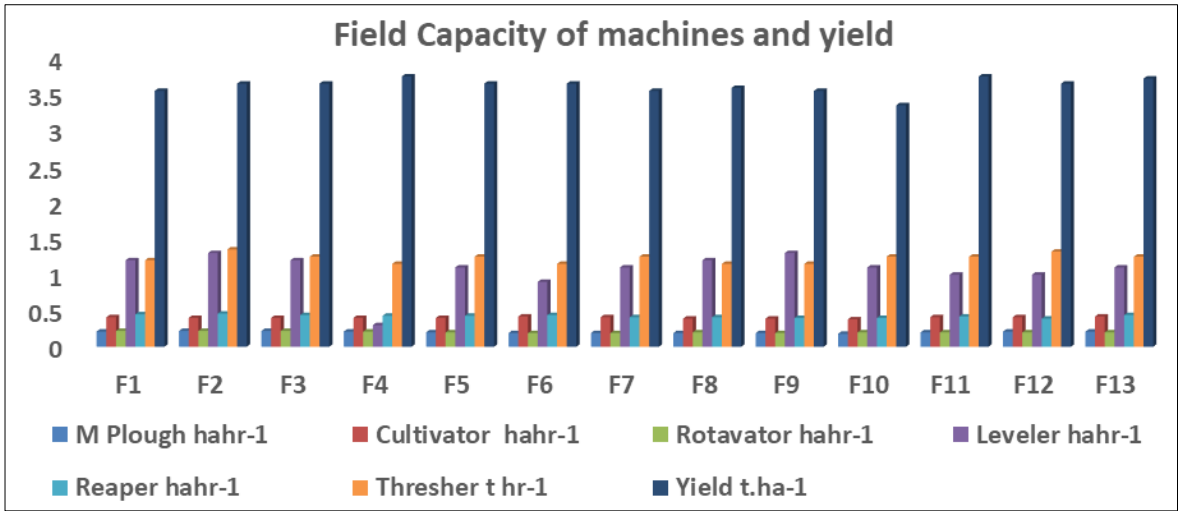


**Fig 2:** Field Capacities Farm Implements and Yield

**Table 3:** Farmer wise Economical data with crop yield

| S.N. | Farmer | FC ha hr$^{-1}$ | Yield t ha$^{-1}$ | Input cost Lakh ha$^{-1}$ | Gross income Lakh ha$^{-1}$ | Profit Lakh ha$^{-1}$ | B:C |
|---|---|---|---|---|---|---|---|
| 1 | F1 | 0.25 | 3.52 | 0.35 | 0.70 | 0.35 | 2.01 |
| 2 | F2 | 0.24 | 3.65 | 0.36 | 0.73 | 0.37 | 2.02 |
| 3 | F3 | 0.27 | 3.65 | 0.37 | 0.73 | 0.36 | 2.00 |
| 4 | F4 | 0.25 | 3.75 | 0.36 | 0.75 | 0.40 | 2.11 |
| 5 | F5 | 0.27 | 3.65 | 0.35 | 0.73 | 0.38 | 2.09 |
| 6 | F6 | 0.25 | 3.65 | 0.34 | 0.73 | 0.39 | 2.15 |
| 7 | F7 | 0.28 | 3.55 | 0.42 | 0.71 | 0.29 | 1.69 |
| 8 | F8 | 0.25 | 3.59 | 0.41 | 0.72 | 0.31 | 1.75 |
| 9 | F9 | 0.29 | 3.55 | 0.43 | 0.71 | 0.29 | 1.67 |
| 10 | F10 | 0.25 | 3.35 | 0.40 | 0.67 | 0.28 | 1.70 |
| 11 | F11 | 0.25 | 3.75 | 0.40 | 0.75 | 0.36 | 1.90 |
| 12 | F12 | 0.25 | 3.65 | 0.39 | 0.73 | 0.34 | 1.88 |
| 13 | F13 | 0.25 | 3.72 | 0.40 | 0.74 | 0.35 | 1.88 |
| A.M. | | 0.26 | 3.62 | 0.38 | 0.72 | 0.34 | 1.91 |
| S.D. | | 0.015 | 0.109 | 0.029 | 0.022 | 0.041 | 0.168 |
| Min. | | 0.24 | 3.35 | 0.339 | 0.67 | 0.275 | 1.67 |
| Max | | 0.29 | 3.75 | 0.425 | 0.75 | 0.395 | 2.15 |
| C.V. | | *5.75* | *3.01* | *7.57* | *3.01* | *11.87* | *8.78* |

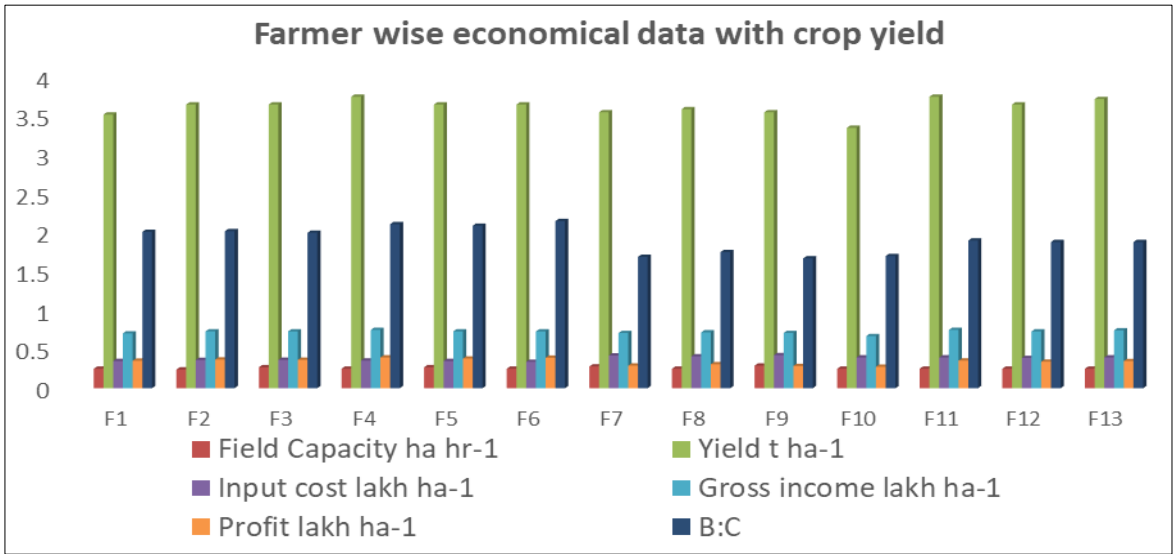


**Fig 3:** Field Capacity Rice Transplanter and Yield data

MB Plough

Cultivator

Rotavator

Leveller

Self-Propelled Reaper

Rice Thresher

**Fig 4:** Various Improved Farm Machinery used in Rice Crop

**Summary and Conclusions**

Farm mechanization plays an important role in rice production as well as saving time and cost of cultivation. There are number of farm implements being used in rice field from field preparation to its harvesting and processing. It has been observed that timely rice transplanting of seedling has play an important role in rice production and productivity. Rice transplanting by transplanter machine gives significant changes in rice cultivation. Rice yield varies from farmers to farmer and it depends upon agronomical practise applied by farmer and fertility level of soil. There are other different factors which affect the yield of crop. In this study we have selected that farmer those are sowing same short duration varieties. Selected varieties are medium to short duration variety and good response in the district.

It has been observed that M B Plough is a important implement to break the soil upto 30 cm depth because frequent use of Rotavator compact the soil and reduce the water recharging in rainy months or heavy rainfall. So, it is recommended to use plough at every 4 to 5 years interval in rice growing area. Similarly cultivator, Rotavator, leveller reaper and thresher are very important farm machineries for rice production. Rice transplanter machine is highly recommended in the district and it need to be educated regarding its proper use since mechanized transplanter requires mat – type nursery reported by Shinde *et al.* 2018 [11]. In self-propelled rice transplanting machine tray mechanism worked but the design should be altered or improved. The transplanter machine can be easily coupled to a weed remover mechanism which could further help farmers in the weeding process of paddy plantation. It has been observed that all above necessary farm machinery needs proper repair and maintenance timely. Operator play a important role in enhancing filed efficiency and field capacity of any machines, So operator needs frequent trainings and skill development activities. Proper care and maintenance of farm implements and timely use of machine defiantly increase the crop production and farm income.

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