

Turbo bund former:

Direct bund forming technology under straw mulch

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Bund is the structure made by piling the soil mass employed to demarcate the field and apply irrigation effectively. Mostly, bunds are trapezoidal or triangular in shape and after water application through continuous use, they become semicircular. Moreover, flood irrigation is the most commonly used method to apply water to wheat sown fields that induce land and water degradation problems due to soil movement and water contamination. Bunds prevent degradation by arresting surface runoff and high erosive velocity of water during flood irrigation. It sensibly conserves water by solving water logging problems, especially in flood irrigated agricultural fields that further helps in stabilization of existing sub-soils. Bund divides the field into several compartments for equal distribution of water and restricts water loss. Thus, a turbo bund former is a machine that makes bunds in mulched fields for conserving soil with saving labour to the tune of 78% over the conventional bund forming method.

Keywords: Bund, Bund former, Rotary tillage, Soil conservation, Straw management

IN the paddy wheat crop rotation system, it is essential to put up bunds. The small window period between the crops compels farmers to continue with either existing bunds or go on with making bunds with residue retained field. Under mulch free soils, kiaras or compartments are conventionally prepared by forming board or disc type bund formers before irrigation application. Whereas, in mulch retained soils, conventional bund forming mixes the crop residue and soil owing to water leakage followed by breakage of bunds. Lack of porosity upsurges seepage through bunds causing water logging during successive wheat crop growth causing yellowing of wheat. Thus, the issue of forming bund under mulch is addressed using PAU turbo bund former developed at Punjab Agricultural University, Ludhiana. The brief description of different types of bund former is given in Table 1.

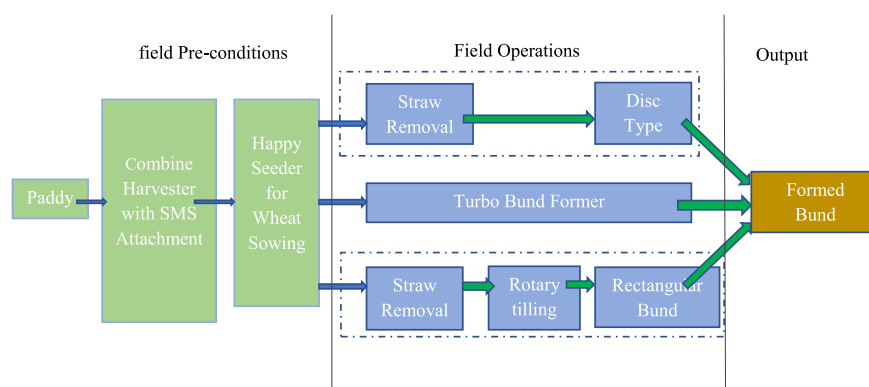
Turbo bund former is a unique solution for directly preparing

bunds in mulch fields with moderate (4.0–4.5 t/ha) to heavy residue load (6.0–6.5 t/ha) of paddy straw. It is capable of performing three operations namely mulching, rotary tillage and bund forming in one pass. It is a residue managing and irrigation handling technology at the same time. Happy Seeder or Super Seeder is popular sowing machinery used for paddy wheat crop rotation systems. This machine caters the residual problems linked with sowing and mulch managing

machinery. The machine can form length of 800 m bund/h with field capacity of 1.0 ha/h. Bund former assists in improving wheat crop yield, managing straw (*in-situ*) water saving and soil conservation productively. Mulching with crop residues provides an effective method of reducing water erosion and associated nutrient losses.

Traditional bund forming techniques

Manual bund forming: In this method, bund is formed using



Bund forming procedure layout using conventional and turbo bund former under straw mulch



Developed Turbo bund former (a) and working view of the machine (b)

manually operated tools like hand hoe and spade where a farm worker pile up soil in a row followed by compaction. This method is accounted as drudgerous, laborious, tedious and time consuming.

Forming board type bund former: Forming (rectangular) board bund former is a mounted type machine operated by the tractor. It collects the soil after rotavator operation in the field and makes heaps of soil. Under mulch conditions, straw is first removed by farm labour followed by mechanical rotary tilling and bund forming operation.

Disc type bund former: Disc type bund former is mounted type tractor operated equipment that can work both in straw free soil and mulch retained soil. Generally, disc bund former is directly introduced into the mulched field which causes incorporation of residue with the formed bund.

Hence, the conventional method was found to be futile when it came to bund forming under mulched

fields. To operate properly, prior operations such as straw clearing using labour and rotary tilling were mandatory which made bund forming expensive and inefficient.

Newly developed Turbo bund former

A tractor-operated bund former is a mounted-type machine that makes bunds in mulched fields. It performs three operations such as straw removing (up to 1.25 m width) using mulcher rotor, followed by soil pulverization done by rotavator rotor, and trapezoidal shaped soil bund formation performed by bund forming plates simultaneously in one pass. Bund former consists of a mulcher rotor with 10 flat flail blades (bent at 22° angle) fitted in a staggered manner which throws away loose residue and standing stubble out of a chute opening on top of formed bund whereas 30 C-type blades (35–40 mm overlapping) mounted onto rotavator rotor flanges churn the soil. The desired soil volume is extracted by rotavator

and pushed behind towards bund forming plates. The bund forming unit has forming boards (rectangular shaped) attached to a mild steel frame with one end broad and narrower towards the other end. It is PTO driven machine that powers a T-type double-action gearbox. The output shafts of gearbox rotate in different directions allowing mulcher and rotavator rotors to operate in opposite directions to each other using pulley, belts chains and sprockets. The mulcher rotor rotates at 1100 rpm and rotavator at 210 rpm. A rubber flapper (6 mm thickness) is used for separation in between the rotavator and mulcher unit. The developed machine is intended to work under straw mulch field conditions while facilitating bund forming. The machine leaves the soil straw free to allow easy binding of pulverized soil using bund forming plates. After operation, wheat can be sown into kiaras using Happy Seeder, Super Seeder or Smart Seeder. Further, irrigation can be applied with ease without worrying about bund breakage or overtopping of water towards other field (Table 1).

Cost analysis of different bund forming techniques

The cost of tractor operated bund formers was calculated and compared among each other. The cost of operation was calculated

Table 1. Description of different bund formers used for forming bunds

Particular	Disc type	Rectangular type	Turbo bund former
Type of machine	Mounted	Mounted	Mounted
Power source, hp	≥45	≥40	≥42
Bund forming unit	Disc	Rectangular	Rectangular
No. of plates/disc	2	2	2
Opening width of bund formers, mm	200	450	410
Weight, kg	280	330	675
Overall dimensions, mm	150×100×60	145×142×45	1240×208×46



Compartmental bunding with irrigation water applied in paddy harvested wheat sown field

using straight line method based on the initial cost of machine ₹10000, 40000 and 75000, for rectangular type, disc type and developed Turbo bund former respectively. The life of machine was 12 years for rectangular type bund former, 08 years for disc type bund former and 10 years for developed bund former. Average annual usage was 300 h for rectangular type and disc type bund former each, whereas 400 h for developed bund former. Rate of interest was kept at 12%, skilled human labour was ₹50.3/h whereas unskilled human labour was ₹48.75/h, field capacity was 1.03 ha/h for rectangular type bund former and 1.10 ha/h for disc type bund former whereas it was 1.17 ha/h for developed bund former. The cost of operation for rectangular type, disc type and developed bund former were ₹828.07/ha, ₹789.70/ha and ₹792.36/ha respectively. Since, no unskilled labour was required for removal of straw before operating the developed bund former, the cost savings were 4.31% over rectangular type and 0.33% over disc type bund former. Hence, it can be stated that the overall cost

of operation in developing bund former, rectangular and disc type bund former were at par but labour saving is observed (as no labour is required for removal of loose straw) in developed bund former with increased field capacity.

Merits of Turbo bund former

- The bund former is capable of operating under different types of mulch retained field which eliminates the need of separate tilling or mulching operations.
- The developed bund former is the only machine that can form the bunds in the paddy straw mulched fields with reduced energy input through mechanized operation.
- The optimum bund height and width can be obtained as 200–278 mm and 600–720 mm.
- The seepage of water through bunds is prevented due to reduction in porosity caused by mulch and soil separation.
- The effective field capacity of the tractor operated bund former was 1.0 ha/h at forward travel speed of 1.5 km/h.

SUMMARY

Turbo bund forming is an innovative soil and a water conserving technology. It has potential to comprehend the category of *in-situ* straw management techniques by enhancing residue use efficiency coupled with water use efficiency. With the help of turbo bund former, bund forming, residue and irrigation management can be done single handedly. The problem of bund forming under mulch conditions sown with Happy or Super Seeder can be overcome by this machine. This farm friendly technique has several direct and indirect benefits as far as complementing the popularity of sowing and residue managing machinery is concerned. The machine performance is satisfactory, given that it gives a whole solution for multiple issues. It is a reliable and economical solution, as cost savings of 0.33–0.5% and 4.30–5.50% were obtained over conventional rectangular and disc type bund formers.

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