

Development and evaluation of Straw Chopper-cum- Seeder for small holdings in Odisha

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Background and Objectives

Rice-green gram cropping system is predominant in the agrarian scenario of Odisha. After harvest of kharif paddy, the farmers have little scope for subsequent crop due to lack of adequate irrigation facility; thus during rabi season, huge area remains fallow, otherwise termed as Rice fallow. Thus, Rice-fallow cropland areas are defined as the areas where rice is grown during kharif season (June–October), followed by a fallow during the rabi season (November–February). In Odisha, rice is cultivated in a wide range of soils like sandy loam, clay loam, silty clay and clayey etc. Heavy textured soils with high water holding capacity is suitable for rice, which provides a scope for inclusion of short duration pulse crop in rice based cropping systems. The state is having 12.2 lakh ha of rice fallow due to various reasons such as early withdrawal of monsoon rains leading to soil moisture stress at sowing time of rabi crops, growing of late duration rice varieties or late planting of Kharif rice, water logging and excessive moisture in rabi, lack of appropriate varieties for rabi season and socio economic problems like stray cattle, bulls etc. Odisha accounts for around 10% (12.2 lakh ha) of the total rice fallow of India (11.65Mha). In Odisha, mungbean is the prominent crop in rice fallow situation. The crop is generally grown during November- December after the harvest of kharif rice. The crop is mainly grown in Kalahandi, Puri, Dhenkanal, Balasore, Koraput, Bhadrak and Mayurbhanj districts. For increasing area under pulses in rice fallow, there is a need to develop and deliver location specific and viable technology after thorough understanding of the system ecology and constraints.

About 60 per cent of the pulse area is grown as pure crop through land preparation before sowing i.e. conventional tillage. In some areas pure crop is also grown by sowing in undisturbed land followed by ploughing. Paira crop is adopted in 40 per cent pulse area in the state i.e. sowing pulse crop 10-15 days before harvest of paddy crop.

Besides this, mechanization of paddy harvesting has gone a long way from self propelled reaper to combine harvester where harvesting, threshing and cleaning are done simultaneously with less time, labour and cost. Hence, the demand for combine harvesters in the state has increased appreciably. Even, the sale of combine harvester during 2015-16 was 528 and the cumulative sale in the state has reached 1716. Moreover, many combine harvesters from neighbouring states have been used during harvesting seasons and operate on custom hiring basis. As large area of the state is harvested by combine harvesters, a huge quantity of straw residues is left in the field unused and farmers generally burn the straw residue in the field before taking up the subsequent crop. Burning of the unused straw causes environmental pollution, hazardous to human health, produces greenhouse gases inducing global warming, results in loss of plant nutrients like N, P, K & S and harmful to the microorganisms in soil. Straw residues left over in combine harvested fields prohibit sowing of any further crops and hence, these areas also remain fallow. To utilize these areas, suitable straw management system (SMS) along with sowing attachment is highly essential for the state. Therefore, appropriate management of crop residues assumes a great significance. The loose straw residues and stubbles can be chopped into pieces and by spreading the chopped straw in the field, soil moisture can be conserved. Chopped straw, scattered over the fields acts as mulching which subsequently incorporated in the soil and thereby increase the fertility of soil. A seed cum fertilizer drill with zero till tynes for line sowing of seeds and fertilizer followed by spreading of the chopped straw simultaneously can be the solution. In this context, a new innovative machine called tractor operated straw chopper -cum-seeder need to be developed in order to resolve the above issues which would further increase the area under pulse crop in rice fallow areas of the state, country as well.

Aims and Objectives:

- i. To evaluate the performance of existing straw chopper (commercially available) in farmers' field.
- ii. To develop a straw chopper-cum-seeder to be operated by 35-42 hp tractors, commonly available in the state of Odisha.
- iii. Prototype development of straw chopper-cum-seeder in association with local SSI units.
- iv. To evaluate the prototype of the developed straw chopper -cum-seeder in farmers' field.

- v. To promote the straw chopper-cum-seeder for its adoptability in the state by conducting field demonstrations.

Strategy and Interventions:

- i. To develop a straw chopper -cum-seeder for adoption in the state.
- ii. To educate the farmers about the use of straw chopper -cum-seeder and to create awareness on latest methodology of straw residue management and line sowing of pulses.
- iii. Extension personnel and other stake holders of the state will get exposure of this method of residue management and line sowing of pulses.

Outcome:

- **Development and performance evaluation of the tractor operated straw chopper in research station and farmers' field.**

A tractor operated straw chopper was fabricated and was evaluated in research station and in farmers' field to assess its suitability for chopping loose straws and the stubbles left over after harvesting by combines. The performance of the straw chopper was found to be satisfactory with respect to the chopped size of the straw and stubble, making them suitable for mulching and later facilitating decomposition.



Evaluation of the tractor operated straw chopper in OUAT Research Station



Evaluation of the tractor operated straw chopper in Farmers Field at Village-Beraboi, Block-Delanga, Dist.-Puri.

- **Development of the straw chopper cum seeder incorporating adequate modifications such as inclusion of a set of zero till tynes (5 nos) and roller and cup type metering mechanism for green gram seeds.**

The fabrication of a furrow opening assembly with five nos zero till tynes was accomplished and was fitted behind the straw chopper unit. Further, a seed cum fertilizer metering assembly was fabricated and fitted above the straw chopper assembly with the seed and fertilizer delivery pipes being inserted into separate delivery pipes with the zero till tynes. The roller and cup type metering mechanism were used in the system, suitable for small seeds like green gram and black gram.



Fabrication of furrow opening assembly with five nos zero till tynes and fitting with straw chopper



Fabrication of a seed cum fertilizer metering assembly with roller & cup type metering mechanism and fitting with straw chopper

- **Performance evaluation of the developed straw chopper cum seeder in research station and farmers' fields**

The performance evaluation of the developed tractor operated straw chopper cum seeder was conducted in research station and subsequently in farmers' field at Village-Balakati, Block- Bhubaneswar, Dist.-Khurdha. It was observed that the seeds were missing before delivery, although pick up was proper. This was due to vibration of the chopper unit which was also transmitted to the seed cum fertilizer delivery system. The average height of stubbles left in the field after the operation of the chopper cum seeder was found to be 13.2 cm against the stubble height of 35.4 cm prior to the operation as left over in combine harvested field. The average depth of operation of the furrow openers was recorded as 5.6 cm, which was good enough for green gram sowing. The average speed of operation was observed to be 1.6 km/h for the chopper cum seeder.



Performance evaluation of the developed straw chopper cum seeder in OUAT research station

- **Modification of the straw chopper cum seeder with fluted roller metering mechanism in place of roller and cup type metering mechanism for higher accuracy in metering green gram seeds.**

Fluted roller type seed metering mechanism was incorporated in place of roller and cup type metering mechanism to improve the seed picking and delivery of green gram seeds



Fabrication seed cum fertilizer delivery assembly with fluted roller metering mechanism and fitting with Straw chopper cum seeder

- **Performance evaluation of the developed straw chopper cum seeder with fluted roller metering mechanism in research station.**

The performance of the developed straw chopper cum seeder with fluted roller metering mechanism for seeds was evaluated in research station. The metering mechanism was found working better as compared to the roller type metering mechanism. Further study of the positioning of the seed cum fertilizer delivery assembly needs to be taken up to minimize the vibration of the seed cum fertilizer delivery assembly before the field performance evaluation of the



Performance evaluation of the developed straw chopper cum seeder with fluted roller metering mechanism in OUAT research station

Future Plan:

- The prototype of the straw chopper cum seeder with fluted roller metering mechanism is to be fabricated soon considering the design criteria after due stress and vibration analysis.
- The prototype will be evaluated in research station and in farmers' field for further modification if required.
- The final prototype will be demonstrated in different locations of the state to find out its suitability and cost economics.