I. INTRODUCTION

Paddy is rice before it is milled. Rice is the seed of the monocot plants *Oryza sativa*. As a serial grain, it is the most widely consumed staple food for a large part of the world’s human population, especially in Asia. Paddy cultivation involves different steps like preparation of field, transplantation, field maintenance, harvesting and threshing. It is the grain with the third highest worldwide production, after sugarcane and maize, according to data of FAOSTAT 2013[9]. Rice, a monocot, is normally grown as an annual plant, although in tropical areas it can survive as a perennial and can produce a ratoon crop for up to 30 years. The rice plant can grow to 1–2.5 m tall, occasionally more depending on the variety and soil fertility. It has long, slender leaves 50–100 cm long and 2–2.5 cm broad. The small wind-pollinated flowers are produced in a branched arching to pendulous inflorescence 30–50 cm long. The edible seed is a grain (caryopsis) 5–12 mm long and 2–3 mm thick[7].

Rice is the staple food of over half the world's population. It is the predominant dietary energy source for 17 countries in Asia and the Pacific, 9 countries in North and South America and 8 countries in Africa. Rice provides 20% of the world’s dietary energy supply, while wheat supplies 19% and maize (corn) 5%.

Rice is a type of kharif crop. Kharif crops are usually sown with the beginning of the first rains in July, during the south-west monsoon season. In India, the kharif season starts on 16 April and lasts until 15 October. In India, the kharif season varies by crop and state, with kharif starting at the earliest in May and ending at the latest in January, but is popularly considered to start in June and to end in October. Kharif stand in contrast with the Rabi crops, cultivated during the dry season. Both words came with the arrival of Mughals in the Indian subcontinent and are widely used ever since. Kharif means “autumn” in Arabic. Since this period coincides with the beginning of autumn / winter in the Indian sub-continent, it is called "Kharif period”.

II. METHODOLOGY

With the demand for the grains on rise, the aim was to fabricate affordable reaper collector for increasing the economy of small scale farmers, for the fulfillment of this aim, it is decided to follow following steps:

- Interview agricultural equipment manufacturers to get information about various equipments that are available and are in demand
- Refer various international papers in small scale harvesters produced earlier
- Design of reaper collector harvester

III. DIFFERENT DESIGN CONCEPTS

A. Concept 1(Modification to Brush Cutter)

This is a conceptual design based on the design of brush cutter. It is walk behind type of harvester. It works almost same as brush cutter but with two circular blades.

1) Advantages
   - Other than paddy it can be used for clearing grass, small bushes and undergrowth
   - The brush cutter is more robust and stronger
   - The denser vegetation can be cleared with it easily
   - The brush cutter is fitted with a longer shaft to increase its working area

2) Principle of working

Power to the circular saw blade is directly provided from engine. Mechanism is a single slider crank mechanism with two cranks. The two blades rotate in opposite directions. The cut paddy spreads on both the sides.

Reason for dropping this concept, collection mechanism was absent, making the crop to fall on either sides creating problem for farmer to collect the cut crop. Other than that handle bar should be angled relative to the shaft, to prevent an uneven load being placed on our work and machine should have excellent vibration damping to ensure to have a energy to work for a long time without getting tired.
A machine for cutting grass and the like having a flexible strip-like cutting member supported by a disc within a housing.

1) Principle of working
The power to the blade is provided from engine shaft. Two blades are provided which act like driver & driven gear respectively. Driver and driven gears rotate in opposite direction.

Reason for dropping out this concept because collecting mechanism is absent and working mechanism is bit complex.

C. Concept 3 (Modification to Reaper)
In this concept it is thought of making some changes to the existing paddy reaper keeping in mind the cost like, instead of using the star wheel for collecting mechanism using collector belt with extensions on it. Cutter assembly cuts the paddy crop and collecting belt makes the paddy crop to move one side which helps the farmer to collect cut crop for further processing.

IV. OPERATION
rotary motion to linear Sliding motion. Scissoring action is obtained due to reciprocating movement of cutter blade over stationary blade is used to cut the crops.

It is a walk behind type of harvester which is powered by the 1.5Kwatt, 3000 rpm petrol engine. With the help of V-belt, drive power is transmitted from gear box. As the required rpm at cutter is as less as 300 rpm, a bevel gearbox is used. Here bevel gear is used to change the direction of drive in the gear system by 90˚ and reduce the speed to required. One of the output shaft of gear box is connected to slider crank mechanism which converts rotary motion of shaft into reciprocating motion of cutter blade. Reciprocating cutter blade slides over fixed blade and creates scissoring action responsible for cutting the crops. While, other shaft coupled to run a collecting mechanism consist of flat belt with collecting plates bolted on it. Collecting belt simply carry cut crops sideways.

V. SPECIFICATIONS
A. Complete assembly of Mini paddy Harvester
It is a walk behind type of harvester which is powered by the 1.5Kwatt, 3000 rpm petrol engine. With the help of V-belt, drive power is transmitted to gearbox. Here, bevel gear is used to change the direction of drive in the gear system by 90˚ and to reduce the speed by 8 times. One end of this output shaft is connected to slider crank mechanism which converts rotary motion of shaft into reciprocating motion of cutter blade. Reciprocating cutter blade slides over fixed blade and creates scissoring action responsible for cutting the crops. Collecting mechanism consist of flat belt with collecting plates bolted on it. Collecting belt simply carry cut crops sideways.
VI. RESULTS
The Mini Paddy Harvester is built to be compact and efficient to cut the paddy crop. The machine was tested in a laboratory to check its cutting capability and efficiency. The test results as shown that the machine is capable of performing according to the design specification. The cost of harvesting by this machine is considerably less compared to that of manual harvesting. It is found that engine is capable to deliver the required power to run a harvester. Speed reduction of gear box for the working, Reciprocating action and cutting capability of the blades is found to be satisfactory.

VII. COMPARISON OF HARVESTING COST BY TRADITIONAL METHOD AND MINI PADDY HARVESTER

A. Harvesting done by Manual Process:
Amount paid to the labour for one day = Rs. 300 per labour
Total number of labour required in general to harvest the 1 acre farm of paddy in a day = 5
Total amount paid to the labour = 5 x 300 = Rs. 1500 per acre in one day
Therefore, total expenditure in one day is = Rs. 1500

B. Harvesting done by Mini Paddy Harvester:
Quantity of petrol require for 0.25 to 0.3 acre = 1 litre
Quantity of petrol require for 1 to 1.2 acre = 4 litre
Cost of petrol per litre = Rs. 70
Total cost of petrol for 1 acre farm for a day = 4 x 70 = Rs. 280
Amount paid to the labour = Rs. 300 per day
Total expenditure = Total cost of petrol + Amount paid to the labour + Maintenance
=280 + 300 + 100

=Rs. 680 ~ Rs. 700
Amount saved by using the harvester = 1500 – 700
= Rs. 800 per day per acre.

VIII. CONCLUSION AND SCOPE FOR FUTURE WORK
A. Conclusions
The primary objective of the present work was to develop a paddy harvester which is simple and cost effective. The objective has been successfully met, simple and cost effective paddy harvester was developed. The following conclusions are drawn based on the work carried out.

- A detailed specification of the paddy harvester was developed based on the literature review to meet the requirements of paddy harvesting
- A detailed design of paddy harvester which included, cutting system, transmission from the engine to the cutting system and main frame has been carried out
- A complete 3D model of the paddy harvester was developed using Solid edge modelling software to assess the design and to aid the fabrication of the developed design
- All the components and subsystems of the paddy harvester which included, the cutting system, transmission from engine to the cutting system and main frame have been fabricated successfully
- All the subsystems have been assembled and integrated to achieve satisfactory working of the paddy harvester
- The assembled paddy harvester has been tested for its working and found to be working satisfactory
- It makes the harvesting process faster hence reduces the time required to harvest the same amount of yield manually, which will ultimately leads to the reduction in cost of harvesting by 53.33%
- The total cost is to manufacture this newly designed mini paddy harvester is found to be around 14,000/-

B. Scope for Future Work
- The developed mini paddy harvester is larger in size and there is a scope for making it more compact and light in weight
- The developed mini paddy harvester is walk through type at present and traction can be provided

REFERENCES
evaluation of the BRRI reaper and Chinese Reaper compared to manual harvesting of rice


[9] Niranjan Chakraborty “Rice Proteomics and Beyond”, Jawaharlal Nehru University, New Delhi, India
