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Multipurpose Agro-Power

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ABSTRACT

Farmer is the backbone of India and agriculture production is main key of Indian economy. India has older history of agriculture, In earlier days farmer used animals, like Horses, Oxen, Bulls, Donkey etc and humans in agriculture for cultivation purpose but due to population explosion and industrial revolution there is drastic reduction in agricultural land thereafter the new techniques implementation is required in agriculture sector. Due to the industrial revolution the rational development took place in the technology which in turn led the scientists and engineers to think about cultivation using machines. This led them to develop the equipment's like tractors for ease of work. In India nearly 75% of peoples are farmers whose main source is the agriculture but in that 18% are Small farmers having farming area of about 1.0 – 2.0 hectares whereas 57% are Marginal farmers (area less than 1 hectare). Nowadays most of the farmers were using tractors for cultivation of land .But tractor is not economical for small land owners or farmers and its initial cost is huge which small farmers cannot afford it, whereas Horses, Oxen, Donkey, Bulls are requires regular maintenance and more time consuming. Thereafter in this work we are going to design & manufacture multipurpose or multi task agricultural equipment for farmers which can accommodate different types of attachable/detachable equipment for farming. Because of that we can reduce the cost of land preparation, reduce the labour cost, increases the speed of work and also reduces the human's effort. The main purpose of this work is to design small, compact, handy & user friendly equipment even small farmers can afford and use it comfortably.

Keywords: Chisel, Plougher, Gears

I. INTRODUCTION

Everyone knows "Farmer is back bone of country" and also Lal Bahadur Shatri said great words "Jai Javan Jai Kisan**"**.The agriculture is developed up to Vedic literature in India. Rig-Veda hymns for example a Sanskrit text suggested to be 2500 years old agriculture, some archaeologist believes that rice was a domesticated crop along banks of the river gangs in sixth millennium BC. India has older history of agriculture but nowadays population upsurge and also increase in industrialization in India resulting in the agriculture land reduction so that the new technique implementation is required in agricultural sector. In India the nearly 75% of peoples are farmer & who earns on the agriculture basis but in that 18% are Small farmers hold farming area of about 1.0 – 2.0 hectares, 57% are Marginal farmers (area less than 1 hectare), In India 13.7%of gross domestic product come from agriculture bases, India exported $39 billion worth of agricultural product in 2016,making it the seventh largest export worldwide Indian agricultural foods are exported more than 120 countries, as per 2010 FAO world agriculture statistics ,India is the world's largest producer of many fresh fruits and vegetables, milk, fibrous crops but we also know that for farmers basically it's harder to cultivate the land or preparation of land for different crops .older day Horses, Oxen, Donkey. Bulls are used. Now a day's tractor are using for cultivation of land .But tractor is not economical for small land owners or farmers & its initial cost is huge which small farmers cannot afford the sum.& Horses, Oxen, Donkey, Bulls are required regular maintenance & using animals it requires more time.

SOURCES OF FARM POWER

There are different sources of farm power available in India which are classified as

(i) Human power
(ii) Animal power

(iii) Mechanical power (Tractors + Power tillers + Oil engines)
(iv) Electrical power
(v) Renewable energy (Biogas + Solar energy + Wind energy)

II. AIM OF THE WORK

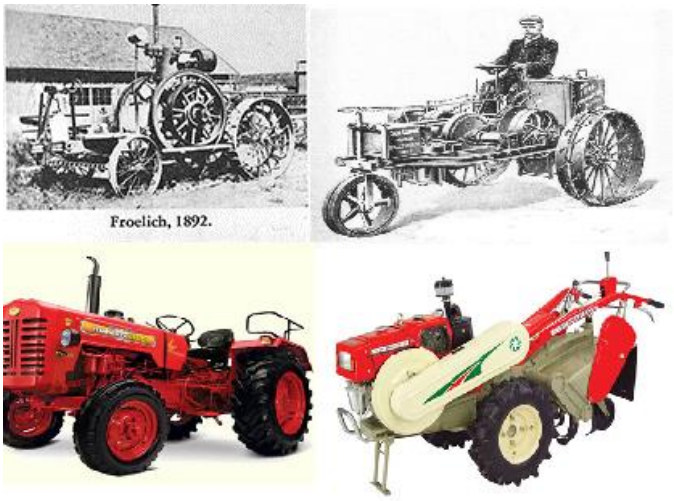
- To design & manufacture multipurpose or multi task agricultural equipment for farmers.
- To reduce the cost of land preparation.
- To reduce the labour cost by increasing the speed of work & reduce the humans effort.
- To design equipment that can accommodate different types of attachments for farming.
- To design small, handy & user friendly equipment
- Main purpose of this work is even small farmers can afford and use it comfortably.

III. BRIEF HISTORY

In earlier days agricultural techniques where not up to the mark, due to of lack of technology and knowledge in that field. Those days' farmers used animals, like Horses, Oxen, Bulls, Donkey etc. and humans in agriculture for cultivation purpose before industrial revolution. Due to the industrial revolution the rational development took place in the technology which in turn led the scientists and engineers to thought about cultivation using machines. This led them to develop the equipment's like tractor for ease work.

The present tractor is the result of gradual development of machine in different stages. History of tractor development is given below

- In 1892 john Froelich invented & built the first gasoline/petrol powered tractor in Richard Trevithick designed the first semi-portable stationary steam engine for agricultural use
- 1890- The word tractor appeared first on record in a patent issued on a tractor or traction engine invented by George H. 1906- Successful gasoline tractor was introduced by Charles w. Hart and Charles H. Parr of Charles City, Iowa
- 1908- First Winnipeg tractor trails were held
- 1911- First tractor demonstration was held at Omaha (Nebraska)
- 1915-1919- Power take off was introduced
- 1920-1924- All purpose was developed
- 1936- 1937 – Diesel engine was used in tractor and pneumatic tires were introduced
- 1950-1960- Manufacturing of diesel tractors on extensive basis throughout the world was taken up
- 1960-1961 – Tractor manufacturing was started in India by first manufacturer M/s Eicher Good Earth
- 1962-1970 – Manufacturers like Tractor and Farm Equipment , Madras , Hindustan tractors at Baroda, Escorts Tractors at Faridabad and International Harvester in Bombay started work during this period
- 1971- Escorts Tractor Ltd. Started producing Ford Tractors
- 1973- Manufacture of HMT Tractor was started
- 1974- Manufacture of Pitti and Kirlosker Tractor was started
- 1975- Harsha Tractors was established
- 1981- Auto tractors were started



- Studies shows that Alvi and Pandya have conducted trials to test a 7.46 kW power tiller for drawbar pull, fuel consumption and wheel slip. At 18% wheel slip, the draw bar power and specific fuel consumption were 1.38 kW and 1.62 kg/db kWh, respectively.
- The testing of a 4.10 kW power tiller for drawbar performance with Three-bottom mouldboard plough and 5-tyne cultivator revealed that use of 60 kg Ballast weight could develop a maximum pull of 1333.75 N with cage wheels under Field conditions. During the field studies conducted in different soil conditions, it was observed that the pull of the power tiller wheel fitted with enamel coated lugs was higher than that of wheels fitted with uncoated lugs at any level of slip. Moreover cage wheel blocking was not observed in the case of enamel-coated lugs, but blocking was quite frequent with uncoated cage

wheel lugs. Sirohi and Panwar have found that the existing weight of about 200 kg of the IRRI model power tiller was inadequate to develop a pull of 150 kg and recommended that the weight should be at least three times as compared to existing weight. In view of the limitations in availability of drawbar power, a study was carried out at CMERI, to measure the draft and drawbar power of the newly developed 2.28 kW power tiller.

IV. OPERATION

The operation of a machine involves walking behind the machine on a tilled or puddle land continuously for hours. During peak seasons of seedbed preparation, farmers operate even for more than 8h a day. The operator has to guide/control the forward movement of the machine by actuating hand clutches provided on each handle or sometimes by pushing/pulling the handles towards sides. The operator sometimes lifts the rear portion of the machine to take sharp turns at the headlands. The main clutch is a lever on the handle. The lever can be shifted to on or off position while operating in the field. When the lever is shifted to on position, the power from the engine is transmitted through the main clutch to the various parts of it. When the lever is shifted to off position the power from the engine is cut-off from the rest of the transmission.

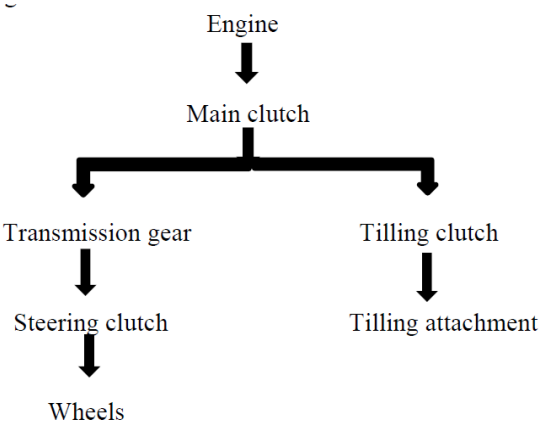
V. Components of a Machine

A power tiller consists of the following main parts:

- Engine: engine is main part of machine that is give the power to the machine
- Transmission gears: Transmission gears consist of gears, shafts, and bearings. Transmission gears reduce speed of the engine and increase the torque at the wheels.
- Clutch: Power goes from engine to main clutch through V- belt – pulley arrangement
- Brakes**:** All power tillers have braking arrangement for stopping the movement of power tiller.
- Belt: it is use to connect wheel and engine
- Attachable equipment: These are the part that are used in cultivation of land

Power Transmission in a Machine:

For operation of power tiller, the power is obtained from the IC Engine, fitted on the power tiller. The engine power goes to the main clutch with the help of belt or chain. From main clutch, the power is divided in two routes, one goes to transmission gears, steering clutch and then to the wheel. The other component goes to the tilling clutch and then to the tilling attachment. The flow diagram for transmission of power is given below



1. ENGINE

a) Engine power

The engine power is defined as the amount of mechanical work performed during a certain period of time. It is the product of torque and engine speed. The rated power, which is mostly quoted in instruction manuals, is stated as the power at rated engine speed. It has to be noted that this is not always the maximum power.

- Power of engine -7.5bhp
- Torque developed by bigger sprocket

  T=60*P/2ΠN
  P=7.5*0.736
  =5.52 KW
  T=60*P/2ΠN
  =60*5.52/2*3.142*1500
  =35.14Nm
- Torque developed by small sprocket

  T=60*P/2ΠN
  P=7.5*0.736
  =5.52 KW
  D1/D2=N2/N1
  N2= (D1/D2)*N1
  = (60/180)*1500
  =500rpm
  T=60*P/2ΠN
  =60*5.52/2*3.142*500
  =105.42Nm
- Power developed by overall engine

  P=2ΠNT/60*1000

= 2*3.142*1000*70.28/60*1000
P=7.359KW

b) GEAR

For running an engine in the most efficient way for saving fuel the gear system has to enable an optimal correlation between power, engine speed and driving speed. An important precondition for that is a precise gear shifting.

A power shift transmission and a continuously adjustable transmission both enable to change speed without being forced to interrupt the power flow and without stopping. For example, when working on areas with uneven soils or slopes, they are able to adapt the speed of the tractor (engine power) directly to the specific conditions. Time and fuel can therefore be saved. Speed changes by shifting the gear with gearboxes demand to stop the tractor. To avoid these situations in practice it is necessary to change down the gear for being able to drive non-stop without shifting the gear. But in these cases the tractor does not drive at full capacity or with a (too) high engine speed when driving on easy soils or grounds without slopes. The power shift transmission has the advantage compared to gearboxes that each gear can be splitter three - four times and can also be shifted up or down under load.

c) Power take-off

A power take-off driven equipment is not only used in the part-load operation range of a tractor. In the meantime modern tractors already include economizing power take-offs which provide - at an engine speed of 1.500 to 1.600 revolutions per min - the standard engine speed (540 or 1.000 revolutions/min) at the power take-off. Thus, the tractor can be driven at part-load within the range of the minimal specific fuel consumption. But also without economizing power take-off the tractors can - under certain circumstances - be driven with the standard engine speed of 540 rev. /min within the part-load range with the 1.000-P.T.O. in an economical way.

d) Clutch

Clutch is a device, used to connect and disconnect the tractor engine from the transmission gears and drive wheels. Clutch transmits power by means of friction between driving members and driven members.

Necessity of clutch

- Engine needs cranking by any suitable device. For easy cranking, the engine is disconnected from the rest of the transmission unit by the clutch. After starting the engine, the clutch is engaged to transmit the power from engine to gear box
- In order to change the gears, the gear box must be kept free from engine power, otherwise the gear teeth will be damaged and engagement of gears will be difficult. This work is done by clutch
- When the belt pulley of the tractor works in the field it needs to be stopped without stopping the engine. This is done by a clutch

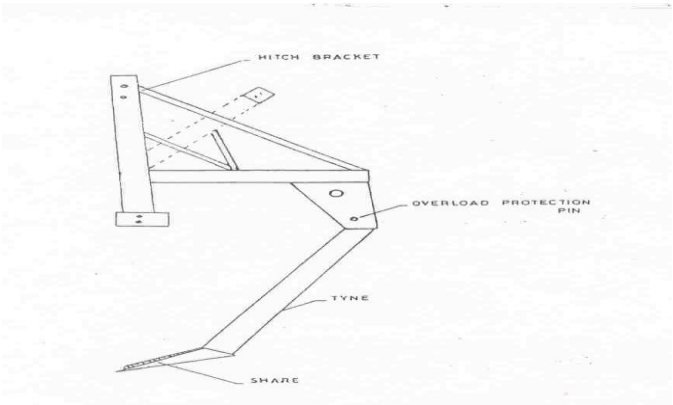
VI. Different type of attachments

There are different types of equipment's used in the agro power machine that will help in the agriculture like ploughing.

1. Cultivator or chisel plough

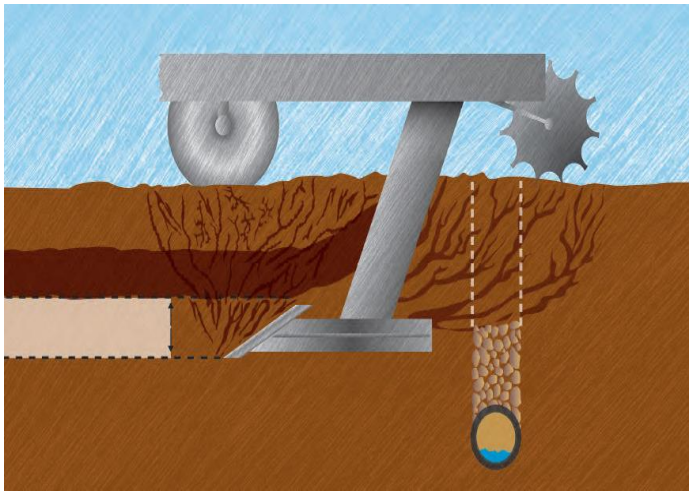
A cultivator is a farm implement for stirring and pulverizing the soil before planting or to remove weeds and to aerate and loosen the soil after the crop has begun to grow. It is powered by a tractor and stirs the soil, usually to a greater depth than does the harrow (which is usually not powered). Many are equipped with hydraulic wings that fold up to make road travel easier and safer. Similar but much smaller machines are used for gardening.

The figure shows components of cultivator or chisel plough.



The chisels of the implement are sturdy and strong enough to withstand the stresses applied when they are working at depth where the soil conditions are hardened. The implement frame is also strongly constructed usually of box section steel to withstand the stresses applied. The chisel plough has a sturdy but light structure made of 3 mm thick hollow rectangular tubular mild steel sections. The share has a lift angle of 20 deg. The implement could be used for deep tillage up to a depth of 40 cm for bursting of the sub-soil hard pan, improving the drainage and aerating the soil

Effect of cultivator:



- Reduces the bulk density of soil.
- Two fold increase in hydraulic conductivity of sub-soil.
- Conserves around 30 to 40% more soil moisture.
- Roots proliferation is improved from 40 to 45%.
- Nutrient mobility especially N and K increased by 20 to 30% and 30 to 40% respectively.
- Enhances the crop yield by 15 to 20%.
- Residual effect can be realized for three seasons.
- Easily operated by any 35 to 45 HP tractors.

VII. CLASSIFICTION

1. Trailed type implement
2. Semi-mounted implement
3. Mounted implement

1. Pull type implement

A pull type or trailed implement is one that is pulled and guided from single hitch point and is never completed supported by the tractor.

2. Semi-mounted implement

This type of implement is one which is attached to the tractor along a hinge axis and not at a single hitch point. It is controlled directly by tractor steering unit but its weight is partly supported by the tractor.

3. Mounted implement

A mounted implement is one which is attached to the tractor through a hitch linkage in such a manner that it is completely supported by the tractor when in raised position. The implement can be controlled directly by the tractor steering unit.

VIII. PLOUGHING

Ploughing is used for initial cultivation of soil in preparation for sowing seed or planting. The primary purpose of ploughing is to turn over the upper layer of the soil, bringing fresh nutrients to the surface, while burying weeds and the remains of previous crops, allowing them to break down. It also aerates the soil, and allows it to hold moisture better. In modern use, a ploughed field is typically left to dry out, and is then harrowed before planting.

Ploughs were initially human powered but the process become considerably more efficient once animal were pressed into service; the first animal powered ploughs were pulled by oxen. In industrialized the first mechanical pulling a plough were steam powered but these were gradually superseded by IC powered tractors.

Type of ploughing:

1. Single plough

- Plough is suitable for ploughing virgin land which is not tilled for long period
- Basic function are inverting breaking and raising of soil
- Tills the soil which has deep roots, unwanted plants. Shrubs and weeds

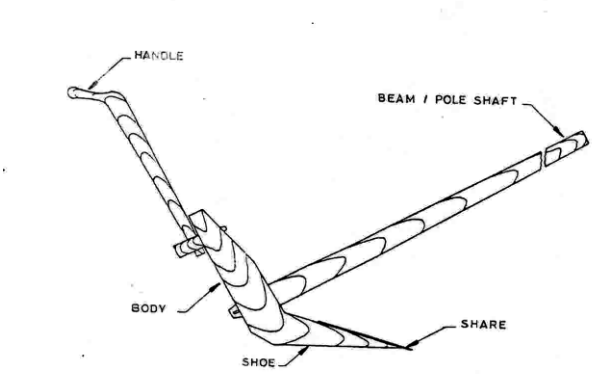
- Best for land preparation
- It can use in tough condition

2. Multi/Reversible plough

- Reversible plough is also called multi plough
- It work same as single plough but it consist on number of plough and it will be rotate 90 degree to the axises
- Basic functions are inverting, breaking and rising of soil.
- Tills the soil which has deep roots, unwanted plant shrubs and weeds.
- Easy of rotating manually.
- It can be used in tough condition.

3. Indigenous plough

It is an animal drawn plough. It penetrates into the soil and breaks it open. It forms V shaped furrows with 15-20 cm top width and 12-15 cm depth. It can be used for ploughing in dry land, garden land and wetlands. The size of the plough is represented by the width of the body and the field capacity is around 0.4 ha per day of 8 hours. The functional components include share, body, shoe, handle and beam. Except share all other parts are made up of wood. In villages local artisans make the plough and supply to the farmers. These ploughs are also called as country ploughs.

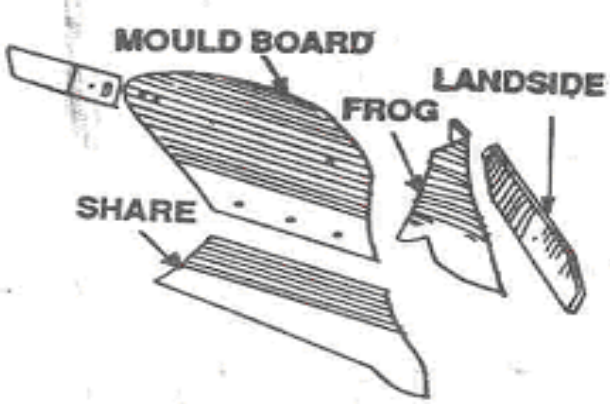


4. Mouldboard plough

Mouldboard plough is one of the oldest of all agricultural implements and is generally considered to be the important tillage implement. Ploughing accounts for more traction energy than any other field operation. Mouldboard ploughs are available for animals, power tiller and tractor operation. While working, a mouldboard plough does four jobs namely a) cutting the furrow slice b) lifting the furrow slice c) inverting the furrow slice and d) pulverizing the furrow slice.
A tractor drawn mouldboard plough consists of

- Plough bottom
- Beam or standard
- Main frame and
- Hitch frame

Plough bottom – The part of the plough which actually cuts, lifts, pulverizes and through the soil out of the furrow. It is composed of those parts necessary for the rigid structure required to cut, lift, turn, and invert the soil. Parts of the mouldboard plough bottom are a) Share b) Mould board c) Land side d) Frog and e) Tail piece. Share, landside, mouldboard are bolted to the frog which is an irregular piece of cast iron



a) Share: It is that part of the plough bottom which penetrates into the soil and makes a horizontal cut below the surface.

b) Mould board: It is the curved part which lifts, turns, and pulverizes the soil slice.

c) Land side: It is the flat plate which presses against the furrow wall and prevents the plough from lateral swinging. The rear part of land side is called heel which slides on the bottom of the furrow

d) Frog: It is the part to which share, land side and mouldboard are attached.

e) Tail piece: It is an adjustable extension, which can be fastened to the rear of the mould board to help in turning the furrow slice.

IX. TYPES OF MOULDBOARD PLOUGHS

1) Fixed type (one way) mouldboard plough

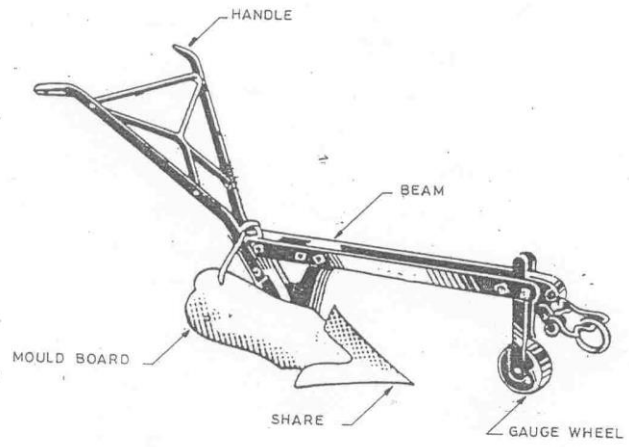
One way plough throws the furrow slice to one side of the direction of travel and is commonly used everywhere. It may be long beam type or short beam type

2) Two-way or Reversible plough

It is a mouldboard plough which turns furrow slice to the right or left side of direction of travel as required. Such ploughs have two sets of opposed bottoms. In such a plough, all furrows can be turned towards the same side of the field by using one bottom for one direction of travel and the other bottom on the return trip. Two sets of bottom are so mounted that they can be raised or lowered independently or rotated along an axis. Two way ploughs have the advantage that they neither upset the slope of the land nor leave dead furrows or back furrows in the middle of the field.

3) Turn wrest plough

There are some reversible ploughs which have single bottom with an arrangement that the plough bottom is changed from right hand to left hand or vice versa by rotating the bottom through approximately 180° about a longitudinal axis. This type of plough is called turn wrest plough. While moving in one direction, the plough throws the soil in one direction and at the return trip the direction of the plough bottom is changed, thus the plough starts throwing the soil in the same direction as before.



X. ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- It can be used in everywhere in agriculture field either land may be small or large.
- Reduces cultivation time.
- Multi work can be done using single machine.
- It is cheaper in cost compared to other agriculture machineries.

DISADVANTAGES:

It is not suitable for heavy works or applications.

XI. APPLICATIONS

- For puddling operation in paddy fields- using rotary tines
- For cutting and pulverizing the soil in dry lands and in garden lands
- For cutting and pulverizing the stubbles of sugarcane, maize and cotton
- For sowing and inter-cultivation works
- For spraying of orchard trees
- For transporting purposes

XII. REFERENCES

[1]. Fasola, sola, O. O., S. Y. Ademiluyi, T. Faleye, D.James and T. Wakatsuki, 2007. Machinery systems management of walking tractor (power tiller) for rice production sawah in Nigeria. Journal of Food, Agriculture, and Environment, 5 (3&4): 281-284.

[2]. Fashola, O. O., O. I. Oladele, J. Aliyu and T. Wakatsuki, 2006. Dissemination of Sawah Rice Technology to Farmers cultivating Inland valleys in Nigeria. Proceedings of the Asian Pacific Extension Network. 6-8th March 2006 Australia.

[3]. Gupta, J. P. and S. Kumar, 2001. Status of Power Tiller Use in Binar A case Study Nalanda District. Agricultural Mechanization in Asia, Africa and Latin America, 32 (No 1): 19 22.

[4]. Gupta, J. P. and S. K. Sinha, 2000. Field performance of Bullock Drawn Puddlers. Agricultural Mechanization in Asia, Africa and Latin America, 31 (No 4): 36 – 40.

[5]. Kathirvel, K., T. V. Job and R. Manian, 2000. Development and Evaluation of Power tiller operated ladder. Agricultural Mechanization in Asia, Africa and Latin America, 31 (No 1): 22 – 27.

[6]. Kong, D., T. Ling and G. Xu, 1983. Small tractors in China. Agricultural Mechanization in Asia, Africa and Latin America, 14 (No 1): 44 – 50.

[7]. Wakatsuki, T. and T. Masunaga, 2005. Ecological Engineering for sustainable Food production and the restoration of Degraded Watersheds in Tropics of Low pH soils: Focus on West Africa. Soil Sci. Plant Nutr., 51(5): 629-636.