

Operation and Maintenance Manual

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PART ONE – OPERATION OF CUSTOM HIRING CENTER

1.1 Introduction to CHC

The sector faces critical challenges in terms of large share of small and marginal farmers, declining land holding sizes, high cost of farm machinery and equipment, inappropriate technology, undeveloped markets, and insufficient policy framework. Land size, cropping pattern, market price of agriculture produces, availability of labor and cost of labor are the major factors generating the growth of agricultural mechanization. With continued decrease in average farm size, more farms will fall into the adverse category thereby making individual ownership of agricultural machinery increasingly uneconomical.

The Custom Hiring Centers (CHCs) offer farm equipment and machineries on rental basis to farmers who cannot afford to purchase agricultural machineries and equipment. The CHCs play a pivotal role in introducing high technology agricultural machinery to even small farmers with the objective to boost crop production, improve quality, timeliness and efficiency of agriculture operations.

Custom Hiring in Nepal faces constraints like high initial cost of equipment, lack of knowledge in the aspects of operation, maintenance and repair of equipment, lack of space for shelter, orientation towards the use of tractors and allied equipment, sub-optimal asset capacity utilization on account of crop specific requirements. To overcome this, virtual or real consolidation of the widely fragmented and scattered land holdings, extension of benefits of mechanization to multiple cropping systems, enhancement of the average farm power availability to assure timeliness and quality in field operations and use of precision (in terai region) and efficient equipment to improve the quality of operations is required.

The Custom Hiring model holds the potential to be the best way to introduce capital intensive, high quality and efficient farm mechanization to the small farming structures prevalent in Nepal. The Custom Hiring model enables new machines to be used at their maximum capacity and enables farmers to gain access to latest technology they would otherwise not be able to afford. Custom Hiring can significantly facilitate diversification in agriculture specifically from wheat and paddy to other crops. Custom Hiring through private entrepreneurs or co-operatives or even the farmers groups will help to increase annual use of these equipment thereby making them viable.

Custom Hiring is a relatively new concept in Nepal and holds an immense potential to change the farm mechanization in Nepal. There is a need to develop and replicate successful business models along with incentivization and policy support for the adoption, capacity building and skill enhancement, development and promotion of farm mechanization technologies.

1.2 Objective and Scope of CHC

The Custom Hiring model holds the potential to be the best way to introduce capital intensive, high quality and efficient farm mechanization to the small farming structures prevalent in Nepal. The Custom Hiring model enables new machines to be used at their maximum capacity and enables farmers to gain access to latest technology they would otherwise not be able to afford. Custom Hiring through private entrepreneurs or co-operatives or farmers groups will help to increase annual use of these equipment thereby making them and the business viable.

The objective of this business is to operate a custom hiring center, especially focusing on the stallholder farmers involved in HVCs commercial production in the hills of Gandaki Province

to enable any farm operation timely manner without losing a favorable window of rainfall or soil moisture available. The **objective of this document** is to guide the potential CHC operators to establish and operate custom hiring service business. A separate sample business plan including the example of financial analysis. This document can be accessed from www.molmac.gov.np.

1.3 Models of Custom Hiring

There are two prevailing models of Custom Hiring, namely

- Tractor centric model
- Operation specific model

The key characteristics of these models are discussed below:

The tractor centric model focuses on tractors along with range of equipment. This model offers only basic services like leveling, ploughing, harrowing, threshing etc. Mostly local entrepreneurs with limited financial capability implement this model in focused territories.

The operation specific model entails one type of high cost machinery with operations in larger territory, even in multiple districts/provinces for better utilization of the machine. This model offers services for operations like cereal harvesting. A very successful example of Custom Hiring is the model used in paddy in Terai districts. Individual entrepreneurs travel across districts/provinces to hire out their machines (rice harvester/combines) to maximize the machines potential, thus earning income. Increasing popularity of such CH is noticeable in Province 2 and 1 in paddy harvesting. The farmer engages the services on call on a “pay for use” basis avoiding the need for owning or operating any of the equipment (on hours, days basis).

In terms of institution, the first type of business model is FOs based models where farmers groups or farmers cooperatives own and operate CHC, and provide services primarily to their member farmers, and as well to non-members in the same area. The advantage of this business model is its ability to pool resources and to utilize economies of scale in lowering the cost of doing business and the cost of equipment. The business risk is spread across beneficiary farmers¹. The second type of CH business is private service provider model where the CHC is own and operated by service provider company and wants to ‘uberize’ the agriculture mechanization services.

1.4 Selection of Machinery and tools

The selection of an optimum equipment set is of paramount importance for successful operation of custom hiring center. The selection of machinery and tools (power sources and related implements) very much depends on a wide range of factors including – targeted area, the size of the farms, soil type, topography, crops under cultivation and cropping pattern,

¹ Group ownership model is often well intended but faces a number of challenges associated with group dynamics, leadership and business management that more often than not lead to the disintegration of the groups. Other challenges include slow decision-making mechanisms, slow pace of service provision that lead to member dissatisfaction, and relatively low profits per member. Group dissolution is often high. The model encompasses cooperative unions, community-based groups such as mixed groups, youth groups, women groups and etc.

cultivation practices, level of commercialization of the area, availability of labor, and finally financial considerations. The types of machinery will also depend upon the chosen custom service modality. Any criteria for the selection of particular farm equipment for CHC should be to enable the farm operation timely manner without losing a favorable window in climate conditions, soil and moisture conditions. Choosing the most feasible power source and corresponding accessories can make the difference between a successful and a failed venture. Custom hire service providers derive their profit from the efficient use of machineries.

Before investing into costly agriculture machineries and implements for custom hiring services, the proponent should analyze the expected outcomes. The detailed assessment must cover -

- Targeted area for mechanization services (e.g. soil types, agriculture production systems including crops, cropping pattern and practices, types of farming (commercial, subsistence etc.), farm size, topography, climatic conditions, availability of skilled labor etc.);
- Marketed volume and sells
- Availability of support services including farm equipment, spare parts, fuel supplier and etc.
- Technical and financial feasibility of proposed machineries and implements
- Demand for the service and existing mechanization service providers
- Clear understanding on the above parameters will facilitate informed decision making.

The technical criteria may include type of agriculture machineries, power (4-WD tractor, 2-WD tractors, power tiller, mini tiller, and etc.), equipment specifications. In most cases the custom hiring services is built around tractors, to which a great variety of accessories can be attached for various functions. The demand for land preparation, harvesting and threshing, and transportation services are in increasing trend and accordingly, the selection of power source and related implements/accessories and their specification should be current need and future trend in agriculture production system.

1.5 Business Planning

Once the situational analysis carried out and information collected (on the equipment needed, demand situation, availability of equipment etc.), the next step is to develop a plan for CHC. By this stage, the prospective service provider should be fully aware of what demand for services exists in the area and who the potential clients are. The service provider should also have knowledge on what time-windows exist to undertake certain tasks and how these are spread throughout the year. Before investing into the business, the entrepreneur must have (i) the technical knowledge and managerial skill to operate the business, (ii) fairly good access to input supply of spare parts and other variable items, (iii) access to repair and maintenance works at all times, and (iv) opportunity to grow the business.

1.6 Costs and hiring charge

The custom hiring business must be profitable i.e. it must generate revenue more than the cost to establish and operate it. Like any business, the costs of operating the CHC business will include purchase price of the machineries, costs of running the business and etc. First, there is purchase price of the machineries that will be used to provide the mechanization services. This is the initial one-time investment that the potential service provider will have

to raise enough to buy all the equipment that is needed to run the CHC. The purchase price is spread over the expected life of the equipment and the annual share of such cost is known as depreciation. Further, there are other costs to own and operate the machinery such as financing costs (interest), insurance and housing costs, repair and maintenance, lubrication, fuel (in case of tractors/power tillers), operator, and etc. some of these costs are fixed in nature and others are variable.

a. Operating Costs

One of the most important items influencing the profitability is the cost of owning and operating the farm machines. Accurate cost estimate plays an important role in every machinery management decision, namely, what and which size to buy, how much to buy, and etc.

There are two types of costs viz. fixed and variable costs. Fixed costs depend on how long a machine is owned rather than how much it is used. It includes depreciation, interest, taxes, shelter and insurance (these are fixed costs because they do not vary/change based on the level/amount of service delivered). Variable costs also called operational costs vary in proportion to the amount of machine used. It includes repair and maintenance, fuel, oil or lubrication and labor costs. Following is the example of calculating operating costs of CHC.

a1. Fixed costs

Equipment Depreciation: The cost of equipment depreciation accounts for purchase price, salvage value, and years of service (also called optimal life). The depreciated value (purchase price – salvage value) can be split equally among the years of service of the equipment because after the first year of use, most machinery depreciates at a fairly consistent rate over the [next 10 to 15 years](#) (with typical use).

Financing Cost: it is the cost, interest, and other charges involved in the borrowing the money to purchase the assets including machineries, shelter, and etc.

If the potential service provider intends to invest 40% of the initial cost from the internal resources (e.g. from the cooperative/farmers group/enterprise promoters) and the remaining 60% is to be financed through bank loan, then the principal and the interest on loan will have to be paid back through equal installments over certain period of time.

The cost of borrowing 40% of the purchase price will be based on an average interest rate for agriculture loans within a certain period of time.

Insurance and Housing: the equipment and facilities will carry suitable insurance against accidental damage and for liability. Suitable housing is also a reasonable measure for maintaining equipment value and performance. These annual costs have been set at 10% of the original purchase price of the machine.

Fixed costs calculation example

Fixed cost is defined as one, which does not change when level of output alters (i.e., it applies to a resource that is fixed in quantity).

- a. **Annual depreciation** can be calculated using the following equation -

$$D = \frac{P - S}{L}$$

where, D = Depreciation, NPR/yr; P = Purchase price of assets, NPR; S = Salvage value of assets, NPR; and L = Life of assets, yr. (The salvage value of machinery after 10 years of useful life is considered zero.)

Purchase Price (P) = 230,000-0/15 = NPR 23000 per year= NPR 20.5 per hrs

- b. The **interest on investment** is included in fixed cost estimation. (Even if the investment money is not actually borrowed, a charge is made since that money cannot be used for some other interest paying enterprises). The following equation can be used for calculating the interest on invest:

$$I = \frac{P + S}{2} \times i$$

where, i = interest rate, decimal. I = interest on investment (NRs)

*Interest on investment (i) = (purchase price + Salvage value)/2)*Interest rate = hrs 10.3 per hrs*

- c. The **insurance and housing costs** (H) is estimate 1% of the purchase price per year = NPR 2.1 per hrs.

Total fixed costs = $D+I+H$ = NPR 32.9 per hrs (see excel sheet for calculations)

a2. Variable costs

The variable cost is direct costs needed in the operation of the businesses and which changes when the level of output alters. Variable cost depends on labor cost, fuel, oil, repair and maintenance cost and other cost resulting from the provisioning of the mechanization services.

Variable costs example

Variable costs include labor cost, fuel, oil, repair and maintenance costs and other cost resulting from the provisioning of the mechanization services. Table below give an example of variable cost for running a power tiller -

Variable costs	Amount (NPR per hrs)
Fuel NPR per hour	150
Oil NPR per hour	8.55
Repair and Maintenance NPR per hour	4.11
Operator NPR per hrs	85.71
Other costs NPR per hrs	5
Total NPR per hrs	253.4

The variable costs depend on the specifications of the equipment under consideration, especially, its field capacity, field efficiency, operator's skill on handling of the equipment, and the condition of the machinery. Generally, it is calculated in per hour bases; i.e. cost of providing an hour of mechanization service. Daily rates can also be calculated accordingly.

Operating costs. The operating costs is the total of fixed and variable costs. The potential CHC operators should keep this cost at the minimum possible level without compromising the quality of its service and overall efficiency of the unit. This is by far the most important parts of the business planning.

Total Operating costs = fixed costs + variable costs = 32.9 + 253.4 = NPR 318.3 per hrs

b. Payment for replacement

Uniform annual payments to a fund are of such a size that by the end of the life of the tractor/equipment, the funds and their interest have accumulated to an amount that will purchase another tractor/equipment. The payment for replacement (PFR) can be calculated using the following equation:

$$PFR = (P - S) \times \frac{i}{(1 + i)^L - 1}$$

where, P = Purchase price of tractor, NPR; S = Salvage value of tractor, NPR; i = Interest rate, decimal; and L = Life of tractor, yr.

Knowing the purchase price of equipment, its salvage value after the optimum life, interest rate and life of the equipment (in years), the potential operator of CHC can calculate the annual payments need over the life of the equipment. Following is an example for 2-wheeler tractor (power tiller) -

SN	Tools	1	2	3	4	5	6	7	8	9	10	11	12
7	Rice reaper												
8	Mini corn harvester												
9	Grain dryer machine												
10	Storage facility												

It is always helpful, if the CHC does planning also in terms of quantity of services. This will help CHC to timely provide the service to the farmers. Table xx provide an example of work quantity estimate. It should be carried out before the season starts. The services such as land preparation, weeding, harvesting etc. should be presented by months (Table xx).

Table xx: An estimate of quantity of service and time needed

SN	Work	Qty of work	Time
	Land preparation	50 ha two times	85 working days
	Weeding	20 ha 2 times	50 working days
	Rice harvesting	10 ha	20 working days
	Maize harvesting	25 ha	25 working days
	Spraying	50 ha	200 working days
	Transportation	50 trips	50 working days
	Irrigation	50 ha	2000 hrs
	Total	210 ha; and 50 trips	430 days+2000 hrs

Table xx: work plan by type of service

Service	Months												Total work days
	J	F	M	A	M	J	J	A	S	O	N	D	
Land preparation													85 days
Weeding													50 days
Irrigation													2000 hrs
Spraying service													150 days
Rice and maize harvesting													45 days
Rice and maize drying													25 days
Transportation													50 days

Timeliness of the service.

In agriculture production system timely operation such as land preparation, planting, irrigation, nutrient management, disease and pest management, harvesting, postharvest management, transportation is very critical and the mechanization service provider should always be ready to provide timely service. The CH service provider must be fully aware of the agriculture practices of their servicing area, have full knowledge of the what time-window exists for the farmers to do certain production functions and what kind of specific services are needed by the farmers. the impact of the custom hiring service will largely depend on the timely provided quality service. The farmers will be willing to pay for the service only if the mechanization service provided to them will result in (i) reduction of cost of production, (ii) increased productivity, and (iii) reduction of losses. and therefore, the management of CHC should be geared towards addressing such concern of the farmers. Furthermore, it is also

imperative that the mechanization has no negative impact on the environment and employment opportunities for rural poor, especially the landless households.

Quality of service.

Quality of the service will determine the effectiveness of mechanization. The quality of the agriculture mechanization service depends on the specifications of the equipment/ implements being used to provide the service, condition of the equipment, skill of the operator. Timing of the operation is also important, for example, right moisture content for land preparation, right time of planting, irrigation timing, right stage of ripening for harvesting and etc. the CH operator must possess full knowledge of the requirements and advance planning is needed to comply with the available window of operation to extend quality service. Furthermore, the equipment must be maintained in good working conditions to ensure quality of services.

Easily accessible to the farmers

The CH Center should be located in the vicinity of its targeted area so that the farmers have the adequate reach to the services. Farmers must be fully aware of the type of services available to them and trust on service in term of timeliness and quality. Users' easy access to the services is key to success and thus should be the motto of the service provider.

1.8 Maintenance Record Keeping

Successful operation of CH business depends on the capacity of the business operator to keep all the machineries in good condition and ready for providing the service at any given time. For this to happen, it is imperative that the machineries are well maintained, have good access to spare parts, maintain a reasonable stock of fuel and lubricants. The manager of the CH Center should be well informed on the condition of the machineries and implements, wear and tear, repair and maintenance, work quantity accomplished, demand for the services and etc. One of the tools to monitor the situation is to keep logbooks. At least three types of logbooks should be maintained as follows;

a. Machinery utilization logbook

An equipment log is very important in CH business as it allows to monitor everything that is related to the equipment being utilized for delivering the custom hire services. Equipment log is the document (logbook) that captures the information and keep track of who used the equipment, for what purpose, how long it was used and job accomplished. The format of equipment log is given in annex.

b. Repair and Maintenance logbook

The custom hiring center relies on the state of equipment for its success. The unavailability of equipment due to worn out or downtime will lead to time wastage and potentially loss of revenue from sales and therefore taking good care of the equipment should be a top priority. All the equipment and machinery should be maintained and inspected as often as needed. A business entity engaged in renting out equipment should always have a well-maintained equipment maintenance log to keep track of the conditions, functioning, and maintenance of the equipment. For CHC service providers, especially for beginners it will help ensure that the revenue generating operations are constantly progressing as planned without any disruptions in the form of unexpected downtime.

The equipment maintenance log is a simple document (logbook) that contains a list of all actions that have been performed on a certain piece of equipment. It helps keep track of the maintenance history of each equipment. The benefits gained from keeping a machinery maintenance log are numerous.

- **Preventing expensive repair works.** Equipment and agriculture implements are subjected to wear and tear and therefore it is important to conduct a regular maintenance checkup after each job hired. The regular maintenance will fix for minor damages before they get worse and expensive.
- **Enhance the safety of the machine and equipment operators.** Malfunctioning of the machinery is less likely if the equipment is well maintained. Preventive maintenance log will keep track of the equipment condition.
- **Resale value of equipment.** It is generally accepted that the resale value of equipment is high if it is well maintained and the logbook is available.
- Having a complete equipment maintenance log lets you know when the time is right to replace equipment. This, in turn, helps you save money. The data that is gathered over time unveils patterns of failure, expenditure, and repair.

Sample format has been given in the annex.

Variable items such as fuel, lubricants, spare parts logbooks

The custom hiring business management should always be aware of the state of stock of supplies such as fuel, lubricants, spare parts etc. to minimize the downtime of the revenue generating machineries. A simple tool suggested and which is presented in annex to keep track of the stocks.

PART TWO – SERVICING AND MAINTINANCE OF KEY EQUIPMENTS

2.1 Introduction

Many farm tasks require the use of equipment. Proper maintenance of equipment is crucial in the smooth day to day operations of a farm. Periodic inspections are the best way to prevent potential breakdowns and setbacks. No matter what the equipment is, a few minutes to look things over before getting started could save money and countless hours spent on equipment repair. Several different manufacturers make equipment which performs the same job, but equipment parts and modes of functioning will be different from one manufacturer to the next. Operating the equipment is the best way to become familiar with how it handles and what its limitations are. Required maintenance may also vary between equipment manufacturers. Referring to the owner's manual is the best way to become familiar with and get a basic understanding of how the equipment functions and to find out manufacturer recommendations for required maintenance. The more a piece of equipment is used, the more maintenance will be needed, even more than what the manufacturer recommends. Get to know each piece of equipment. Much maintenance can be done during the off season, but if possible, make repairs immediately, whenever the problem is noted. Many unforeseen problems can occur when working with equipment and making repairs is very much learn-as-you-go.

2.2 Two Wheel Tractor Operation and Maintenance Manual

2.2.1 Introduction to two-wheel tractor

The two-wheel tractor or walking tractor is a single axle, self- powered and self-propelled tractor, which can pull and power various farm implements such as a trailer, cultivator or harrow, a plough and planters. The direction of travel and its control for field operation is performed by the operator walking behind it or sitting on a seat of the implement hitched to it.

Types of Two Wheel Tractors

Small 2WT which can be regarded as "Power tiller" or garden tiller/roto-tiller ranges from 3–7 hp and they are diesel or petrol powered.

Large. These 2WT range from 7 –22 Hp and are usually powered by heavy-duty single-cylinder diesel engines.

Uses of two-wheel tractors

Two-wheel tractors can execute practically all of the chores done by larger 4-wheel tractors, with the exception of items like front-loaders, which obviously have the physical stability requirements of a 4-wheel (two-axle) tractor. Two-wheel tractors are mostly used for agricultural purposes in the following:

For soil-working. Rototillers, moldboard plows, disc-plows, rotary plows, root/tuber harvesting plows, small subsoiler plows, powered and non-powered harrows, seeders, transplanter and planters.

For harvesting, available machines for use with 2WT are: Forage - Sickle bar mowers, disk mowers, hay rakes, hay tedders, hay balers and bale wrappers [for silage production].

Grain harvest - reaper/grain harvesters.

For transport. Trailers with capacities from 0.5 to 1.5t categories are available.

Shelling - The tractors can also be used for the shelling.

2.2.2 Two Wheel Tractor Safety

- Keep children away from tractors and machinery.
- Always remove cranking handle from tractors when they are not in use.
- Have an up to date maintenance schedule.
- Follow safe maintenance and jacking procedure.
- Operators must not attempt to use tractors and machinery they are not sure of how to operate.
- Keep all guards in place
- Always wear well-fitting clothes /avoid loose clothes especially when working with the belts.
- Muffler is a high temperature spare part, do not touch the power tiller in work or out of work freshly.
- When the power tiller is working, keep an eye on the rotary parts, do not be too close to the machine to avoid being hurt by rotary blades.
- Keep the components of oil box away from fire and smoke.

***Warning:** Burn hazard, do not touch the cylinder, the muffler enclosure and its adjacent frame during usage and within 20min after stopping the engine. longer period is needed if the environment temperature is higher than 20 C.*

Precaution

- When disconnecting the battery remove the negative terminal first, and when connecting, install the positive terminal first.
- Use the recommended batteries only.
- Do not reverse positive and negative terminals
- Maintain recommended tire pressure
- Do not use ripped or worn out tires
- Check for any straws or alien substances from the engine, muffler/silencer, battery, and oil tank before starting the engine.
- When inspecting the tractor, disengage the covers or other implements safely.
- Engage the covers or other implements properly after the inspection
- When starting the engine, be sure to locate the main clutch lever and make sure it is in the OFF position and the shift lever in the neutral position.
- Do not make abrupt start, stop and a sharp turn.
- Stop operation of any attached farming implement while driving on farm or public roads.
- Before driving the tractor in reverse, check to see that there are no obstacles around.
- Hold the tractor handles tight to prevent it from rising when driving in reverse.
- Do not reverse the tractor at high speed
- Keep away from hot engine.

- Completely stop the engine for inspection and avoid touching the engine until it is cooled off
- Ensure tire pressure is sufficient before using the tractor
- Check bolts securing tires, engine and onto frame before starting.
- Check belt pulley alignment
- Check belt condition
- Check oil and water levels

2.2.3 Operating a two-wheel tractor

To Start Diesel Engine

The following should be done before starting

- Using the dipstick provided check the engine oil level. Top up with recommended oil if necessary, to keep up to the level.
- Check water level and top up if necessary.
- Check fuel level. Only use diesel from a clean container. Never re-fuel when the engine is hot or running.
- Check position of the fuel cut off valve and open if closed.
- Ensure the gear lever is in neutral position and the power take-off (PTO) lever is disengaged.
- Set throttle (accelerator) level to the start position.

Starting

- Press and hold the decompression lever on the side of the engine.
- Crank the engine with the crank handle gently until it engages then, keeping the decompression lever depressed,
- Press, but do not hold the decompression lever and give the starter handle a good strong cranking to start the engine. Release decompression lever once engine speed is good and at the same time remove cranking handle.
- Once the engine has started return the throttle lever (F) to idle position.
- Lift front stand
- Engage gears, lower clutch handle gently and the tractor will start to move

Stopping

- Engage clutch lever to the neutral position.
- Locate gear lever in neutral position.
- Disengage drive to the digging knives by pulling the PTO lever backwards.
- Move the engine stop lever to position 'STOP' which will result in engine stopping.

2.2.4 Maintenance schedules and procedures for two-wheel tractor

Maintenance is the regular care done to machines to work well and prolong their life span. Maintenance protects machines from break down or wear out too quickly. During the working period of the power tiller, the wear and tear may cause malfunctioning of the system including drop of engine power, increase of oil consumption, and failure of the machine that eventually effects efficient use of machine. To minimize the such scenario, it is suggested to follow a strict and regular maintenance job.

Maintenance protects machines from -

- Wear – Grease and oil are used to protect moving parts from wear.
- Dirt – Filters are used to catch and hold dirt before it gets inside and damage parts.
- Heat – The cooling system protects the machine from heat provided it has enough coolant and it does not leak.

Regular maintenance of the machine will:

- Reduce failures on the farm and therefore increases productivity,
- Save on operation cost,
- Keep the tractor/power tiller/mini-tiller in good operational condition.

This manual will only give general procedures of maintaining two-wheel tractor.

2WT Maintenance Schedule

	Operation	Every day (8 hrs)	The 1st month or after 20 hours	The 3rd month or after 150 hours	Every year or after 1000 hours
Engine	Check engine oil level	X			
	Replace engine oil			X	
Gear box and controls	Check gearbox oil level	X	X		
	Check nuts and bolts	X	X		
	Ensure clutch has free play	X	X		
	Check tire pressure		X	X	
	Lubricate control cable/linkages		X		
	Check control cable operation	X	X		
	Change gearbox oil			X	
	Grease gearbox speed detent ball		X	X	
Radiator	Check water level	X	X		
	Replace water	When water level is low			

Maintenance Checks and Procedures

Pre-inspection (Using a 2WT for the first time)

- Check engine oil level and top up to the optimum level if necessary.
- Check gearbox oil level and top up if necessary.
- Tighten wheel nuts and check tire pressure.

The following are daily checks and procedures carried out daily before starting the day's work. As a general rule all tractors need the following care after every 8-10 tractor hours:

a. Engine /Transmission Oil Level

Before checking oil level on the two-wheel tractor, it is important to position the level position to avoid false reading if the tractor is in a tilted position.

Let the tractor position be in a horizontal orientation supported by its own stand when checking oils.

- The level of engine oil is checked in the sump with the Dip stick.

- Dip stick is marked with max and min points, the oil level should be in between the 2 points.
- For a tractor with a separate dip stick for transmission, the same procedure as above should be followed.

b. Air Cleaner

Main air cleaners can be either Dry element or Oil bath type.

- For Dry element use a compressor to blow out dirty dust from inside.
- For Oil bath check the oil level mark and add if necessary, change oil if the color turns brownish.

c. Water Cooling System

- Check the water level in the radiator, top up if necessary and use clean water
- Check radiator for dirt, leaves, insects which block the fins and clean if necessary.

d. Battery (optional on some tractors)

- Check security clamps, tighten nuts if need be.
- Check terminals for acid corrosion, clean with warm water if there is need.

e. Fuel

- Fuel tank should be filled after each day's work to avoid condensation overnight.
- Regularly check the fuel sediment bowl for dirt and water, clean if necessary.
- Refill with clean fuel from reputable suppliers

f. Bolts and Nuts

- Bolts and nuts should be checked by spanner to see if they are tight.
- Special attention should be given to wheel nuts and implement bolts and nuts.
- Check and tighten bolts and nuts especially those for the wheel hubs and engine.
- Inspect operation of the main clutch and direction clutch.

g. Weekly Checks

- Wash the tractor thoroughly with degreaser.
- Tension drive belt and ensure belt/pulley alignment.
- For 2WT with a clutch grease thrust bearing.
- Tighten bolts and nuts for firmness of handles.

h. Monthly Checks

- Complete all weekly servicing requirements.
- Change Engine oil /transmission oil.
- Change oil and fuel filters.

i. Tractor Adjustments

▪ Wheel Adjustments

Wheels are adjusted to suit into different types of row crops. This is done through interchanging the wheel, the left wheel to the right side and the right wheel to the left side. The lugs should always face forward.

▪ Main Clutch Lever

The length of the clutch rod should be adjusted so that it starts to engage at 2-3cm.

- Direction control clutch

Tighten the setting nut on the lever to move 1-2mm freely by the adjustment bolt. If not correctly set, the direction control lever will not work properly.

2.2.5 Troubleshooting

Symptoms	Possible causes	Remedies
Failure to start	No fuel	Fill in the fuel tank
	Start lever is in off position	Check the start lever Return the lever to on
	Decompression lever is not returning to its off position	Position
	Fuel leak between tank and injector	Repair the connection
	Fuel supply lever is closed	Check the supply lever
	Injector pump is not working	Replace
	Injector blocked	Check the injector
	Inlet and exhaust valves closing	Check the valves
	Cylinder and gasket damaged	Replace
	Excessive worn out rings	Replace
Gears failing to engage	Thrust bearing worn out/clutch fingers worn out	Replace
	No gear oil	Fill in the oil
	Rust in the gear box	Make use of the rust remover
Low engine power	Blocked fuel pipe	Check the pipe
	Faulty injector	Check injector
	Faulty injector pump	Check the pump
	Worn out piston rings	Replace the rings
	Damaged gasket	Replace
	Engine speed too high	
Tractor will not turn	Steering clutches not set properly	Properly set the clutches
Smoke coming from the clutch thrust bearing	Bearing failure	Replace
Engine failing to cut when accelerator is pushed down	Accelerator lever engine stop link not functioning well	Check the connection
Tractor keeps moving when the clutch is in neutral or park position	Worn out clutch fingers	Replace
	Clutch assembly support bearings damaged	Replace
Engine difficult to turn when starting	Decompression lever not functioning	Check the lever
	Valves not functioning well	Replace the valves
	Low engine oil	Fill up the oil

Best Management Practices

- Become familiar with the equipment. READ THE OWNER'S MANUAL.
- Inspect equipment periodically, particularly before and after jobs requiring extended and heavy use.
- Check the fluids (engine oil, transmission fluid, coolant level, etc.)
- Check for leaks around hydraulic lines, fuel lines, radiator hoses, oil lines, and cylinders.
- Check for loose and broken bolts and pins.
- Check bearings for any play or grinding.
- Check tension on belts and chains.
- Check belts for cracks.
- Check the air filter and change as needed.
- Check the tire pressure.
- Listen for any unusual sounds.
- Pay attention to any unusual odors.
- Pay attention to any unusual responses from equipment.
- Change oil and oil filter as needed. Oil and oil filter will need to be changed more frequently with heavy use of equipment.
- Change hydraulic oil once every couple of years. Hydraulic oil will need to be changed more frequently with heavy use of hydraulically driven implements.
- Change fuel filter at least once a year.
- Grease equipment frequently. Lubricate cables and chains frequently.
- Tools that are used frequently should be kept with the equipment.

2.3 Maintenance Schedules and Procedures for Mini-Tiller

During operation of the power tiller, wear and tear may cause malfunctioning of the system including drop of engine power, increase of oil consumption, and failure of the machine that eventually effects efficient use of machine. To minimize the such scenario, it is suggested to follow a strict and regular maintenance job.

2.3.1 Breaking-in

1. Refer to the instruction manual (provided with the supplier) for the breaking-in of the diesel engine
2. As for a new or overhauled power tiller, it should be working for 1 hour under no load or 5 hours under light load, then drain all the lubricant from the gear-box and crankcase of the diesel engine, refill appropriate fix of clean diesel, and clean them at a slow speed for 3-5 minutes, then drain the diesel off. Refill engine oil into them according to 4/Clause Three/Chapter III to enter four hours breaking-in, then the machine can work.

2.3.2 Maintenance and storage

1. Keep all nuts, bolts and screw tight to ensure the equipment is in safe working condition.
2. Never store the equipment with diesel in the tank inside a building where fumes can reach an open flame or spark.

3. Allow the engine to cool before storing in any enclosed place.
4. To reduce the fire hazard, keep the engine, muffler, battery compartment and diesel storage area free of vegetative material and excessive grease.
5. Replace worn or damaged parts for safety.
6. If the fuel tank has to be drained, this should be done outdoors.
7. After adjustment or maintenance, the safety protection guard must be attached to the machine.

2.3.3 Technical Service of Power Tiller

Maintenance by each work shift (conducted before and after each shift)

1. Listen and observe if there are any abnormalities (such as abnormal sound, overheating and bolt loosening)
2. Check if there is oil leakage in engine, gear-box and Traveling box.
3. Check if the oil levels of the engine and gear-box are between the two extremes of the oil dipstick.
4. Timely clean the mud, weeds and smear on the machine and its parts.
5. Keep a good farming record/running of machinery

Level one Maintenance (every 150 working hours)

1. Do all the things listed for each work shift maintenance.
2. Clean the gear-box and Travelling box, and change the engine oil.
3. Check and adjust the clutch, shift system and reversing gear system.

Level two maintenance (every 800 working hours)

1. Do all the things listed every 150 hours for service.
2. Check all the gears and bearing, replace with new ones if serious abrasion is found.
3. Other parts of the power tiller, like cultivating blade or connection bolts if damaged, replace with new ones.

Technical overhaul (every 1500-2000 working hours)

1. Take the machine apart in the local special service center, clean and check the machine, then replace or repair the seriously-attired part.
2. Specialized service men are invited to check the friction piece and clutch.

Micro Tiller's Maintenance Table

Work clearance Maintenance content	Every day	Work eight hours under half load	The first month or 20 hours after	Every year or 1000 hours later
Check and tighten the nuts, bolts	√			
Check and refill the oil	√			
Clean and replace the oil		√ (first time)	√ (second time)	√ (third time and after)
Check for leaks	√			
Check and tighten the nuts, bolts	√			
Check for leaks	√			

Remove dirt, grease, weeds, keep clean				✓
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2.4 Maintenance Schedules and Procedures For 4-W Tractors

2.4.1 Daily Maintenance Checklist

Every tractor comes with a maintenance schedule in the owner's manual. That's critical information to ensure the machine gets the service it needs at the right times. But in between those hour intervals, there's a lot more that can be done to keep the tractor up and running.

Because of the workload they carry, the tractors rack up a lot of wear and tear. And that makes routine maintenance all the more important. Checking the condition of the tractor every day helps to catch and fix small problems before they become big repairs. Following are the five maintenance checks to every day schedule;

1. General.

Carry visual inspection of the tractor and its components. Walk around the machine and look for:

- Leaks
- Signs of wear or damage
- Cuts, breaks, or tears in the tread or sidewalls of the tires
- Build-up of dirt and debris
- Loose or damaged hoses, belts, cables, clamps, and drain plugs

Most of these issues have a simple solution. It might just need to tighten something up, replace a small part, or do a better job of cleaning.

2. Check all fluids and fuels.

Leaks are warning signs that the tractor is running low on oil, diesel, lubricants, or other fluids. After correcting the cause of the leak, top off the oil levels so the tractor is adequately oiled and fueled.

Check the engine oil, fuel, coolant, hydraulic fluid, transmission fluid, and any other fluid that tractor carries and fill up any tank or reservoir that needs it. Don't forget the grease. Lubricate every joint and fitting on the machine to ensure smooth operation.

If the machine requires adding engine oil often but haven't spotted a leak, it may have an internal leak. Pay close attention for any indicators while funning. If it doesn't have its normal power or sends out some bluish exhaust, the oil may be leaking onto other parts of the engine.

3. Test the battery.

Inspect the battery for loose connections and a bad battery. Secure any loose connections and clean them, if necessary. Check the fluid level of each battery cell. If accessible, use a voltage meter to get the charge. If the reading after securing all the connections is below nine volts, it's time to replace the battery.

4. Check the tire pressure.

Optimal tire pressure depends on the task. Having tires that are over- or underinflated for chore can greatly reduce the power through slippage or increased resistance.

Make sure the tires are inflated to the recommended levels for the type of work on the day's to-do list. Follow the manufacturer recommendations.

5. Test the safety systems.

It's easy to overlook the tractor's safety features. Unlike other tractor parts, safety features aren't essential in keeping the machine running. But it may be hazardous if the safety protocols are not followed. See the recommendation of the manufacturer.

2.4.2 Servicing of a New Tractor

Operation of new tractors starts with a breaking-in period. It is very important that a daily maintenance schedule is followed. The daily maintenance work will help to identify issues early on. Contract for the dealer for repairs for problems that may be factory related.

Once the tractor hit 10 hours, check the torque on the wheel bolts. Follow all over the daily schedule. After the tractor's first 50 hours, in addition to checking the parts inspected before the 50-hour mark, it is recommended to:

- Change the hydraulic oil and filter.
- Clean the suction screen.
- Check the hose clamps on the radiator and air filter.
- Gauge the pressure in the tires.
- Clean the battery and check the charge.
- Check the oil level in the front axle.
- Lubricate the joints and fittings.
- Clean cab air filters or replace them if they're dirty.
- Check the belt tension on the alternator.

After 50 hours, the tractor is out of the breaking-in period and moving onto routine maintenance. Every tractor's a little different, so the operator should always read the owner's manual first for the maintenance schedule specific to the tractor.

2.4.3 Periodic Maintenance of a Tractor

Farm work is hard. Performing periodic maintenance ensures that the machine is up to the task every day for years to come. Follow the tractor maintenance schedule as suggested by the manufacturer. Depending on the usage, it may needed do some things more or less regularly.

Every 10 Hours

Even though the tractor might be used for a couple of hours, the operator should still complete the five maintenance tasks. At minimum, the tractors should undergo daily maintenance checkups.

Every 50 Hours

Do the same as it was for the initial 50 hours during tractor's break-in period.

Every 200 Hours or every year

Complete the 200-hour check-up every year (whichever is earlier).

- Check the engine oil and replace the oil filter.
- Adjust the alternator and fan belts.
- Check wheel bolt torque.

Every 400 Hours

The annual rule applies to 400-hour maintenance as well. While the machine won't hit that mark in a year, complete these items anyway:

- Follow all the checks recommended for 200 hrs
- Change transmission oil and filters.
- Replace the fuel filters, as well as the water separator.

Every 600 Hours

Add a few more bullets to the maintenance to-do list:

- Check the air filter element, intake, hoses, and clamps and replace them as necessary.
- On the front axle, change the oil and check the torque on the thrust bolts.
- Check the brake adjustment.

Every 1,000 Hours

At 1,000 hours, it is required to contact the dealers to check the engine valve clearance. It's also time to flush and replace the engine coolant. This should be done every year, even if the hour meter on the machine hasn't increased much.

Every 2,000 Hours

Every 2,000 hours or every two years, whichever is sooner, it is required to service the fuel injection nozzles.

Annexes

ABC Custom Hiring Center

Equipment job Logbook:

Equipment type:

Model:

Driver:

Accessory:

Registration No.:

Date of Works		Hour Reading		KM Reading:		Work Description	Quantity Completed	Signature of operator
Start Date	End Date	Start	End	Start	End			
Remarks:					Total KM:		Total hours of work:	

ABC Custom Hiring Center

Equipment Maintenance Log:

[illegible]

ABC Custom Hiring Center

Variable items Log:

[illegible]

