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Laser Land Leveling for Optimization of Resources

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INTRODUCTION

Depletion in the groundwater, unavailability of irrigation water and uncertainty in rainfall necessitates the adoption of efficient scientific water management technologies. In modern agriculture productivity is prioritized which is dependent on good seedling emergence, better crop stand and improved water use efficiency which are concomitantly can be achieved through laser land leveling (LLL). Laser land leveling is a laser guided precision land leveling technique used to make ground level very smooth to ensure even distribution of water in the field. It increases the net cultivation area as it reduces the area needed for bunds and irrigation channels and it is the best adoption technique to save water, increase fertilizer use efficiency and to face the challenges associated with climate change and weather variability. Recent studies predict that there would be at least a 10% increase in irrigation water demand with a 1 ℃ rise in temperature in arid and semi arid regions of Asia; it indicates that India is at stake with growing population. This draws to the importance in adoption of the precision land leveling through LLL which is more economical and time saving practice than the traditional methods.

WHAT IS LASER LAND LEVELING?

Technically it is a process of smoothening the land surface (± 2cm) from its average elevation using laser equipped drag buckets with the use of large horse power tractors and soil movers which will be equipped with GPS and laser- guided instrumentation, the soil will be moved either by cutting or filling to create the desired slope/level.

TYPES OF LASER LEVELERS

Manual leveling laser:

This kind of laser leveling requires a human support to level the unit with the use of unit's screws and bubble vials. The laser has to be leveled in both X and Y axis. The operator has to check on bubbles for accuracy. The maximum accuracy that could be achieved by this process is of 1 cm to 100 m.

Semi self –leveling lasers:

This type of lasers uses compensator to adjust themselves. The laser will be equipped with circular bubble with bull's eye or with electronic lights. Theses posses a shut-off feature which will be helpful when the laser is fallen off or goes out of the self-leveling range. An accuracy of 1 cm at 100 m can be achieved by this type of lasers.

Fully self- leveling lasers:

Within a specified range these automatically maintain level. Electronic vial and servomotors are equipped in the lasers. Servo motors electronically level the instrument and with leveling the laser starts spinning. Most easiest method with an accuracy up to 2.5 mm at 100m.

Split-beam lasers:

Here the horizontal and vertical beams will be emitted simultaneously to level the field.

COMPONENTS OF LASER LAND LEVELING SYSTEM

Drag bucket:

It will be mounted on or pulled by a tractor. It is useful to shift the soil from the undulating surfaces. It can also be termed as scraper. Based on the tractor sixe the width of the scraper that a tractor can hold varies.

Laser transmitter:

It will be mounted on a tripod and it will transmit the laser signals from above the field.

Laser receiver:

It is a multi-directional receiver which will detect the laser signals from a transmitter. It will convert the infrared beam light to electrical signal. It will be attached to a drag bucket. According to the signals received the laser receiver will control the height of the bucket.

Control box:

The control box processes the signals from the laser receiver and displays the signals to operator, with which the operator adjusts the position of the drag buckets.

Hydraulic control system:

This system helps in the oil supply to leveling bucket in order to adjust its level. The electrical signal given by the control box activates the hydraulic value to raise or lower the leveling bucket.

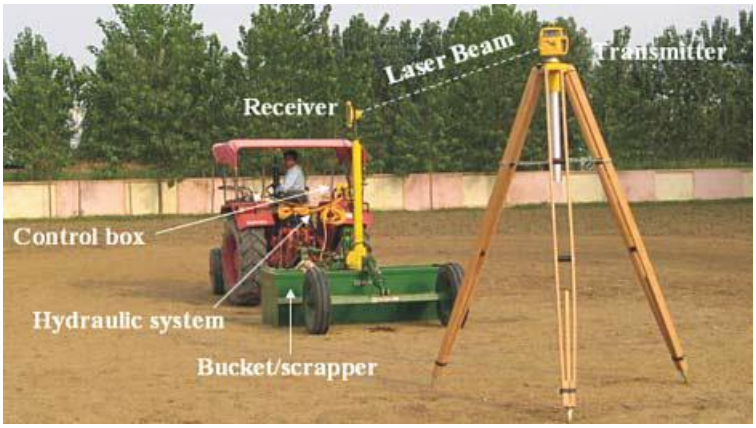

Figure 1: Components of laser land leveller

STEPS IN LASER LAND LEVELING

Step 1: Ploughing of field

Preferably the ploughing should start from the center to outwards and when the soil is slightly moist.

Step 2: Topographic survey

Survey to notice the high and low spots on the field has to be done and eventually has to adjust the positioning of the tripod so that the base plate is even. Attach the laser transmitter to the base plate. If the base plate is uneven the transmitter will not emit the light.

Step 3: Laser leveling of field

Average elevation value of the field has to be set in the control box. Drag bucket

should be kept at the mean height of the field. Cutting blade has to be adjusted slightly above ground level (1-2 cm). Then the tractor has to be driven from high leveled areas to low leveled areas in circular direction. Finally the tractor and bucket has to be run in the desired level without changing the position of the bucket so, that the missed out areas, if any will be leveled at the final drive.

ADVANTAGES OF LASER LEVELING

Reduces irrigation time:

- Irrigation time is reduced by 47-69 hours per hectare per season in rice and improved yield by 7% approximately.
- In case of wheat laser leveling reduced the irrigation time by 10-12 hours per hectare per season and increased the yield by 7-9%.

Ensures food security:

- Increased productivity with the existing resources leads to food security.

Less energy consumption:

- Less time required for irrigating the field saves the energy spent on irrigation. Studies reveal that LLL saves electricity of about 755 kWh per hectare per year for rice-wheat systems.

Reduces cost in leveling the field:

- Laser leveling is flexible to be adopted by even small holding farmers and can be lended on rental basis. It takes only about 4 to 5 hours to laser level a hectare of land and can be redone once in 3 years.

Minimizes water loss:

- Laser leveling is a water-saving technology which ensures even distribution of water in the field by minimizing run-off, water logging and improved water use efficiency.

Reduces green house gas emissions:

- With decreased water pumping time, decreased cultivation time and better use of fertilizers. Emission of greenhouse gases reduces.

Income:

- With increased yields the basic income of the farmer increases.

Key words: Groundwater, Laser land leveling, Fertilizer use efficiency, GPS (Global positioning system), Water use efficiency, Horse power, Compensator, Run-off.

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