

Laser land leveling:

A sustainable approach towards resource conservation technology

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Laser Land leveling (LLL) is a methodology of leveling land surface (± 2 cm) from its average elevation utilizing laser machine equipped drag buckets to achieve precision in land leveling. With precision land leveling, fields are modified to maintain a consistent slope of 0 to 0.2%. To move the soil either by cutting it or filling it in to create the proper slope or level, this procedure uses big horsepower about more than 55 hp tractors and soil movers outfitted with GPS and/or laser-guided instruments. In addition to lowering leveling cost, it ensures an appropriate level of precision. By removing pointless depressions and high contours, it enables efficient use of finite water resources. It has been noted that poor farm design and uneven field are responsible for 30% water losses.

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Laser Land leveling is necessary for good agronomic, soil and crop management practices. It enhances output in crop yield and improves quality of produce while conserving irrigation water and facilitating field operations. Level terrain also aids in mechanization of numerous field tasks. A slope may be provided in one direction or two perpendicular directions, or land leveling may be done to create a level land without any slope, as in rice. Various techniques for leveling fields are described in this article, along with agricultural advantages of effective land leveling as part of land preparation. Crop management and crop yields are significantly impacted by variation in land level within a field (referred to as surface topography). Uneven land level leads to uneven crop stands, more weeds, and uneven crop maturation. By distributing water evenly and improving water use efficiency, laser land leveling makes application more effective, which leads to uniform seed germination, greater crop growth and higher crop yields. Farmers are being forced to use available water resources more

effectively and intelligently due to a lack of canal water supplies and inadequate ground water. In these conditions, LLL can assist farmers with making better and more efficient use of limited land and water resources to boost agricultural yield. According to estimates, this approach could reduce irrigation water use by 20 to 30% without having any negative effects on crop yield. Fields are leveled using laser land leveling equipment so that terrain can be contoured for various irrigation techniques. Using sprinklers, a level field saves water by minimizing runoff and enabling even water distribution. To use water as effectively as possible, furrow irrigation systems require a slight but consistent slope. Laser leveling can enhance crop yields by 10–20% while reducing water use by 20–30%. Standard deviation (SD) of soil surface elevation can be used to measure quality of land leveling in zero-slope fields. Using conventional equipment, a field level can have a standard variation of 20 to 30 mm; however, with laser leveling, the technological limit is extended to 10 mm. While the

expense of leveling operation is 2 to 3 times that of a typical tillage operation, it can result in an increase in application efficiency of more than 10%. A topographic study and field preparation should be done prior to beginning the laser land leveling process. Zero-grade leveling for crop production is one method to increase irrigation efficiency. Fields with zero slope can be drained or flushed more quickly. A more consistent flood depth is possible on level fields, using less water and saving money on pumping. Advantages of precise land leveling last for many years, while field operations and weather circumstances may occasionally necessitate some little ground smoothing. Laser-controlled precision land leveling increases crop yields (wheat 15%, sugarcane 42%, rice 61%, cotton 66%), decreases weed issues, increases weed control effectiveness. It also helps to save irrigation water, increase cultivable area by 3 to 5% roughly, improve crop establishment, improve uniformity of crop maturity, increase water application efficiency by up to 50%.



Laser transmitter



Laser beam receiver

Components of laser land Leveler

Laser transmitter: laser transmitter allows the laser beam to sweep above the field while enabling uninterrupted operation in conditions of high wind speed. With aid of a laser receiver, multiple tractors equipped with drag buckets, laser units can operate from a single transmitter. For automatic guidance of the receiving unit, the laser emitter unit continuously delivers a self-leveled laser beam signal with a 360° laser reference up to a command radius of 300–400 m (depending on its range). Just beyond the field, the laser emitter is set on a tripod platform that is high enough and level enough to allow the laser beam to travel without being impeded. The laser emitter unit has a variety of functional parts and controls, including a laser emission indication, a low battery assembly, and a manual mode indicator for setting the desired grade.

Laser beam receiver: Mmni-directional (360°) laser receiver, which is fixed to the scraper's mast height, identifies the location of the laser reference plane and sends the information to the control panel. Also, this control box instructs the double-actuating hydraulic valve to move the scraper blade in the

desired upward and downward directions to achieve a level field. The grade position LEDs show where the machine's blade is situated in relation to the laser emitter's plane of laser light. With the exception of lighting solidly, these lamps perform the same purpose as the grade position lamps on the control box located on the tractor.

Control box on tractor: Control box receives signals from the machine-mounted receiver and processes them. These signals are displayed to show where the drag buckets are in relation to the finishing grade. The control box produces electrical power to drive the hydraulic valve when it is in the automatic setting. Control box is mounted on the tractor so that the operator may easily access it. When the control box is in automated mode, it generates electrical output to drive the hydraulic valve, which then automatically operates scraper.

Tripod stand: Foundation for laser levels and other leveling tools including rotary laser levels, line laser levels, dot laser levels, builder's levels, transit levels, automatic levels and even torpedo laser levels are provided by tripods, which are three-legged stands. Often, a tripod is used in conjunction with a leveling

tool, grade rod, laser pole and level detector. In addition to providing support and stability both the up-and-down and side-to-side axes of motion tripods are portable.

Drag bucket: A 3-point linkage attached bucket can be pulled by a tractor or mounted to one. This approach is favoured because connecting the internal control system employed by the 3-point-linkage system is more difficult than connecting the hydraulic system of the tractor to an external hydraulic ram. The size and capacity of the buckets will change depending on the power source that is available and the field circumstances. Farmers' markets offer a variety of bucket sizes, from 2 meters wide to 3 meters wide, that are compatible with tractors. The leveling bucket is raised or lowered using oil that is supplied by the tractor's hydraulic system. The hydraulic pump on the tractor typically delivers oil at a pressure of 2000–3000 psi. A pressure relief valve is necessary in the system to allow the hydraulic pump, which is a positive displacement pump and always pumps more oil than is necessary, to return the extra oil to the tractor reservoir. The tractor's hydraulic pump may sustain harm if its relief valve is too small or malfunctions. A 4-wheel tractor is required to drag the leveling bucket. The size of the tractor can vary from 50–60 hp depending on the time restraints and field sizes. Indian tractors ranging in size from 40–90 hp have been successfully used with laser-controlled systems. It is preferable to have a 4-wheel drive tractor than 2-wheel drive and the higher horsepower the faster will be operation. Power shift transmissions in tractor are preferred to manual shift transmissions.



Laser tripod



Laser land leveler

Working procedure of laser land leveler

An electrical control panel, a twin hydraulic control valve, a laser transmitter on a tripod, a laser receiver on a bucket or scraper, a survey receiver need for adjusting the flat ground, and a laser receiver for measuring distances. The leveling bucket-mounted laser receiver uses the rotating laser beam that the laser transmitter transmits as its point of reference. The control panel, which is installed on the tractor, reads the signal received from the receiver and opens or closes the hydraulic control valve, raising or lowering the bucket. For leveling, the dirt must be moved in the most economical manner possible from the high spots of the field to the low points. Prior to starting the leveling process, the fields must be ploughed, and a topographic survey must be conducted. In most situations fields will need to be ploughed and a topographic survey should be undertaken before leveling commences.

Step 1: Ploughing field: Best direction to plough the field is from center to the edges. It is recommended to plough the field when the soil is liquid because doing so requires significantly more tractor horsepower and could lead to greater clod sizes if done when the land is dry. A one-way disc or moldboard may be necessary if the soil is dry. For second workings, disc harrows or tyne devices are ideal. To help soil flow out of bucket, any surface residues must be broken up or eliminated.

Step 2: Conducting a topographic survey: When the field has been ploughed, a topographic survey should be conducted to identify the high and low points. By adding together all the readings from the survey and dividing it by the total number of readings, we can determine the mean height of the field from the readings. The mean height of the field can then be calculated using a field diagram and this information can be strategically used to transport dirt from high to low regions.

Step 3: Setting up tripod: Unlock the tripod legs, then place each one



Demonstration of laser land leveling in adopted village Uprama by KVK, Banka, Bihar



separately until the base plate is essentially level. Get the base plate level by using the horizon as a visual reference. Adjust the various screws on the transmitter's base if the laser is not self-leveling to place the bubble in the middle of both circles. Most lasers require a level transmitter to revolve. Attach the receiver to the staff and turn on the sound monitor after the transmitter is level. The laser is now prepared to start taking height measurements.

Step 4: Leveling the field: location of laser-controlled bucket should correspond to the field's average height. Setting the cutting blade just above ground level is recommended (1–2 cm). The tractor should be moved from the field's higher points to its lower points in a circular motion at a speed of 5 to 6 km/h. In the field, the tractor should be maneuvered in a circular motion from higher to lower areas. As soon as the bucket is almost full of soil, the operator should turn and go in the direction of the lower region to maximize operating efficiency. The tractor should also be turned around and driven back to the upper areas as soon as the bucket is nearly empty. The tractor and bucket should then make a final leveling pass in long runs from the high end of the field to the lower end after covering the entire field in this circular pattern. Once the appropriate level of precision has been reached, the field should be resurveyed. Care must be made to fill the damp portions from the affected edge in a circular motion in wet places where there is a risk of bogging the tractor. Fast-moving wind conditions and fog would render the laser leveler inoperable.

SUMMARY

A contemporary resource-conservation technology endeavour, laser leveling of agricultural land, has the potential to transform how food is produced by improving resource-use efficiency of essential inputs without having any negative or disruptive consequences on the ecosystem's productive resilience. Therefore, in addition to the necessary support from researchers and planners, the widespread popularization of this technology among farmers in a participatory mode on a broad scale requires adequately targeted attention on a priority basis. To achieve the necessary growth rates in food production and agricultural productivity, resource usage efficiency must be significantly improved. This is due to the change in our vision of future agriculture in connection to food and nutritional security, environmental safety and market globalization. Laser leveling is evidently one of the ways by which we can address these issues to a great extent. Despite the fact that laser land leveling technology has a number of direct and indirect advantages, it hasn't yet taken off as a common farming method in developing and impoverished nations. It calls for a range of well-planned and coordinated research, extension, participatory, economic and regulatory activities while keeping in mind the long-term sustainability of our production systems in order to accelerate its popularization and widespread acceptance.

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