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Farmer Participatory Appraisal of Laser Land Levelling

to improve water productivity

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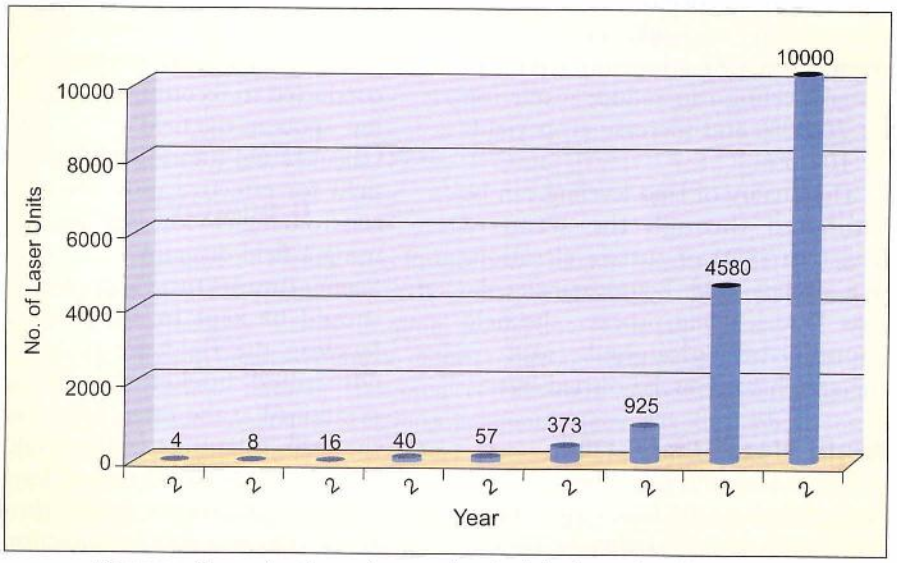
ON farm water management and crop productivity can be improved significantly with precise leveling of fields. Precise land leveling involves smoothing and grading of land to provide a level surface for uniform application of irrigation water and nutrients. It enables efficient utilization of scarce water resources through elimination of depressions and elevated spots in the fields. Level fields allow for a more uniform flood depth, using less water and reducing pumping costs.

Land leveling always improves water, labour and energy resources utilization. However, leveling operations under certain situations may be disruptive for some cultural practices and major topographical changes may sometimes reduce crop production in the cut areas. Therefore, leveling is usually limited to lands, which can be graded economically to slopes, normally not exceeding 2%. The depth of top soil that can be disturbed without reducing productivity often limits the extent of leveling in shallow soils.

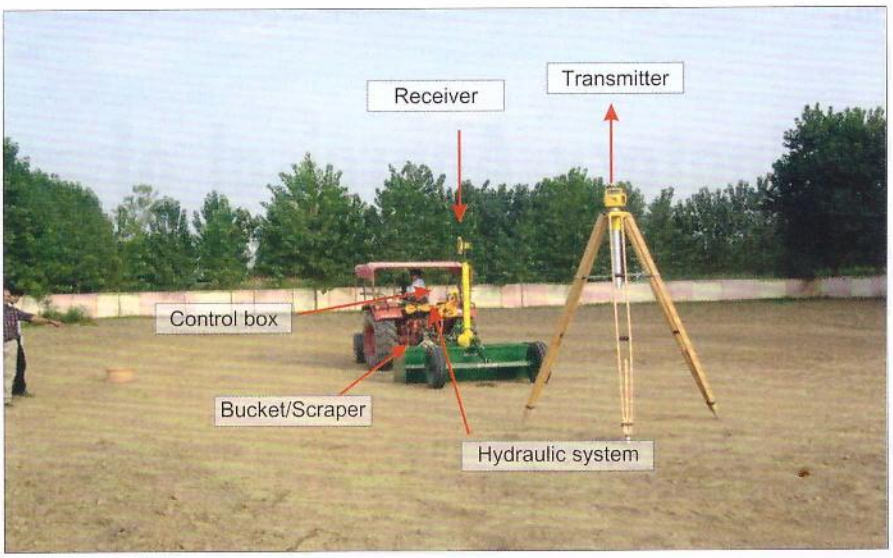
Laser Land Leveling

Effective land leveling is meant to optimize water-use efficiency, improve crop establishment, reduce the irrigation time and efforts required in crop production. New equipments are being continually introduced having improved capability for more precise land leveling operations. Of these, the most significant current advancement has been the laser beam guided land leveling equipment. Laser leveling involves a process of smoothening the land surface by ± 2 cm from its average elevation using laser equipped drag buckets so as to achieve a leveled surface having a constant slope of 0 to 0.2%. This activity requires a large horsepower



Progress of laser leveler custom services in Indo-Gangetic plains of India

An uneven land surface leads to poor crop production and low water productivity since undulations lead to water logging in low-lying areas and moisture deficit at higher elevated areas. Non uniform distribution of irrigation water significantly influences soil moisture, nutrient distribution and salts in the surface soil layers which directly impact the germination, establishment and productivity of crops. Uneven field surface leads not only to loss of significant amount of irrigation water, but also development of salinity patches in the elevated parts and excessive leaching of nutrients from the root zone in lower spots of undulated fields.



Precise leveling of land using laser guided land leveler

tractor and a soil mover equipped with global positioning systems (GPS) and/or laser-guided instruments to enable movement of soil either by cutting or filling to create the desired slope. On account of high equipment cost and lack of awareness the adoption rate was slow initially but large scale demonstration by research organizations and promotion of custom services resulted in fast adoption later on. Laser leveling can reduce water use by 20-30% and increase crop yields by 10-20%.

The quality of land leveling can be estimated through the standard deviation (SD) of surface elevations in a leveling field. Before starting the laser land leveling process, the field should be ploughed and a topographic survey be carried out.

Benefits of Laser Land Leveling

Laser-controlled leveling of land surface leads to the following benefits

- Easy land preparation
- Assist in top soil management
- Less water requirement for land preparation
- Saves fuel/electricity used in irrigation
- More uniform moisture environment for crops
- Good germination and growth of crop
- Less time and water required in irrigation
- Optimization of water use efficiency

Steps in Laser Land Leveling

The following points should be kept in view while preparing for laser guided land leveling.

- Ploughing should start from the center of the field to outwards. Preferably, plough the field when the soil is slightly moist to prevent large clods. Remove surface residues to aid soil flow from the bucket.
- A topographic survey should be conducted to record the high and low spots in the field.
- Calculate the mean height of the field for effective movement of soil from high to low land areas by using a field diagram.
- Some important facts which should be kept in mind while leveling the field are i) laser-controlled bucket should be positioned at the mean height of the field, ii) cutting blade should be set slightly above ground level (1-2 cm), iii) tractor should then be driven in a circular direction from the high areas to the lower areas in the field, iv) as soon as the bucket is almost full with soil, turn and drive towards the lower area and once it is empty, drive to the higher area, v) do a final leveling pass in long runs from the high end of the field to the lower end, vi) re-survey to make sure that the desired level of precision has been attained.

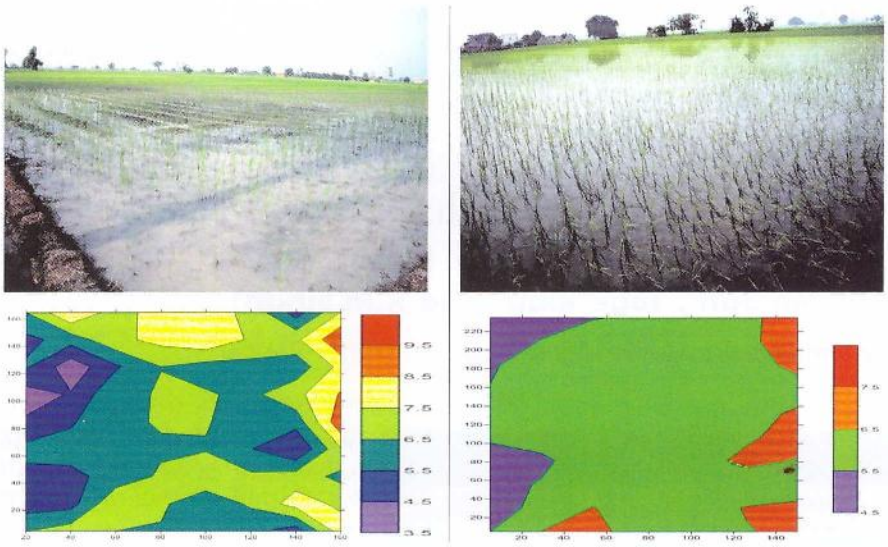
Farmer Participatory Appraisal of Laser Land Leveling

Laser-assisted precision land leveling saves irrigation water, nutrients and agro-chemicals. Though laser leveling offers a great potential for water saving, better environmental quality and higher grain yields, Indian farmers are unable to take full advantage of it due to lack of awareness and non availability of the equipments. Further, necessary data generated at farmer's field are scarce to support and convince the farmers about its impact on crop yield and water productivity. In order to evaluate and demonstrate the benefit of laser land leveling to farmers, field trials were conducted by the Central Soil Salinity Research Institute, Karnal in 6 farmer's fields of one acre area each in Sambhali village, dist. Karnal, under Farmers Participatory Action Research Project (FPARP), funded by the Ministry of Water Resources. Fields were leveled by laser guided land leveler before *kharif* season 2011. The effectiveness of laser levelling was compared with the conventionally leveled adjoining field of same size. The depth of water in the study plots were monitored in a 10 × 10 m gird size, one day after each irrigation. The results presented

Table 1. Impact analysis of laser level technology for rice and wheat production (Average of 6 farmers, Village Sambhali, Dist. Karnal)

Parameter	Rice			Wheat		
	LL	Conv.	% increase/ saving	LL	Conv.	% increase/ saving
Irrigation water applied (cm)	66.4	82.9	20	30.1	38.4	22
Yield (Q ha-1)	38.2	34.6	10.4	63.5	57.9	9.8
Irrigation water productivity (Kg m-3)	0.6	0.4	37	2.1	1.5	40
Water productivity (₹ m-3)	11.0	8.0	37	27.3	19.5	40
Energy consumed (kwhr)	175.2	221.3	21	77.4	100.6	23

*Rate of rice = ₹ 1900/q, *Rate of wheat= ₹ 1285/q,



Water distribution in conventionally leveled field (left) Water distribution in laser leveled field (right)

graphically indicate significant uniform water levels in laser leveled plots as compared to conventionally leveled fields. For the quality of land leveling estimated through the standard deviation (SD) of depth of irrigation water in the field, it was found that SD ranges between 1.2-1.5 in conventionally leveled fields, whereas in laser leveled fields SD varied from 0.5-0.8. The average water productivity in 6 closely monitored conventional and laser-leveled fields was estimated at 1.5 kg/m3 and 2.1 kg/m3 respectively in wheat and 0.4 and 0.6 kg/m3 respectively in rice (Table 1). Laser levelling increased yields of rice and wheat by 10.4 and 9.8 % and reduced mean irrigation water requirement by 20 and 22 % respectively, resulting in an additional income of ₹ 14,116/ha (₹ 6,824/ha in rice and ₹ 7,292/ha in wheat). The corresponding increase in water productivity (Kg/m3 of applied water) were estimated as 34.6% and 37.6% for rice and wheat or ₹ 4.7/m3 for rice and ₹ 5.9/m3 of applied water in wheat. This also resulted in a reduction of 20.9 and 23.1% in electric consumption for irrigating in rice and wheat in laser leveled fields as compared to conventionally levelled fields. Therefore, evaluation of the technology at farmers field clearly indicates that laser land leveling not only saved water and energy but also enhanced crop yield, water productivity and farmers income.

SUMMARY

Laser-assisted precision land leveling saves irrigation water, nutrients and energy requirements. It also enhances environmental quality and crop yields resulting in increase in farm income. If adopted on a large scale, the laser leveling would help in reducing ground water withdrawal.

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