Sustainable Ground Water Management by adopting Laser land levelling (LLL) Technology under ABY, Haryana:

Prelude:

In Sirsa nearly half of this land area is devoted to agriculture which provides livelihood and food security. There is a growing realization that agriculture of the post-Green Revolution and declaration of dark zone will be guided by the need to produce more of quality food at reduced cost from the marginal quality lands and water resources. In the face of increasing resource constraints (water, land, and labour), new resource conserving technologies must be developed and adopted in both irrigated, and rain fed ecosystems to meet the food and Groundwater needs of a growing population. Particular attention must be given to practices that increase water productivity and protect the environment. Rice and wheat are the two principal food crops in the Sirsa region that contribute more than 80%, in the food pool of the region. These crops are grown in sequence mostly in dark zone. The total water requirement for rice-wheat system is estimated to vary between 1382 mm to 1838 mm in the block area, accounting to more than 80% for the rice growing season. Thus, to save on water, saving must be affected during rice growing season. Future agriculture security in this region is severely threatened by unsustainable groundwater use and inappropriate water management practices. For the rice-wheat systems of the Rania & Ellenabad area (Dark zone), Atal Bhujal Yojana in collaboration with its line departments (Agriculture & Soil conservation department) has been developing several water-saving technologies for water-short irrigated environments which besides the development of irrigation schedules and frequency, crop choices and their appropriate cultivars also included the precursor technology known as precision land levelling (LLL). In irrigated and rainfed environments, precision land levelling improves uniform application of water, betters the crop stands and helps reduce abiotic stress intensities, enhancing survival of young seedlings and robustness of the crop to withstand stress and stabilize yields through improved nutrient-water interactions. Sirsa (Rania & Ellenabad) has good channel source in the development of irrigation water resources from a mere 72,197 hectares during 2022- 2023.

However, there is a wide gap (-265.45 mcm) between the Availability (7521 MCM) and existing Demand (1018.66 MCM) irrigation potential in the Rania & Ellenabad Block. This gap is mainly due to inefficient water management. It is estimated that only by bridging the gap. Most of the area in this region is irrigated by surface application methods such as flood irrigation, check basin, border strip and furrow irrigation. The application efficiency of these methods has been found to be only 30 to 50 percent as compared to attainable level of 60 to 80 percent. This is due to the mis-match in water

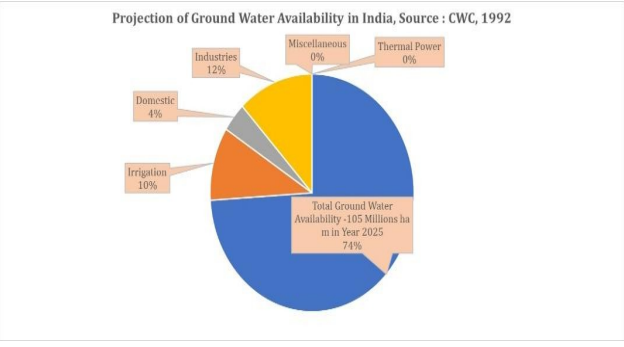
application methods with the stream size, soil type, field size, and slope etc. In surface irrigation, land levelling is essential for high application efficiency that ensures high water-use efficiency and crop yield.

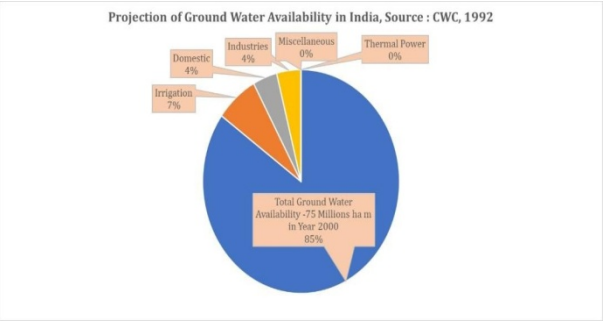
Issues & Challenge

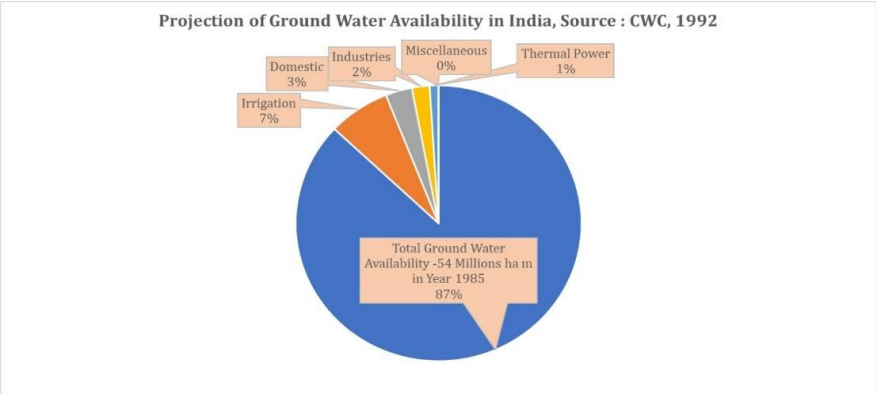
Declining irrigation water availability and crop productivity and increasing water demand necessitate quick adoption of modern scientific technologies for efficient groundwater management. Farmers have been practicing irrigated and intensive agriculture on alluvial soil, for many years. Use efficiency of water at the field level has been poor due to water loss in conveyance. Traditionally farmers level their fields using animal drawn or tractor-drawn levellers.
DSR water logged with traditional leveling practice

These levelers are implements consisting of a blade acting as a small bucket for shifting the soil from higher to the low-lying positions. It is seen that even the best leveled fields using traditional land leveling practices are not precisely leveled and this leads to uneven distribution of irrigation water.

The common practices of irrigation in intensively cultivated irrigated areas are flood basin Source. Non-unform water logging in a Rice- wheat field and check basin irrigation systems. These practices on traditionally levelled or unlevelled lands lead to waterlogging conditions in low-lying areas and soil water deficit at higher spots. A Significant amounts (10-25%) of irrigation water is lost during application at the farm due to poor management and uneven fields. Conservation agriculture practices coupled with precision land levelling facilitate uniform water application and reduce deep percolation losses of water.







Solution by adopting Laser land levelling (LLL):

To solve the problems of irrigated agriculture due to the effects of climate change and low groundwater availability, it is necessary to carry out measures and introduce technologies to save water resources by reducing the irrational use of available water resources.Keeping in view the importance of the laser land levelling technology, declining water tables and deficit rainfall over the years Based on the experience of previous study of projects, the ongoing Atal Bhujal Yojana starts project and conducted a situation analysis and found solution that the LLL (Laser land levelling) is one of the key innovations, which is designed to prepare the basis for the further transition to water and soil-saving technology. The main goal of the land levelling in agriculture is to eliminate irregularities in the surface of the field, which impede the implementation of high-quality irrigation and reduce the loss of Groundwater or increasing the efficiency of water resources use.

Modern intensive agriculture relies on the timely planting for enhanced crop yields and profits, Lasercontrolled precision land levelling increases crop yields (wheat 15%, rice 61%, cotton 66%), decreases weed issues, increases weed control effectiveness while reducing water use by 20–30%.

Laser Land leveling on Direct Seeded Rice in Rice-Wheat cropping system:

A Small field survey was conducted in 78 (ABY)Village district Sirsa during Kharif 2023-24 for evaluation of Laser Land leveling on Direct Seeded Rice (DSR) in Rice-Wheat cropping system particularly to estimate the effects on ground water saving and water productivity. The results indicated that with laser leveling, farmers could save irrigation water by 15% and obtained 21.54% higher yields in DSR. The irrigation duration and total applied water depth was reduced to 9.52% and 14.10% in laser leveled DSR crop as compared to traditional leveled fields. The average water productivity in rice has improved by 30.43%. The average net return from the laser leveled field was 46.54% higher in DSR than that from the traditional leveled field mainly due to declined in costs of irrigation (21.35%) and weeding (10%).

Map of study area

DSR field with laser land leveling method

DSR is becoming popular because of its potential to save water and labour (Kumari et al., 2019) Currently, DSR covers 50% paddy area in Ellenabad block and 70% of the total rice area in Rania block, respectively (As per previous Convergence data of Block)

Effective land leveling aims to maximize water use efficiency, promote crop establishment, and reduce irrigation time and crop management effort (Rickman, 2002). Laser leveling can level fields to ±2 cm, improving water application, distribution efficiency, production, fertilizer efficiency, and weed control (Jat et al. 2004). However, just a few studies have been undertaken to assess the effectiveness of laser land leveling. This strategy was expected to save 25-30% of irrigation water without affecting crop output (Bhatt and Sharma, 2009).

Benefits of laser land levelling Tecnique:

Small-sized and uneven fields can cause poor management and low efficiency of agronomic inputs. It can also hamper mechanization and cause lodging of rice plant and non-uniform paddy at maturity stage leading to high postharvest losses.

- Precise level and smoother soil surface.
- Reduction in time and water required to irrigate the field.
- Uniform distribution of water in the field.
- Uniform moisture environment for crops.
- Good germination and growth of crops.
- Less seed rate, fertilizer, chemicals and fuel requirements.
- With sprinklers, a perfectly level field conserves water by reducing runoff and allowing uniform distribution of water.

A significant reduction in total water use in wheat as well as rice was recorded due to precision land levelling compared to traditional land levelling. The total water uses in wheat and rice in laser leveled field was reduced to 49.5% and 31.7%, respectively (Jat et al. 2003).

Conclusions and recommendations

Laser levelling of agricultural land is a recent resource-conservation technology initiative in India. The results are quite encouraging in ABY Area. It has the potential to change the way groundwater conservation enhancing resource-use efficiency of critical inputs without any disturbing and harmful effects on the productive resilience of the ecosystem of dark zone.

This technology is widespread adoption among the farmers is being facilitated through participatory engagement via the IEC framework on large scale and it is evidently one of the ways by which we can address Ground water management issues to a great extent. The farmers who adopted LLL DSR received 46.54% more net return mainly due to declined in costs of Laser levelling is irrigation (21.35%) and weeding (10%). The BCR of 2.35 was computed for LLL DSR in comparison to conventional DSR crop. Hence, this technology has a great potential for optimizing the wateruse efficiency in DSR paddy cultivation without any disturbance and adverse effect on the productivity of paddy crop. In spite of several direct and indirect benefits derived from laser land levelling technology, it is yet to become a popular farming practice in the Atal Bhujal Yojana adopted block.