# Climate-Smart Implementation

## Promoting climate-smart water technologies and innovations for sustainable water resources and rice production under climate change in the Lancang-Mekong Region

**SEI Field Report April 2024**

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# Implementation of Climate-Smart Water Technologies in Nakhon Ratchasima

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# Implementation of Climate-Smart Water Technologies in Nakhon Ratchasima

Nakhon Ratchasima emerges as a pivotal hub for climate-smart technologies, driven by alarming projections from the Intergovernmental Panel on Climate Change (IPCC) that designate the region as highly vulnerable to drought. Two pilot sites in Nakhon Ratchasima province were selected to recognize the vulnerability following a survey, discussions on the needs of farmer groups, and an assessment of current climate risks and irrigation challenges. This selection of the pilot sites involved discussions among experts from the Office of National Water Resources (ONWR), Rajamangala University of Technology Isan (RMUTI), and the Stockholm Environment Institute (SEI), also leading to the identification of climate-smart technologies that are well-suited to address the specific requirements of the region's farmers.

The project vision is to build climate-resilient water resources and rice farming systems in the Mekong-Lancang Region.

In a significant step towards implementing climate-smart technologies, the Stockholm Environment Institute (SEI) organized a field visit and training workshop from April 26$^{th}$ to 28$^{th}$, 2024. The primary objective of this visit was to introduce laser-controlled land leveling to the farmers, provide training on its use, and facilitate communication with the laser-controlled land leveling company. The pilot sites were chosen to evaluate the effectiveness of implementing climate-smart technologies (a) Phimai District and (b) Sung Noen District. Sung Noen District has access to irrigation, while the Phimai District relies entirely on precipitation for its water supply. This approach allows for a comprehensive assessment of the technologies under varying water availability conditions.

Implementing climate-smart technologies involves two steps: (a) before sowing the crop and (b) after the crop is sown. The climate-smart technique selected for sites was laser-controlled land leveling to improve the soil condition and optimize irrigation.

**Laser-controlled Land Leveling**: Laser-controlled land leveling is an advanced method in precision agriculture, utilizing laser-equipped machinery to measure and establish either a wholly flat or a uniformly inclined surface, optimizing irrigation and agricultural efficiency. A laser transmitter is positioned on a tripod in the field, projecting a steady, horizontal laser beam

received by the receiver mounted on a leveling implement attached to a tractor to enable it to alter its height, either removing or adding soil, to achieve the pre-set level of the field. It promotes more efficient water usage, promoting uniform water spread and minimizing water runoff. This process contributes to enhanced crop production due to uniform crop germination and growth. It also decreases soil erosion, conserves fuel and time by reducing the need for water pumping and improves the effectiveness of fertilizer and pesticide application due to the even terrain. A limitation is the initial investment in equipment can be substantial, and the operation of this laser technology demands specific technical expertise. For smaller farms without financial aid or subsidies, the cost-effectiveness of this technology might be questionable.

During the visit, the expert from Chokchai Agricultural Machinery Co., Ltd. gave an introductory session to the farmers, explaining the machinery used for land leveling. They provided a comprehensive overview of how the laser guide system operates, ensuring the farmers understood the technology's principles and benefits.

*Photo 1: Demonstration of the laser and leveling instrument and training of the farmers on the instrument*

The Chokchai Agricultural Machinery Co., Ltd. used a Celec laser land leveler for demonstration. This advanced machine uses a laser-guided system to achieve precise leveling of agricultural fields. The laser transmitter emits a beam, establishing a reference plane over the field. The receiver, mounted on the leveling equipment, detects this beam and adjusts the blade height automatically to ensure an even field surface. This method enhances water distribution, reduces water usage, and improves crop yields by creating an optimal growing environment. The demonstration included practical, hands-on training, where farmers could see the

machinery in action and ask questions directly to the experts. This interactive session aimed to build the farmers' confidence and competence in effectively using the laser land leveler.

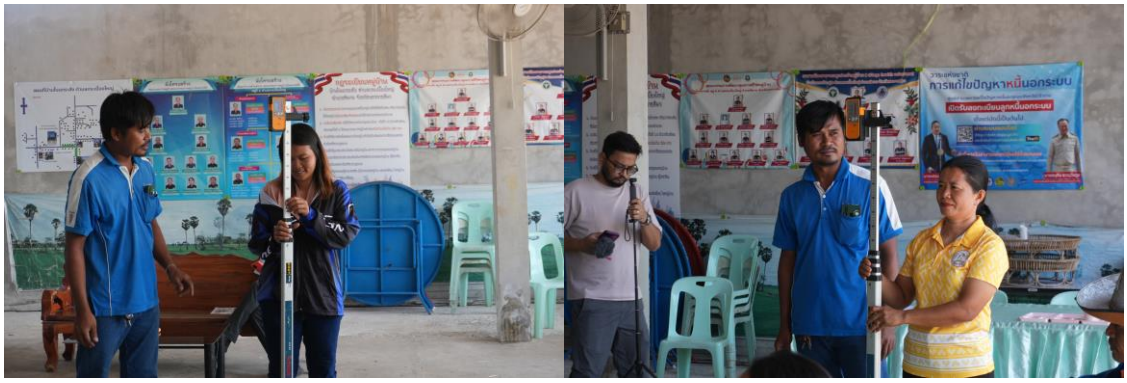

*Photo 2: Participants having first-hand experience in measuring the height of the plot using a laser-guided scale*

**Laser-Controlled Land Leveling Process:** Before starting the land leveling process, an initial survey is conducted to assess the field's topography. This step involves setting up the laser transmitter at a central location to cover the entire field. The transmitter emits a laser beam as a reference plane for the leveling process.

**Setting Up the Laser Receiver:** The laser receiver is mounted on the leveling equipment. It is calibrated to detect the laser beam emitted by the transmitter. The height of the receiver is adjusted according to the desired field level. Once the receiver is in place, it continuously communicates with the leveling machinery to maintain the correct blade height.

**Taking Measurements:** Measurements are taken across various points in the field to determine the current elevation relative to the laser reference plane. The following steps outline the measurement process:

- **Grid Pattern Measurement:** The field is divided into a grid pattern. Measurements are taken at each grid intersection to map out the elevation profile of the field accurately. This grid approach ensures comprehensive coverage and accurate data collection.
- **Elevation Data Collection:** At each grid point, the laser receiver detects the laser beam and records the height difference between the current field level and the desired level. These measurements are used to create a detailed topographical map of the field.

- **Recording Variations:** Any variations in elevation are noted, highlighting areas that require more soil removal or addition. This information is critical for guiding the leveling process.

*Photo 3: Site at Phimai District, Nakhon Ratchasima (a) Farmer using laser guide to measure in the field, and (b) laser land leveling*

| | | | | |
|---|---|---|---|---|
| -9 | -5 | -2 | 0 | 0 |
| -7 | -2 | 0 | 2 | 2 |
| -1 | 0 | 1 | 4 | 4 |
| 0 | 0 | -1 | 5 | 3 |
| 2 | -2 | 5 | -1 | 2 |
| 2 | 5 | -2 | -3 | -5 |
| -8 | 1 | 4 | 4 | -2 |
| -1 | -3 | -5 | -5 | 0 |

| | |
|---|---|
| 0 | 0 |
| 1 | -2 |
| 1 | 1 |
| 0 | -2 |
| 1 | 0 |

*Figure 1: Field measurement of plot one at Phimai District (a) Variation in the field before land leveling, and (b) variation in the field after land leveling*

| | | | | |
|---|---|---|---|---|
| -16 | -9 | -4 | 1 | -7 |
| -5 | -4 | -8 | 3 | -7 |
| -8 | -4 | 5 | 1 | -7 |
| -5 | -4 | -9 | 1 | -6 |
| 4 | 6 | -5 | 3 | 0 |
| 1 | 1 | 4 | 1 | 3 |
| 3 | 1 | 3 | 1 | 4 |
| 5 | 6 | 6 | 3 | 4 |

| | |
|---|---|
| 0 | 1 |
| 0 | 1 |
| 0 | 0 |
| 1 | 0 |
| 0 | 0 |

*Figure 2: Field measurement of plot two at Phimai District (a) Variation in the field before land leveling, and (b) variation in the field after land leveling*

**Adjusting the Field:** Based on the collected measurements, the leveling equipment is adjusted to ensure the blade operates at the correct height. The laser receiver continuously monitors

the blade's position relative to the laser beam and makes real-time adjustments to maintain the desired level.

**Continuous Monitoring**: Throughout the leveling process, continuous monitoring ensures that the field is leveled accurately. The laser receiver provides constant feedback, allowing the operator to make necessary adjustments promptly.

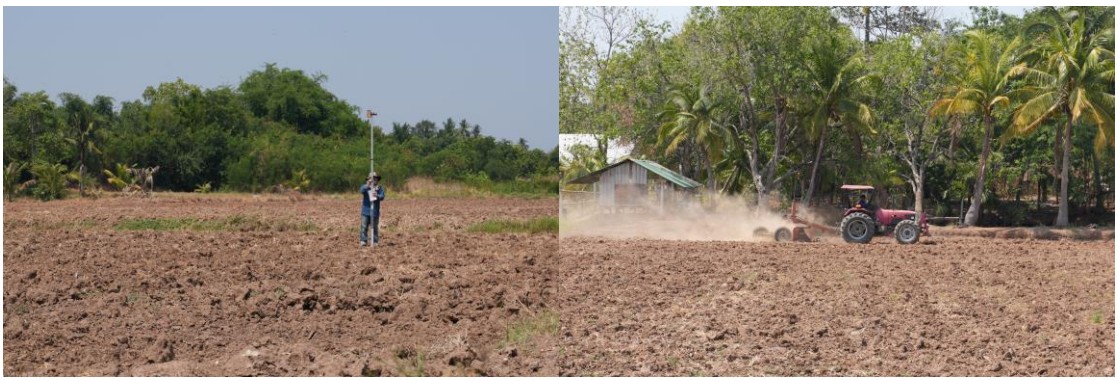

*Photo 4: Site at Sung Noen District, Nakhon Ratchasima (a) Farmer using laser guide to measure in the field, and (b) laser land leveling in action*

| | | | | |
|---|---|---|---|---|
| 2 | 1 | 2 | 2 | 2 |
| -3 | -2 | 1 | 2 | -2 |
| -3 | 3 | 0 | -3 | 2 |
| -1 | -2 | 0 | -1 | 3 |

| | |
|---|---|
| -1 | 1 |
| -1 | 1 |
| 0 | 1 |
| 0 | 1 |
| 1 | 0 |

*Figure 3: Field measurement of plot one at Sung Noen District, Nakhon Ratchasima (a) Variation in the field before land leveling, and (b) variation in the field after land leveling*

| | | | | |
|---|---|---|---|---|
| 8 | 1 | -2 | -1 | -2 |
| 1 | 0 | -2 | -3 | -3 |
| 2 | 0 | -5 | -2 | -3 |
| 1 | 1 | 2 | -1 | 1 |

| | |
|---|---|
| 0 | 0 |
| 0 | -1 |
| 1 | 0 |
| 1 | 1 |
| -1 | 0 |

*Figure 4: Field measurement of plot two at Sung Noen District, Nakhon Ratchasima (a) Variation in the field before land leveling, and (b) variation in the field after land leveling*

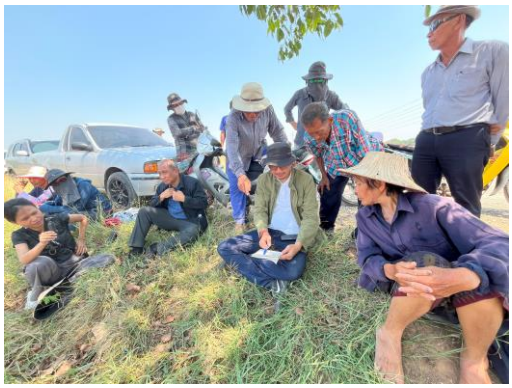

*Photo 5: SEI staff explaining how the field measurements are used to calculate the average for the laser guide*

**Final Verification**: After completing the leveling process, a final survey is conducted to verify the field's level. Additional measurements ensure that the entire field meets the desired specifications. Any discrepancies are addressed, providing the field is perfectly leveled for optimal water distribution and crop growth.

The Laser Land Leveler ensures precision and efficiency by following this detailed measurement and leveling process, ultimately leading to improved agricultural outcomes.

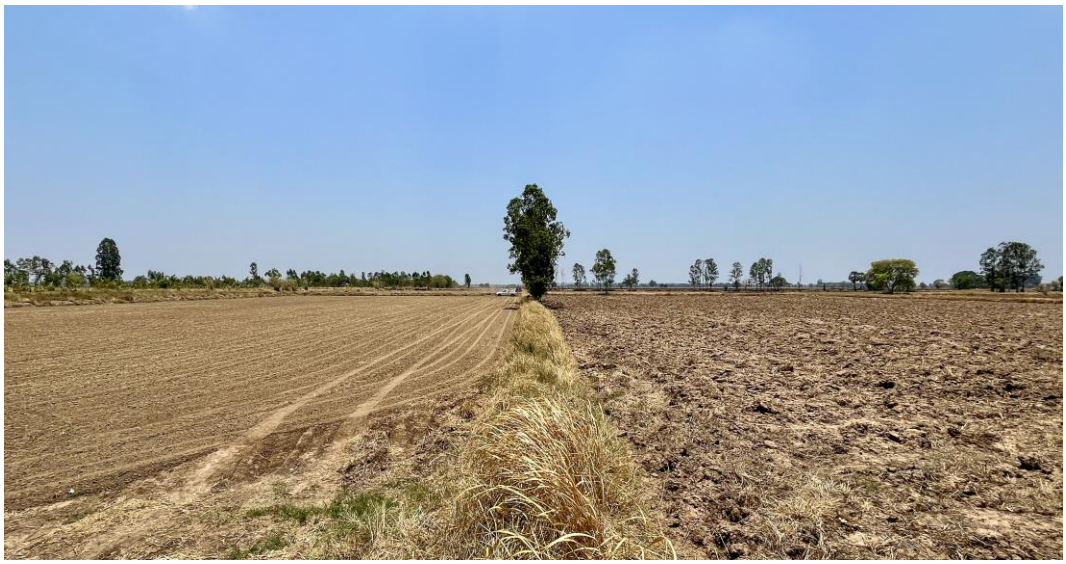

*Photo 6: Photo illustrating the difference in the field with and without land leveling*

# Conclusion

By introducing laser-controlled land leveling to local farmers, the Stockholm Environment Institute (SEI), in collaboration with the Office of National Water Resources (ONWR), effectively demonstrated the potential benefits of advanced agricultural practices.

Farmers received comprehensive training on using the Laser Land Leveller throughout the visit. They learned about its operation, including setting up the laser transmitter and receiver, taking precise measurements across the field, and making real-time adjustments to ensure an even surface. The hands-on training sessions and practical demonstrations enabled the farmers to grasp the technology's principles and applications, enhancing their confidence and competence in using the equipment.

The selection of two pilot sites—one with irrigation access and the other relying on precipitation—allowed for a thorough assessment of the laser-controlled land leveling technology under different water availability conditions. This approach provided valuable insights into the technology's effectiveness in optimizing water use, improving crop yields, and promoting sustainable agricultural practices.

Continuous monitoring and evaluation of the pilot sites will be crucial to refining the implementation process and addressing any challenges. Additionally, expanding training programs and providing financial support or subsidies to smaller farms can help ensure broader adoption of these technologies, ultimately contributing to sustainable water management and agricultural productivity in the Lancang-Mekong Region.

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The SEI would like to sincerely thank Chokchai Agricultural Machinery Co. Ltd. for their invaluable support and expertise during the field visit. Their contribution was instrumental in the successful demonstration and training sessions, and their partnership is greatly appreciated.

Overall, the field visit and training workshop were pivotal in advancing climate-smart agricultural practices in Nakhon Ratchasima. The collaborative efforts of SEI, ONWR, RMUTI, and Chokchai Agricultural Machinery Co. Ltd. have laid a strong foundation for future initiatives to enhance the resilience of water resources and rice farming systems under changing climate conditions.


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