Groundwater irrigation and on-farm residues as means to improve cash crop production.

Results and progress at the Faculty of Water Resources Demonstration Site,
Tad Thong Campus, Lao P.D.R.

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Prepared

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1. Introduction

- Agriculture is an important component of the economic and livelihoods in Lao PDR.
- Historically, agriculture of Laos was depend on rainfed use leading to insufficient water use and low yield production.
- Groundwater resource is a potential option to sustain water use in agricultural areas where are absent of surface water.
- Groundwater use for irrigation is still virtually non-existent in Lao PDR.

1. Introduction

- Expansion of small-scale groundwater irrigation offers an attractive option to smallholder farmers to enhance dry-season production and ensure poverty reduction.
- Soil fertility is already known as a major constraints in Lowland rainfed agricultural systems in Lao P.D.R.[1]
- In this context of subsistence agricultural system, applying on-farm residues can be a sustainable approach to improve soil properties and fertility.[3,4,5]

2. Objectives

- To assess the potential of biochar and compost to improve soil water availability.
- To assess whether or not rice husk biochar inoculated with cow manure, cow manure, and compost in soil increase soil nutrient status and improve crop yields relative to the traditional farming practice.
- To assess efficiency crop water use

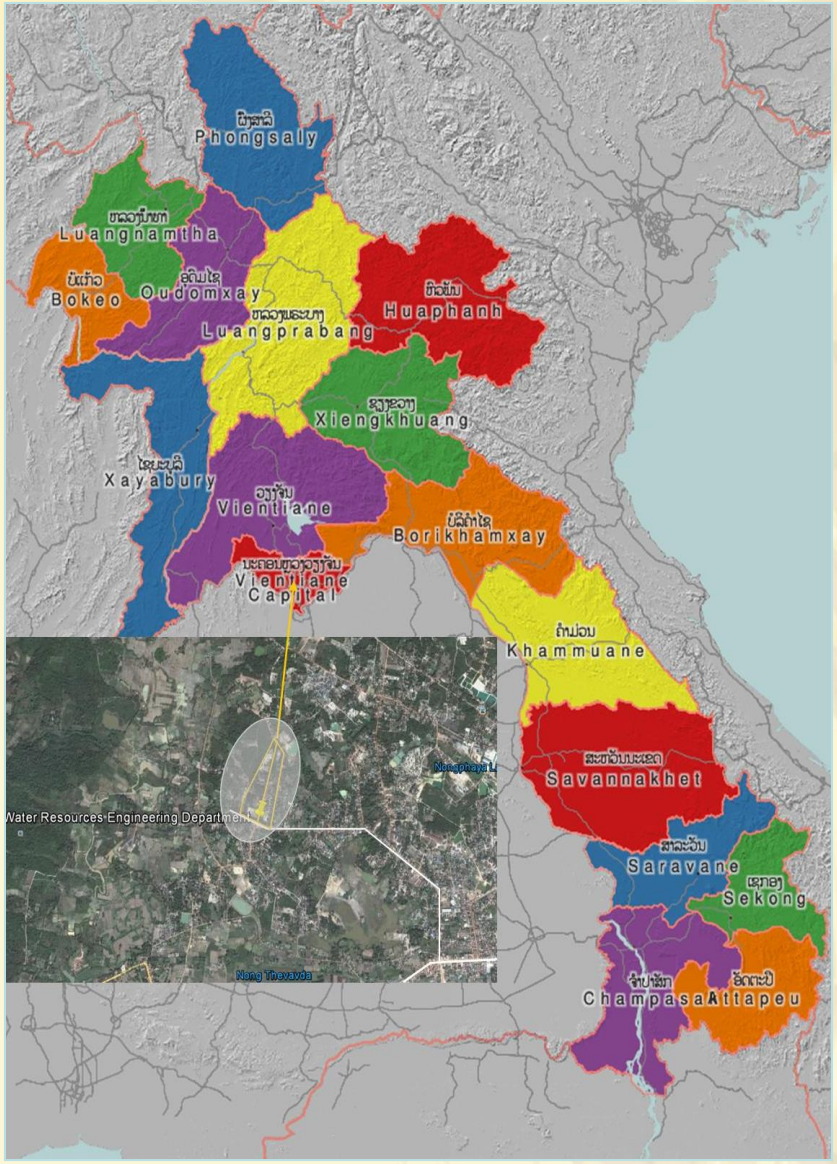
3. Methodology

3.1 Study site

Faculty of Water Resources

National University of Laos

Pilot trial Areas, (40x40) m



3. Methodology

1. Biochar Preparation

Filled and burned rice husk into open pitch

Covered with steel sheet on top of pitch

And keep until rice husk burned for 48 hrs and took and washed with clean water to remove ash and soil

Coconut cover

2. Compost preparation

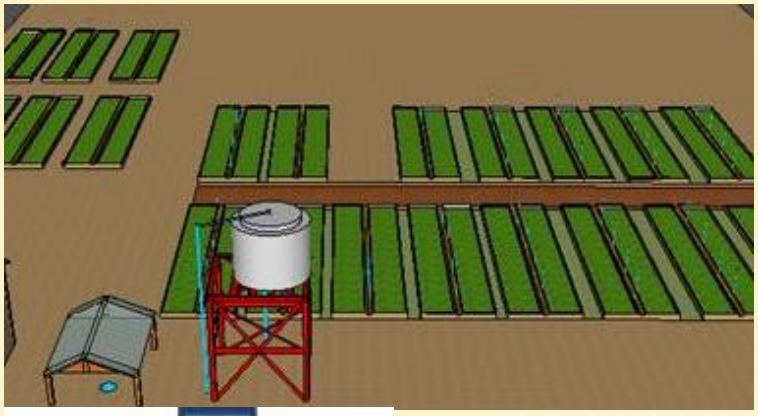
Compost Ratio 1:2:3 by weight of raw material

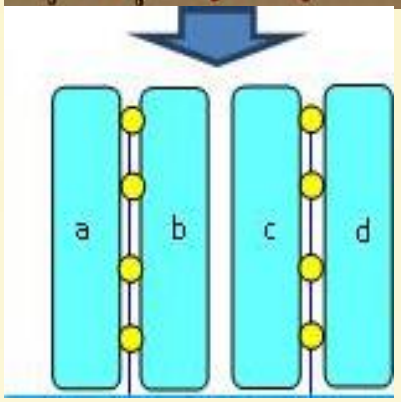
1. Cow manure
2. Biochar
3. Vegetable waste

Processes

3. Methodology

3. Site demonstration





4. Treatment

a. Natural soil
b. Biochar
c. Cow manure
d. Cow manure+Biochar
e. Composting

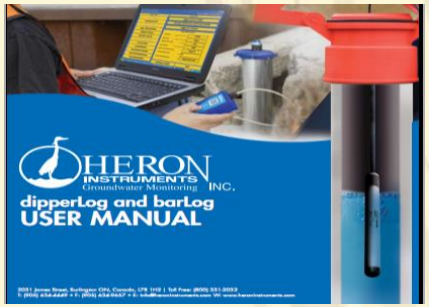
Irrigation treatment

1. **Furrow**
2. **Sprinkler**
3. **Drip**
4. **Spray**

5. Environmental Monitoring

1. Weather Station

2. Evaporation pan



3. Groundwater monitoring

3. Methodology

Crop and soil monitoring

1. Soil moisture content
2. Crop Growth
3. Soil density
4. Water use
5. Crop yield

4. Results and discusion

4.1 Environmental factors

4.1.2 Evaporation and Temperature

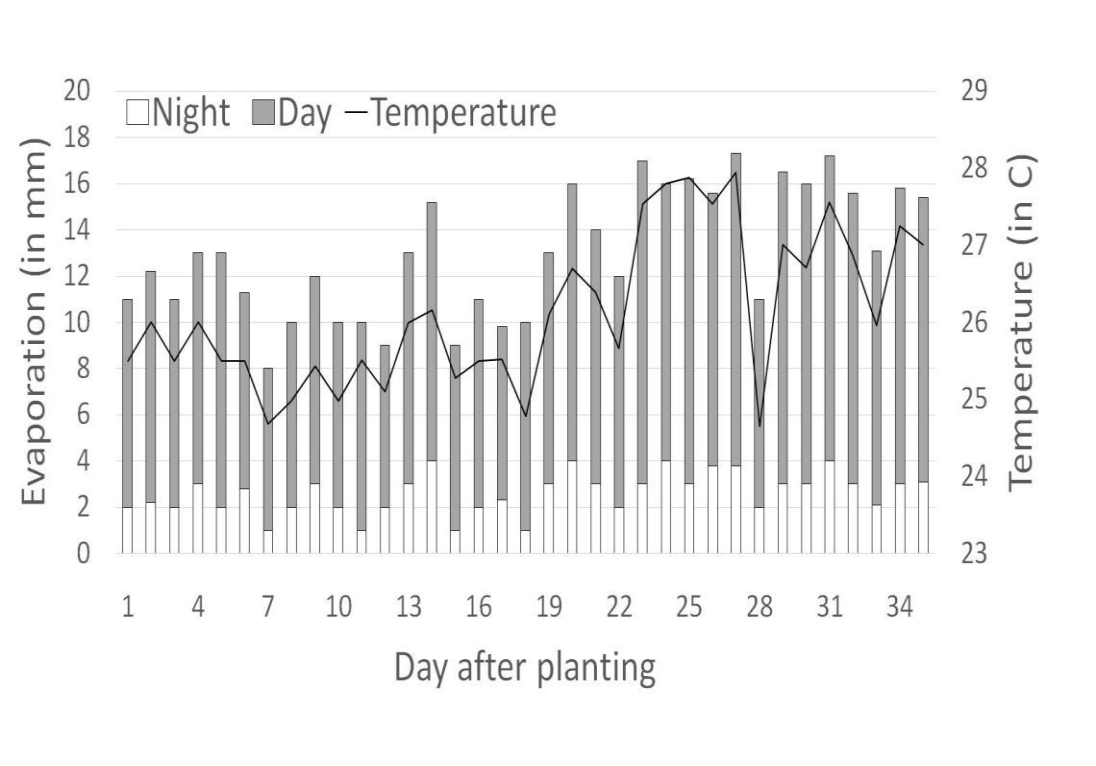


Fig. 1 Evaporation and temperature

- Experiment was conducted on dry season. This indicated that evaporation was high during the day (Fig 1).

- High evaporation occurred leading to loss to water content in surface soil.

- Fig 1 showed the temperature during the experiment and indicated that temperature was increased significantly leading to loss moisture content Yang et al., 2015.

4. Results and discusion

4.2 Treatment

4.2.1 Moisture content

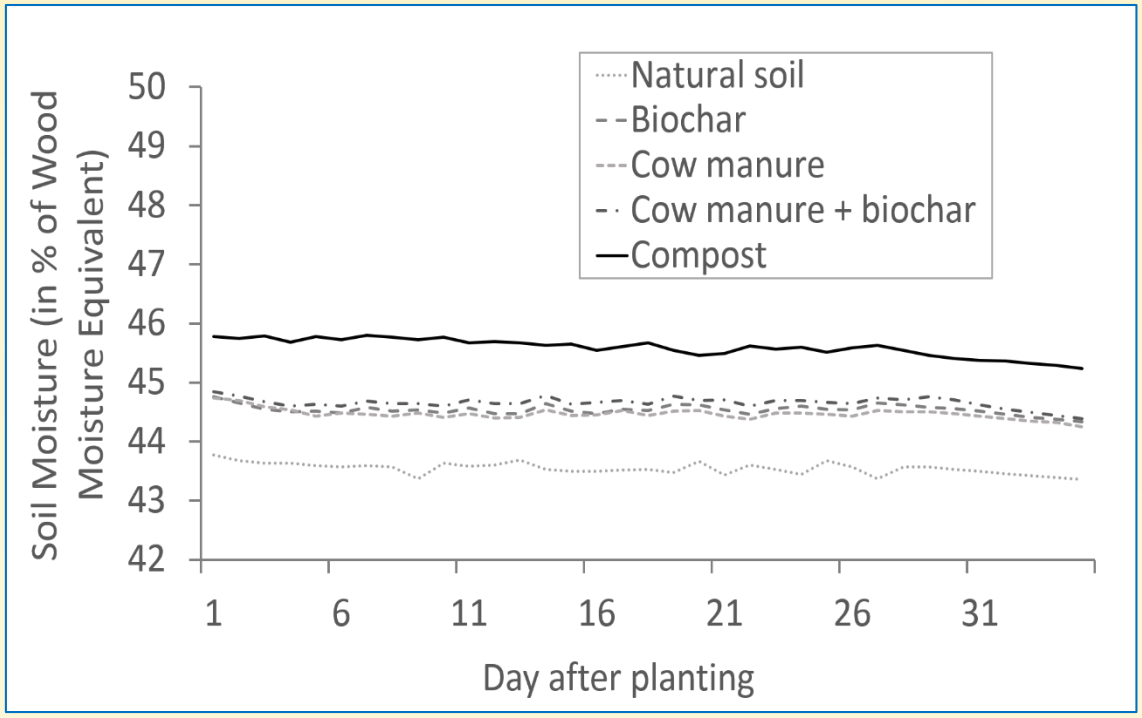


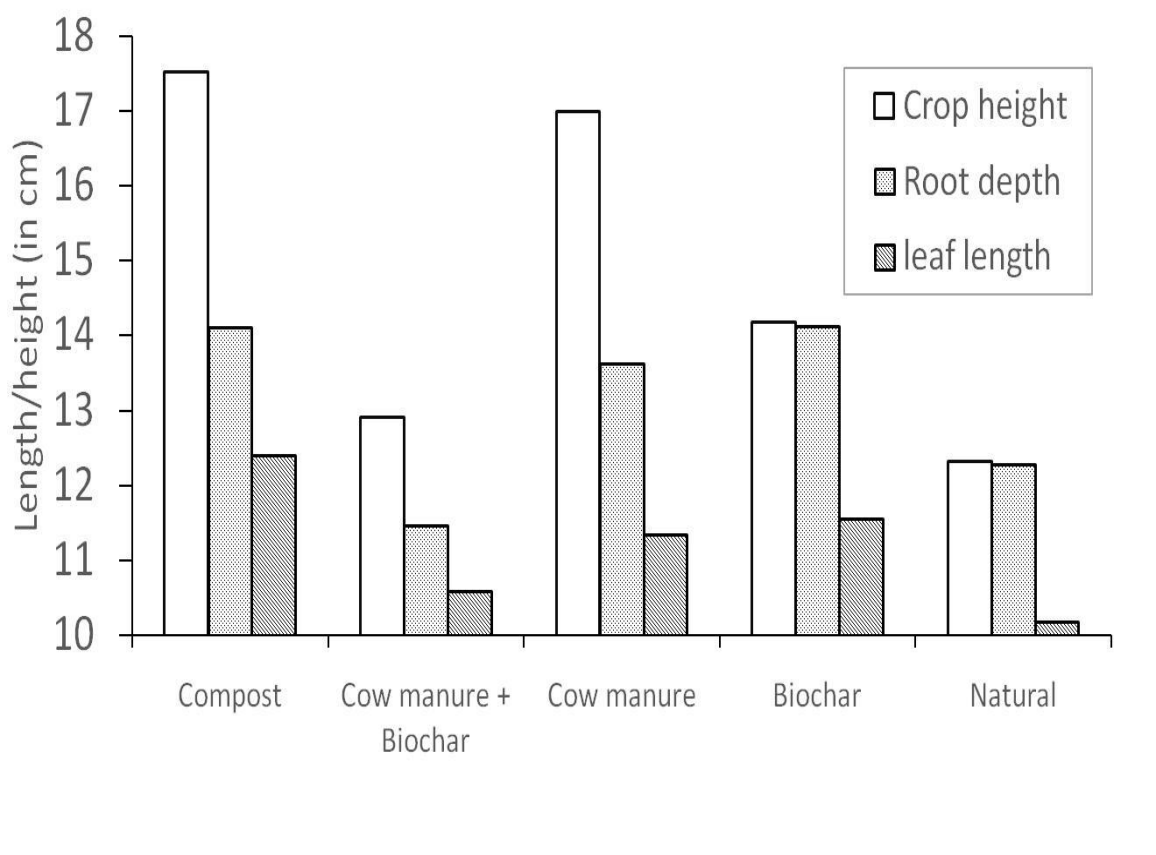
Fig. 2 Moisture Content after treatment

- On-farm residues fertilizers significantly improved soil moisture content with better results under compost treatments. *(Figure 2)*

- Improving soil moisture content is a key parameter for building more resilience agricultural system to climate change.

4. Results and discusion

4.2.2 Crop growth

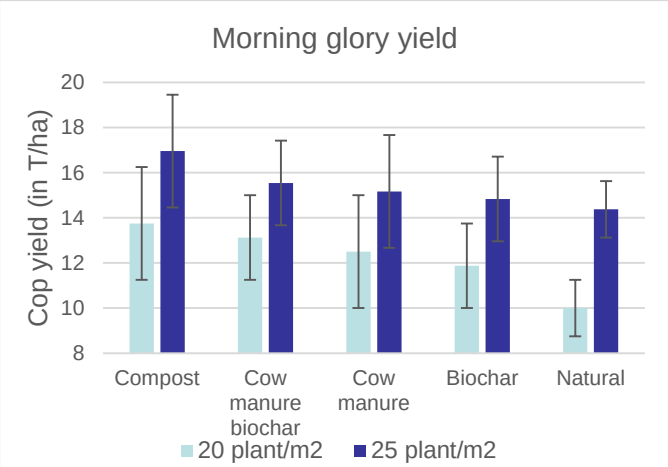


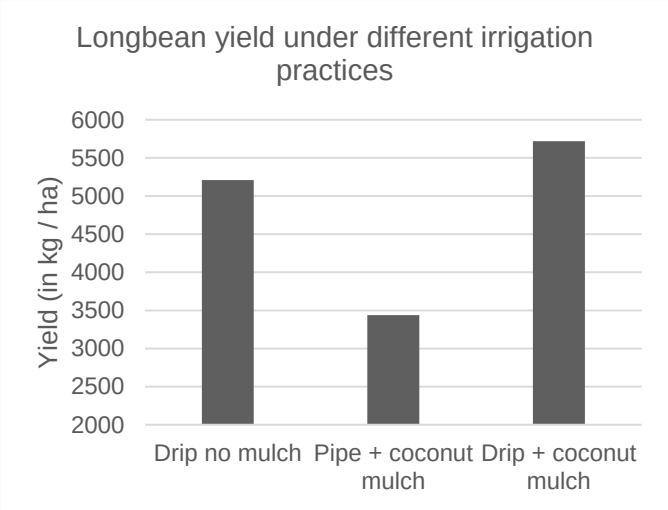
Compost and cow manure treatments increased crop height and rooting depth of respectively 3 and 2 cm (Fig 3)

Fig. 3 Crop growth

4. Results and disscusion

4.2.3 Crop production





Morning glory yields grown with compost, cow manure and cow manure combined with rice-husk biochar were increased significantly.

Highest yield increased were obtain with compost application (20%). *(Figure 4)*

Drip irrigation with the different irrigated methods showed the high yield with drip+coconut mulch

Fig. 4 Crop yield

4. Results and discusion

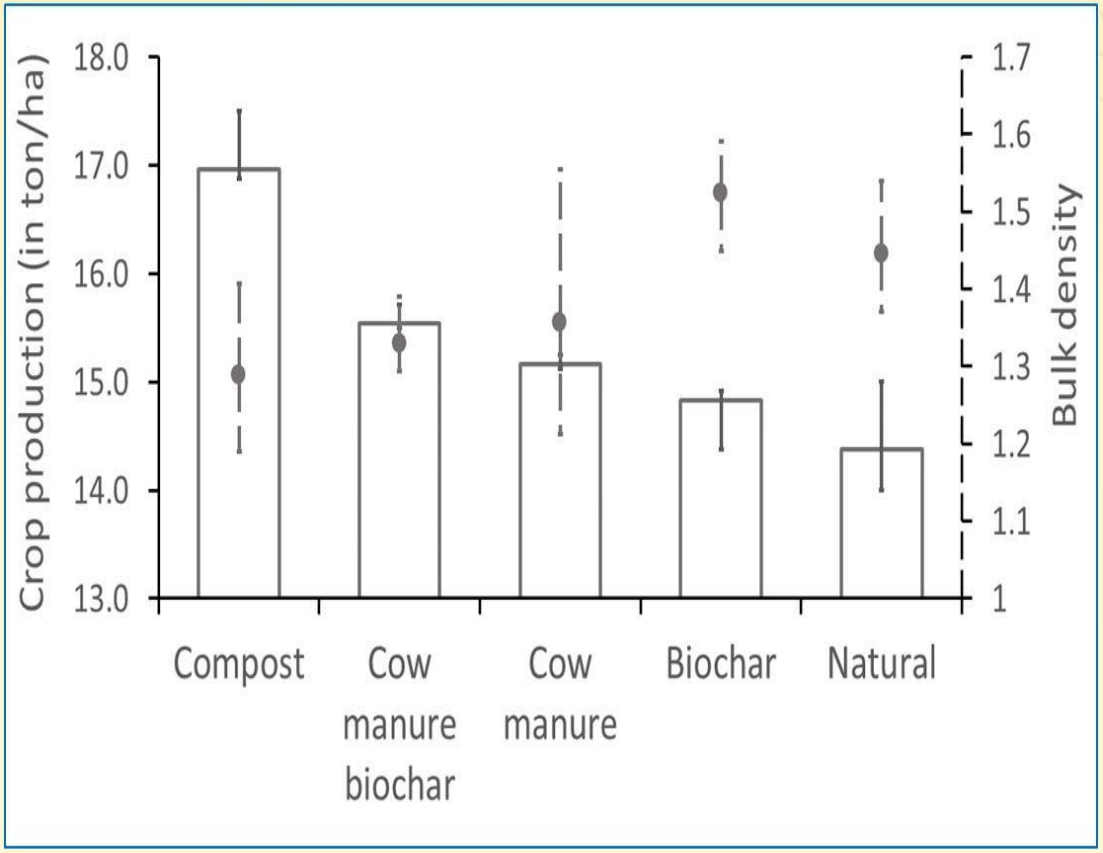


Fig 5. crop yield versus soil density

- Interestingly the increase in crop productivity seems correlated to soil density decrease

- Sustainable fertilization practices lead to more productive agricultural system.

4. Results and discusion

Crop water use for long bean

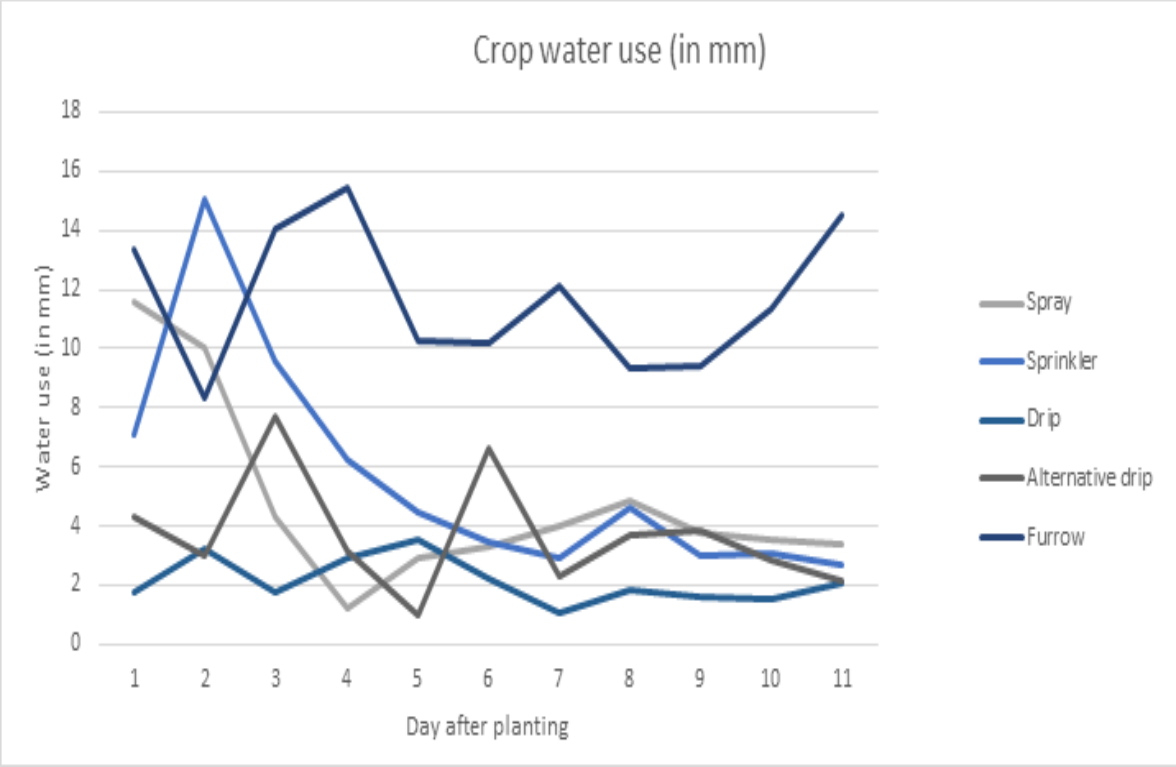


Fig 6. crop water use with different irrigated method

4. Results and discusion

- Groundwater monitoring

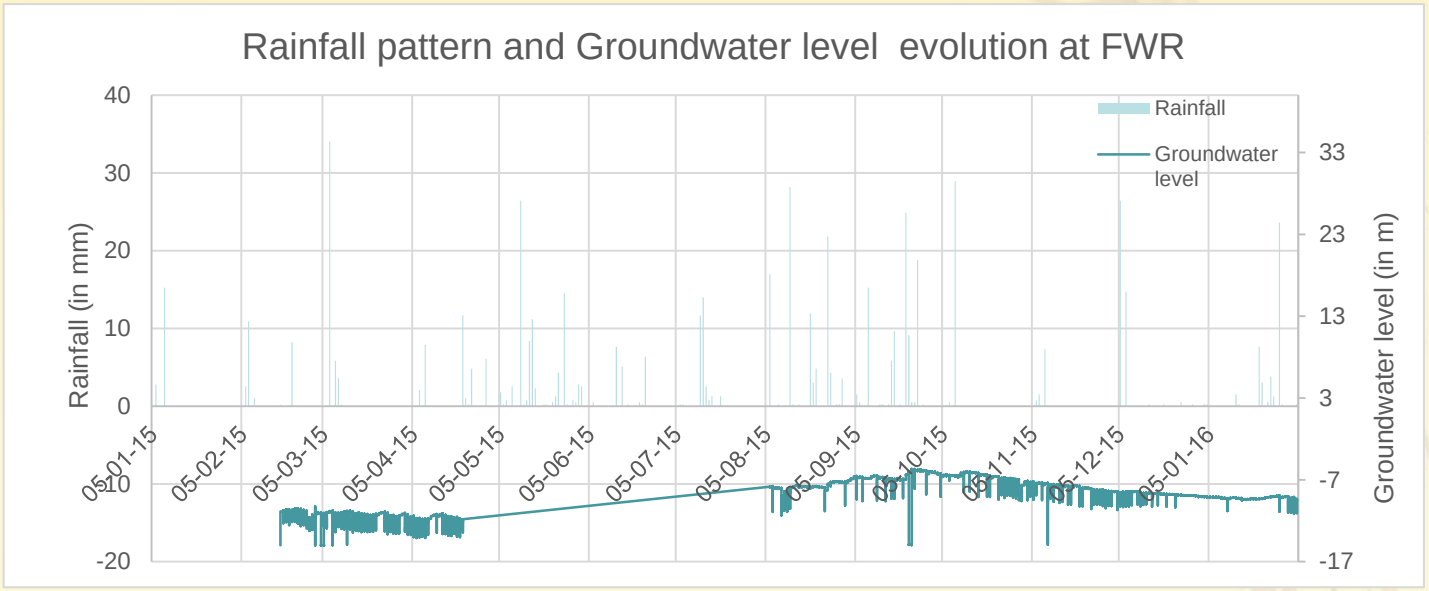


Fig. 6 groundwater record

Even though using groundwater for cash crop production does not affect the resource if the intake suit the groundwater capacity.

5. Capacity building

- Staffs member attended groundwater modeling training in KKU, Thailand and domestic
- Field practice of students, 2 classes
- Final thesis of 3 students (finished)
- Final thesis of 3 students (ongoing)
- Data collection 6 students (ongoing)
- Advised 3 master students (ongoing)

6. Future expectations

- Pilot trial will be used as field practice of students in faculty of water resources
- Final year students will be involved in research experiment for groundwater management for the department of water resource development and management.
- Water distribution, sprinkler, drip, furrow and alternative method will demonstrate to the students in irrigation engineering department
- Weather station and groundwater monitor will be used for the students of Meteorology and hydrology department

7. Conclusion

- This study shows that using groundwater for irrigation provides a reliable and flexible water supply and allowed farmer to grow dry-season cash crops in Lao P.D.R.

- Applying on-farm residues fertilizer increased crop productivity and soil water content and soil density. This is an innovative fertilization practices will prevent farmers from soil fertility losses.

- Improvement of the soil structure and properties seems to be done and this rejoin the results of previous studies results[3]. Complementary long-term study will be done on order to balance today's results.

- Application in Lao P.D.R. through community management of groundwater irrigation systems might be a solution to reduce expensive cost of deep tube wells drilling.

Acknowledgement

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