Relationship between the water storage and cultivated area in the dry season in Lam Pao Operation and Maintenance Project

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Abstract. This research aims to study the relationship between water storage and cultivated area in the dry season. The study was in the Lam Pao operation and maintenance project, Kalasin province. The long term data records from 1987 to 2020, a total of 33 years, including the amount of water storage in the Lam Pao reservoir and the cultivated area in the dry season (December to May) were analyzed using the Multiple Regression Analysis. The results of the study showed that the maximum cultivated area was in 2020. The total area of 300,353 rai comprised of 295,304 rai of dry season rice, 97 rai of field crops, 100 rai of vegetables, 1,496 rai of fish pond and 3,356 rai of shrimp pond. The minimum cultivated area was in 1994. The total area of 3,419 rai comprised of 209 rai of dry season rice, 2,552 rai of field crops, 488 rai of vegetables, 35 rai of fish ponds and 135 rai of shrimp ponds. It can be concluded that the amount of water storage at the beginning of the dry season is significantly correlated with cultivated area in the dry season.

Keywords: water storage, Lam Pao Operation and Maintenance Project, dry season, cultivated area

1. Introduction

Formerly, Kalasin province had a problem with the environmental structure concerning the agriculture \cite{1}, especially the lack of water storages or reservoirs and irrigation systems. The flooding and drought problems had frequently occurred almost every year. Since Lam Pao dam was completed and started irrigation to the cultivated area, the problem was decrease. The farmers in the Lam Pao operation and maintenance project could grow crops all year round. Irrigation water could be supplied to the full area of the project in the rainy season \cite{2}. But for the dry season, a joint crop plan must be done between the Royal Irrigation Department and the farmers \cite{3} in accordance with the water availability at the beginning of the dry season.

Due to the climate change which is confirmed by the statistics of rainfall data around the Lam Pao dam \cite{4} and the changes in the socio-economic condition of Thailand, the farmers had problems with crop damages and also low product price. They required to grow more for earning sufficient income which was contrary to the water availability and uncertain climate change condition. It is difficult or hardly increase the new large reservoirs \cite{1} because there is no suitable areas and will have a greater impact on the environment. Thus, the water should be fairly allocated to water users in various activities. Decision making should be planned for each activity \cite{3} so that the amount of water allocation is appropriate and balanced, and also in line with the economic, social and environmental conditions of Thailand. As from the above reasons, it is necessary to study the relationship between the water storage...
and the cultivated area in the dry season in the Lam Pao operation and maintenance project, Kalasin province, in order to plan the dry season crop and response to the economic and social needs of farmers with the least impact on the environmental structure.

2. Research Methodology

The research process, follow as Figure 1

2.1. In-depth interviews: The officers responsible for water management of the Lam Pao operation and maintenance project are the Project Director and Head of Water Management and Irrigation Improvement. The interview items are the general condition, water delivery in rainy and dry seasons, agricultural farming and project problems.

2.2. Collecting data from the Lam Pao operation and maintenance project: The long-term data records from 1987 to 2020, a total of 33 years, are the amount of water in the Lam Pao reservoir, water delivery in the dry season and planted area in the dry season.

2.3. Review and analyze data: Water storage in the early dry season, arable area in the dry season, Agriculture in the dry season.
2.4. Find relationships: By using the multiple regression analysis [5], the relationship of water storage and the amount of water delivery in the dry season was prepared, including with cultivated areas in the dry season. The model used in the analysis is as follows.

Water storage = f (amount of water delivery in the dry season, dry season area)

The written equation form is

\[ Y = A + b_1 X_1 + b_2 X_2 \]  

(1)

Where

\( Y \) = amount of water storage (unit: m\(^3\))
\( X_1 \) = amount of water delivered in the dry season (unit: m\(^3\))
\( X_2 \) = dry season area (rai)

3. Results

It was found that the maximum water storage in the early dry season was 1,845 million cubic meters in 2011. The minimum volume was 332.95 million cubic meters in 2012. The maximum arable area was 300,353 rai in 2020. The minimum arable area was 3,419 rai in 1994. The summary results are presented in Figure 2. The dry season crops consisted of rice (with the highest ratio), field crops, vegetables, fish ponds and shrimp ponds. The results are shown in Figure 3.

By using the Multiple Regression Analysis, it was found that the factor of the amount of water delivery in the dry season and the factor of the dry season area had a statistically significant change in the water storage. The level of confidence of 95% (Level of Confident) indicates that the Lam Pao operation and maintenance project should consider the effective water management and farmland management in the dry season. As a result, farmers in irrigated areas will have more incomes.

\[ Y = 6.019 + 0.266 X_{1**} + 0.000756 X_{2**} \]

\[ F - test = 8.816' \]

(2)

**It was statistically significant at a 99 percent confidence level.**
**Figure 2.** Water Storage and Dry Season Area in Lam Pao Operation and Maintenance Project Between 1987-2020.

**Figure 3.** Agriculture in Dry Season Area in Lam Pao Operation and Maintenance Project Between 1987-2020.
4. Discussion & Conclusion
The study of the relationship between water storage and cultivated area was done for 33 years, from 1987 to 2020. It was found that the Lam Pao operation and maintenance project could manage water efficiently. The water storage at the end of the rainy season could be operated to supply the agricultural areas in the dry season. The water was sufficient for various activities as planned. However, the excess water could be operated to supply more area out of the plan in some year.

The factor of the amount of water delivery in the dry season and the factor of dry season area affect the change in the water storage. This shows that the water management of the Lam Pao operation and maintenance project was well managed, in according with Sanchai Ketvorrachai [6] and Sukittiya Boonlai [7]. The project could supply water to irrigate area of 314,000 rai in the rainy season and up to 300,353 rai in the dry season [8]. The cropping pattern should be adjusted in order to generate the highest income and benefit. The transformation of farming model from crop to fish and shrimp farm which have higher demand for water must be controlled to avoid the argument problem.

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