The modification of dry season cropping pattern with the maximum net income possibility in Lam Pao operation and maintenance project, Kalasin province

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Abstract. This research aims to find the solution for the dry season irrigation problem in Lam Pao operation and maintenance project, Kalasin province. The modification of dry season cropping pattern was a process when the irrigation water was shortage. The long-term data records from 1987 to 2020, a total of 33 years, the maximum cultivated area was in 2020. The total area of 300,353 rai were 295,304 rai of dry season rice, 97 rai of field crops, 100 rai of vegetables, 1,496 rai of fish ponds and 3,356 rai of shrimp ponds. The minimum cultivated area was in 1994. The total area of of 3,419 rai were 209 rai of dry season rice, 2,552 rai of field crops, 488 rai of vegetables. 35 rai of fishponds and 135 rai of shrimp ponds. The dry season area in 2020, 10 crop varieties, were glutinous rice, rice, sweet corn, watermelon seeds, seed, cantaloupe seeds, tomato seeds, asparagus, fishpond and shrimp pond. The crop with maximum net income was cantaloupe seeds, 446,000 baht/rai of net profit. The other crops with lower net income in descending order were tomato seeds 363,600 baht/rai, zucchini seeds 76,450 baht/rai, shrimp pond 49,000 baht/rai, watermelon seeds 18,500 baht/rai, asparagus 16,000 baht/rai, fishpond 12,000 baht/rai, glutinous rice 4,904 baht/rai, rice 1,514 baht/rai and sweet corn 1,200 baht/rai. However, the modification of dry season cropping pattern concerned not only the maximum net income but also the farming skill, market demand and farmer lifestyle.

Keywords: Cropping Pattern, Lam Pao operation and maintenance project, Dry season, Maximize net income

1. Introduction

Since Lam Pao Reservoir had been increased its capacity in 2010, [1], the dry season area was increased from 180,000 rai to 236,500 rai. The water management planning for Lam Pao in dry season was prepared following the water availability at the end of wet season in November. The planning was done by using the Reservoir Operation Study which was developed by RID. The application proceed in Microsoft Excel which was usable by RID staff. The input data were crop water requirement, effective rainfall, reservoir inflow and reservoir water balance. The result was the target dry season area for the water availability which was in the dry season period from the end of wet season in November to May. The crop plan activity was done by Lam Pao staff and farmers in cooperation. [2,3]

Some year, Lam Pao reservoir had limited water availability due to the drought period occurred in rainy season. The modification of dry season cropping pattern had been used. [4] The process was simple and save cost rather than e.g., building reservoir [5], irrigation system improvement or building pumping...
station. The guideline was for the appropriate reservoir water management and for the maximum benefit. It was corresponded to reservoir inflow and downstream water requirements as well as the reduction of risk for water shortage. Therefore, it was necessary to study the modification of dry season cropping pattern. The study was for the maximum benefit to farmers by the maximum return per rai of each crop in dry season. It would be the guideline for water management in Lam Pao operation and maintenance project, Kalasin province and response to Thailand economic, social and environmental. Decision making should be planned for each activity [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

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, cropping pattern, 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. Study the agriculture data in dry season 2020: The data acquired from the sampling of farmer and was interviewed by Lam Pao staff. The data were type of crop, yield per rai, cost of production and sale price. The calculation result was net income per rai.

2.4. Compare and sort the type of dry season crop according to the net income.

2.5. Suggest the appropriate dry season cropping pattern which could maximize the net income to farmer.

3. Results

Cropping pattern of Lam Pao operation and maintenance project [4] is shown in Figure 1. The wet season is from June to November and dry season is from December to May. Including in the cropping pattern is rice, field-vegetable crops, fish farming and shrimp farming. Dry season area is shown in Tab.1. The maximum area was in 2020, 300,353 rai. The minimum area was in 1994, 3,419 rai.

![Figure 1. Cropping Pattern of Lam Pao Operation and Maintenance Project](image_url)
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.

Table 1. Agriculture in dry season area in Lam Pao operation and maintenance project between 1987-2020

| Year | Rice | Field crops | Vegetable crops | Fish farming | Shrimp farming | Sum |
|------|------|-------------|-----------------|--------------|----------------|-----|
| 1988 | 15,827 | 22,726 | 5,097 | 2,538 | 662 | 46,850 |
| 1989 | 43,497 | 34,589 | 3,668 | 2,228 | 55 | 84,531 |
| 1990 | 108,007 | 29,513 | 4,138 | 1,988 | 106 | 143,752 |
| 1991 | 91,735 | 25,356 | 3,668 | 2,047 | 55 | 123,042 |
| 1992 | 113,940 | 20,199 | 3,439 | 2,047 | 55 | 138,659 |
| 1993 | 132,795 | 17,083 | 2,557 | 1,836 | 107 | 154,378 |
| 1994 | 209 | 2,552 | 488 | 35 | 135 | 3,419 |
| 1995 | 65,597 | 14,278 | 2,525 | 2,466 | 209 | 85,075 |
| 1996 | 107,194 | 29,513 | 4,138 | 1,988 | 106 | 143,752 |
| 1997 | 108,666 | 8,922 | 2,177 | 2,392 | 2,336 | 124,493 |
| 1998 | 2,055 | 2,863 | 1,284 | 1,576 | 8,353 |
| 2000 | 157,543 | 6,277 | 3,900 | 2,704 | 1,954 | 172,378 |
| 2001 | 178,736 | 6,277 | 1,750 | 2,704 | 1,877 | 191,254 |
| 2002 | 160,746 | 8,700 | 2,051 | 2,906 | 2,508 | 176,911 |
| 2003 | 201,330 | 6,038 | 1,524 | 2,587 | 3,887 | 215,366 |
| 2004 | 216,299 | 5,209 | 1,613 | 2,252 | 5,198 | 230,571 |
| 2005 | 224,826 | 5,686 | 1,521 | 2,201 | 5,474 | 239,708 |
| 2006 | 227,228 | 7,056 | 2,128 | 2,383 | 2,088 | 173,010 |
| 2007 | 235,978 | 1,545 | 937 | 2,104 | 5,749 | 246,048 |
| 2008 | 251,911 | 750 | 742 | 2,619 | 5,562 | 260,784 |
| 2009 | 252,222 | 1,401 | 845 | 1,712 | 5,483 | 261,663 |
| 2010 | 262,541 | 1,349 | 725 | 1,642 | 5,620 | 271,877 |
| 2011 | 270,543 | 1,062 | 509 | 2,138 | 5,361 | 279,613 |
| 2012 | 266,186 | 425 | 343 | 2,069 | 5,369 | 274,392 |
| 2013 | 0 | 0 | 0 | 0 | 0 |
| 2014 | 278,014 | 457 | 53 | 1,627 | 3,752 | 283,903 |
| 2015 | 271,207 | 169 | 160 | 1,603 | 2,834 | 275,973 |
| 2016 | 264,517 | 400 | 445 | 1,557 | 2,916 | 269,835 |
| 2017 | 263,378 | 450 | 646 | 1,577 | 2,922 | 268,973 |
| 2018 | 281,532 | 604 | 188 | 1,518 | 3,136 | 286,978 |
| 2019 | 270,500 | 100 | 262 | 1,481 | 3,217 | 275,560 |
| 2020 | 295,304 | 97 | 100 | 1,496 | 3,356 | 300,353 |

The detail data of Lam Pao operation and maintenance project were yield, crop input and price in dry season 2020 [6] as shown in Table 2. Total 10 crops were glutinous rice, rice, sweet corn, watermelon seeds, seed, cantaloupe seeds, tomato seeds, asparagus, fish pond and shrimp pond. The maximum net income was from cantaloupe seeds which the revenue was 450,000 baht/rai. The secondary revenue was from tomato seeds, 444,000 baht/rai. The minimum revenue was from sweet corn, 2,400 baht/rai.
Table 2. Cost and profit from agriculture (Dry season 2019/2020)

| Types of plants   | Average yield (kg/rai) | Selling price (baht/kg) | Revenue (baht/rai) | Cost/Rai (baht) | Net Profit (baht/rai) |
|-------------------|------------------------|-------------------------|--------------------|----------------|----------------------|
| Glutinous rice    | 725                    | 12                      | 8,454              | 3,550          | 4,904                |
| Rice              | 633                    | 8                       | 5,064              | 3,550          | 1,514                |
| Sweet corn        | 120                    | 20                      | 2,400              | 1,200          | 1,200                |
| Watermelon seeds  | 15                     | 1,500                   | 22,500             | 4,000          | 18,500               |
| Zucchini seeds    | 80                     | 1,000                   | 80,000             | 3,550          | 76,450               |
| Cantaloupe seeds  | 25                     | 18,000                  | 450,000            | 4,000          | 446,000              |
| Tomato seeds      | 37                     | 12,000                  | 444,000            | 80,400         | 363,600              |
| Asparagus         | 600                    | 35                      | 21,000             | 5,000          | 16,000               |
| Fish pond         | 500                    | 50                      | 25,000             | 13,000         | 12,000               |
| Shrimp pond       | 300                    | 230                     | 69,000             | 20,000         | 49,000               |

As from revenue and cost of production, the calculation result was the net profit. The net profit was from cantaloupe seeds which was 446,000 (baht/rai). The other crops with lower net income in descending order were tomato seeds 363,600 baht/rai, zucchini seeds 76,450 baht/rai, shrimp pond 49,000 baht/rai, watermelon seeds 18,500 baht/rai, asparagus 16,000 baht/rai, fish pond 12,000 baht/rai, glutinous rice 4,904 baht/rai, rice 1,514 baht/rai and sweet corn 1,200 baht/rai.

4. Discussion & Conclusion

The study result showed that the modification of dry season cropping pattern was necessary to solve the problem of dry season water limited in Lam Pao operation and maintenance project. The farmer could have revenue not less than before, they should reduce the cropping area for sweet corn and rice. The cantaloupe seeds, tomato seeds, zucchini seeds, shrimp pond, watermelon seeds, asparagus and fishpond should be superseded respectively.

Factor supporting the modification of dry season cropping pattern, in addition to revenue, farmers are mainly familiar with traditional crop. They do not want to learn the new crop or the risk for not skilled especially for seed crop which needs intensive care [7], otherwise it will be easy to lost.

The reduction of water use according to the water availability in dry season, for the rice crop, dry and wet planting method may be alternatively used. Sufficiency economy may be adopted to promote the crop with little water use [8].

In addition to farming skill, other factors should be concerned i.e. the provision of market for production [9] and the crop for consumption [10]. Kalasin province in NE Thailand is in particular, the glutinous rice is for consumption prior to sale in market.

The further study of water use for each crop and comparison of net income per unit of irrigation water will be useful for better decision making. And if the water fee is applied in the future, the study result can be used for reference. Farmer may decide for such water fee.

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