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Current Approach to Soil and Water Conservation for Upland Agriculture in Thailand

Hiroyasu KOBAYASHI

Department of Hydraulic Engineering, National Research Institute of Agricultural Engineering (Tsukuba, Ibaraki, 305 Japan)

Abstract

The economic orientation of agricultural production in Thailand during the past two or three decades through rapid conversion of forest land into farm land[1,7,8]) for the cultivation of cash crops such as cassava, sugarcane, etc. has resulted in severe soil erosion, land degradation and decrease of the soil moisture content due to the lack of implementation of appropriate soil and water conservation measures. Under these circumstances, the authorities concerned in Thailand have addressed the above-mentioned problems in terms of effective use of land resources and environmental conservation. In this paper, (1) soil and water conservation measures for upland areas that have been implemented on the project promoted by the authorities concerned in Thailand and (2) the results of the study on evaporation control of farm pond that was carried out from January 1994 to May 1994 in East Thailand were reported.

Discipline: Agricultural environment/ Irrigation, drainage and reclamation
Additional key words: evaporation control, land development, land use planning, soil erosion, soil degradation

Introduction

Thailand is one of the leading exporters of agricultural products in Asia[10], including rice, rubber, cassava, maize and sugar from sugarcane. Most of these crops are planted in the rainy season.

The climate of Thailand can be generally classified into 2 main types, savanna and tropical monsoon. Although the average annual rainfall is about 1,550 mm, the rainfall is not equally distributed throughout the country. Except for the southern region, approximately 85% of the rain falls during the rainy season from May to October. As a result, most of the agricultural land in the mountainous areas often experiences severe erosion by intensive rainfall. In addition, the amount of rain is sometimes insufficient for crop production in rainfed areas even during the rainy season because the distribution of rainfall changes depending on the year and region.

Implementation of soil conservation measures for the rainy season and water conservation measures for the dry season are urgent and important matters in order to promote the development of agriculture in Thailand. Under these circumstances, soil and water conservation for upland agriculture has been

d National Economic and Social Development Plan (NESDP) was adopted in 1967. After the establishment of the Department of Land Development (DLD) in 1963, the DLD which is presently within the jurisdiction of the Ministry of Agriculture and Cooperatives (MOAC) has been assuming the responsibility for the policy.

Soil erosion in Thailand

Soil erosion, which is one of the major problems in Thailand, mostly occurs in upland and deforested mountainous areas due to the lack of an appropriate soil conservation and management program. A systematic study of soil erosion was carried out by Srikhajon, DLD in 1981. According to the study, about 25%[9] of the country's total land area experiences severe erosion. Areas where severe soil erosion has been found are mainly located in the northern, northeastern and eastern parts of Thailand[9]. Soil erosion has led to a decrease of yield due to land degradation and leaching of plant nutrients in soil through runoff water as well as due to the large deposition of soil sediments in waterways, rivers and dams.

Irrigation in Thailand

In Thailand there are more than 23 million ha of agricultural land, accounting for about 46% of the nation's total land area, of which 50% is devoted to the cultivation of rice, 24% to upland crops and 13% to perennial crops (1988)[5].

The area that can be irrigated in Thailand[4] covered 4.16 million ha, or less than 18% of the total agricultural area up to 1989 while the remaining area was still rainfed. In the dry season, however, in only 3% of the total agricultural area can a second crop of rice be planted, especially in the land consolidation areas where irrigation facilities are well developed. With regard to large-scale water management, for example, the construction of canals and dams and flood control are implemented by the Royal Irrigation Department, MOAC.

Up to now, the shortage of irrigation water in the dry season had also been a serious constraint on agricultural development in Thailand.

Soil and water conservation project

Under these natural conditions, a soil and water conservation project in upland areas of Thailand has been implemented by mainly the DLD to alleviate severe soil erosion in the rainy season and water shortage in the dry season. Measures implemented in Northern Thailand are as follows:

(1) In land with an inclination of less than 5% only contour cultivation is recommended.

(2) In land with a 5–20% inclination, it is recommended to make 1 m wide crop strips with 8–10 m contour intervals. Leucaena, pigeon pea, pineapple, banana, grass, or any kind of crops that can be used as barriers and can reduce the velocity of runoff are suitable as crop strips.

(3) In land with an inclination exceeding 20%, hillside ditches with 10–12 m contour intervals and hedges of legume crops in alternative strips are recommended. On the hillside ditches, farmers can grow fruit trees such as mango, tamarind, jackfruit or any kind of crop.

(4) Farm ponds are constructed for irrigation. Silt traps are constructed to prevent bedload from runoff water from settling into farm pond.

(5) Diversion bund is constructed along contour in order to catch the surface water from farm land and to increase the soil moisture level by enhancing percolation.

Obviously, an appropriate farming system[6] including mulching, cover cropping, alley cropping, intercropping, relay cropping, etc. is indispensable to protect the top soil against erosion. The design of a soil and water conservation farm plan can be made by integrated management and farmers' land use requirements based on topographic, cadastral and land suitability maps. After the completion of the design, a meeting should be organized in order to explain activities, work plans, etc. to the farmers. There is an agreement with farmers that casual activities should be performed by the farmers them-

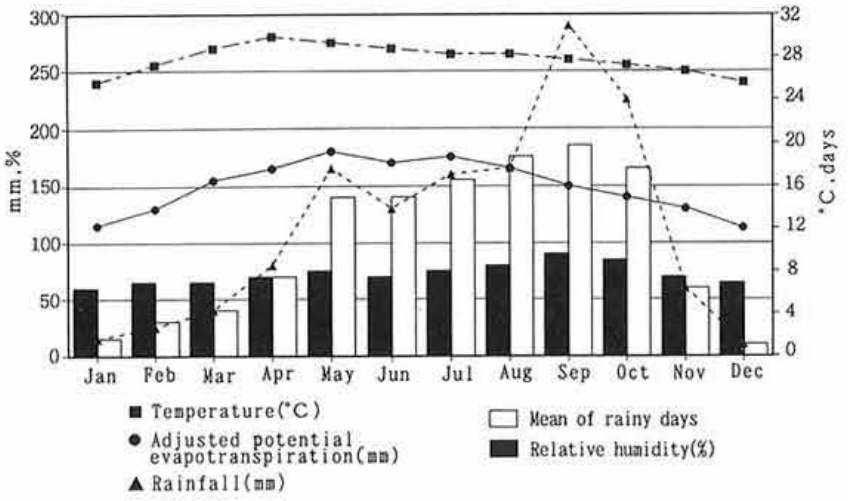


Fig. 1. Water balance at Chon Buri Station (1951–1991)
Source: Data Processing Subdivision, Climatology Division, Meteorological Department, 7 August 1992.

selves, while the cost of introduction of new technology from the project will be covered by the project's own expenditures and labor costs will be shared with the farmers.

Therefore, the authorities concerned in Thailand determined how to keep mechanical measures to a minimum and they attempted to develop simple and economical methods that can be applied by the farmers.

Study on evaporation control for water conservation measures

As shown in Fig. 1, from November to May, the amount of water that evaporates exceeds the amount of rainfall. At that time farmers are facing a water shortage problem at the farm level.

At present, the agricultural authorities concerned are attempting to promote crop diversification including orchards in order to improve the standard of living of farmers. However, it is necessary to secure water resources for the dry season to achieve the above-mentioned objective. For example, since some tropical fruits in the eastern region pollinate from January to February, farmers must use irrigation water at least until February from farm ponds, groundwater, etc. However, water resources in the East are mainly derived from surface water with some supply from groundwater.

1) Background

Construction of farm ponds is one of the measures that can be adopted to alleviate the constraints. However, valuable irrigation water in farm ponds gradually evaporates and percolates under strong sunlight in the dry season. Consequently, it is essential to develop sustainable countermeasures in order to save farm pond irrigation water in rainfed areas as much as possible.

Generally, water conservation measures to alleviate farm pond water loss can be classified as follows:

(1) Evaporation control: Evaporation can be reduced by covering the farm pond surface by applying physical methods such as the use of bamboo or chemical measures such as the use of an oil film. Evaporation can also be reduced by erecting a windbreak around a farm pond.

(2) Percolation control: Mechanical methods that enable to prevent or reduce percolation from farm pond include lining with a rubber sheet, use of soil stabilizers such as soil cement and bentonite, etc.

2) Experimental plan

The experiments were centered on the implementation of the following measures in order to conserve water resources using farm ponds:

(1) Development of economical measures that can be adopted by the DLD.

(2) Introduction of appropriate measures that farmers will accept.

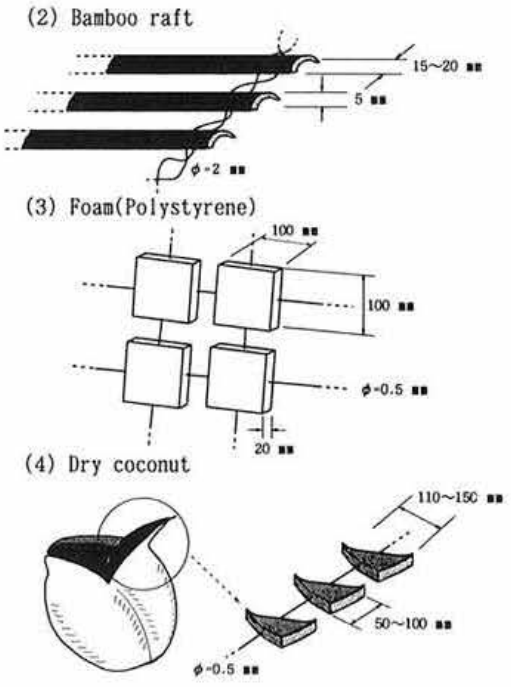
Under these circumstances, my counterparts of the DLD and myself selected three materials (bamboo, foam (polystyrene) and dry coconuts) in the experiments conducted in Shiracha, Chon Buri Province in the eastern region.

3) Materials and methods

We used a round pan (diameter: 46.5 in, depth: 10 in) instead of a farm pond to measure evaporation to exclude the influence of percolation. We used several floating materials for the experiment as described in Table 1.

Table 1. Experimental materials

Floating materials	Percentage of surface area covered (%)	Number of pans
(1) Control (No countermeasures)	0	3
(2) Bamboo raft	65	3
(3) Foam	65	3
(4) Dry coconut	65	3
(5) Bamboo raft	30	3



4) Results

The experiment was carried out from January 13, 1994 to May 2, 1994. However, measurements were not taken for about 1 week in mid-March because of continuous rainfall and for about 2 weeks early in April because of the Thai New Year holiday. The data covered 11 weeks.

The results of the experiment which are shown in Fig. 2 are as follows:

(1) The evaporation rate for foam covering 65% of the water surface (Foam 65) was half of that of the control. In other words, if we use Foam 65 in a farm pond, irrigation water can be preserved twice as long as under natural conditions.

(2) The bamboo raft method was found to be effective for evaporation control. We used two types of bamboo rafts covering 65% (Bamboo 65) and 30% (Bamboo 30) of the water surface. However, we could not detect any apparent difference between the use of Bamboo 65 and Bamboo 30.

(3) The dry coconut method whereby 65% of the water surface (Coco-65) is covered was not effective for the prevention of evaporation.

5) Discussion

In order to analyze the data, we divided the experiment into two periods, one from January to February when the weather is hot and the other from March to April which corresponds to the hottest period in Thailand. The water temperatures in each case are shown in Fig. 3.

The data in Table 2 are the average of 6 data from January 20, 27 and February 3, 10, 17, 24 and the average of 6 data from March 3, 10, 25 and April 1, 18, 25.

The experiments revealed the following aspects:

(1) Foam 65: Since foam displays high insulation properties, the use of Foam 65 retarded the increase of the water temperature by the sun compared with the natural conditions of the control tanks. On the other hand, the water temperature did not decrease during the night time because the foam prevented heat from radiating.

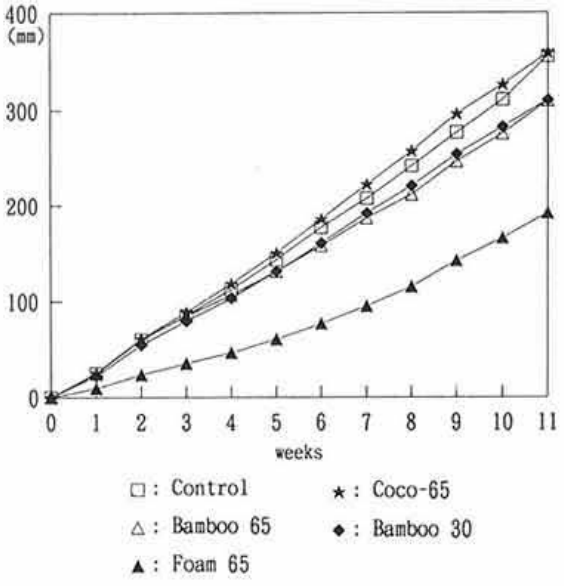


Fig. 2. Evaporation rate

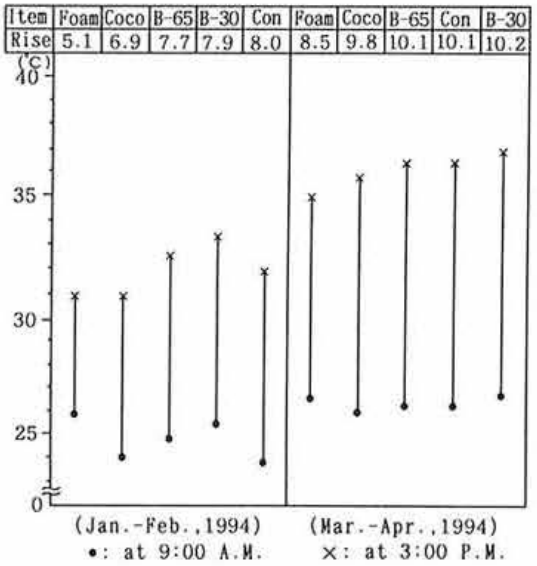


Fig. 3. Water temperature

Table 2. Water temperature (1994)

	January–February			March–April		
	9:00 A.M.	3:00 P.M.	Rise	9:00 A.M.	3:00 P.M.	Rise
Control	23.8	31.8	8.0	26.2	36.3	10.1
Bamboo 65	24.8	32.5	7.7	26.2	36.3	10.1
Foam 65	25.8	30.9	5.1	26.5	35.0	8.5
Coco-65	24.0	30.9	6.9	25.9	35.7	9.8
Bamboo 30	25.4	33.3	7.9	26.6	36.8	10.2

(2) Bamboo: The effect on evaporation control of both Bamboo 65 and Bamboo 30 was less appreciable than that of foam. The evaporation rates from the surfaces of the bamboo rafts were lower than anticipated. The raft made from chopped bamboo may have caused a high rate because it is easier for thinly chopped bamboo to absorb water than for solid bamboo stalks.

(3) Dry coconuts: Dry coconuts acted as a kind of sponge. As a result, the evaporation surface area increased considerably compared with the other cases, as expected. Needless to say, dry coconuts decompose very rapidly in water compared with foam and bamboo. Furthermore, part of the dry coconuts almost sank during the experiment. It is obvious that the use of coconuts is not suitable for evaporation control in farm ponds.

Conclusion

Rapid and recent economic growth in Thailand has resulted in the increase of competitiveness in international markets, a more favorable international balance of payments, etc. On the other hand, it has led to a conspicuous decline in the position of agriculture in the national economy. Even now, however, the farming population accounts for 64% of the total population (as of 1985) and agriculture plays an important role in the national industries in Thailand. Under these circumstances, the Thai Government has recognized the need for implementing soil and water conservation measures for the promotion of sustainable agriculture in upland areas of Thailand, and practically the present approach and program have been adopted in line with the following policies:

(1) To recommend appropriate agricultural measures to the farmers which they can apply to improve their own farming system.

(2) To implement appropriate mechanical measures that are site-specific. The construction of a farm pond and a farm road contributes not only to soil and water conservation but also to the improvement of agricultural management conditions. On the other hand, the construction of a contour bund and a drainage ditch which is likely to be very useful over a long period of time for soil and water conservation reduces the area that can be cultivated. Mechanical effects result from the combination of these measures. In order to promote the project, it is essential that the Thai Government officials inform farmers about this matter through training in a demonstration farm, etc.

(3) To implement an integrated project in order to facilitate the adoption of the above-mentioned concepts effectively and efficiently. Therefore, the DLD has implemented a new "Land Development Village" scheme since 1990. Various DLD activities, dealing for example with soil and water conservation as well as soil improvement, environmental countermeasures, marketing development, the introduction of a credit system, etc. that are carried out in these villages could become the core for facilitating the adoption of appropriate measures and transferring technical information to other nearby villages. This is one of DLD's integrated projects and the DLD plans to set up 810 villages in each "amphur" (district) throughout the country in line with the 7th NESDP (1992–1996).

(4) To develop a new technology and countermeasures in collaboration with foreign engineers and researchers under foreign assistance[2,3]. According to the policy, for example, the "Land and Water Conservation Center Project in the East of Thailand" has been carried out between the DLD and Japan International Cooperation Agency (JICA) since June 1993 with a view to developing appropriate techniques and information systems, and diffusing such know-how to personnel concerned of the DLD.

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