Research article

Change in Effectiveness of Stung Chinit Irrigation System within a Social Economic in Santuk District, Kampong Thom Province

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Abstract Functional irrigation system is one of the most important mechanisms for preventing or minimizing crop failure, and increasing crop yields and cropping calendars. It is functional, if it is properly designed, built, operated and maintained, as well as climate-proofed. It is projected that the climate change effects – flood, drought, and temperature rise – will adversely affect water availability, hence impacting the reliability of the irrigation system and its services. The findings illustrate that Chinit Irrigation System faces several challenges such as insufficient budget for operation and maintenance, especially for repairing the broken earthen canals caused by heavy traffic, cattle, crabs and mice, and flooding. After construction, rice yield, land size and seasonal growing are increased and most of the farmers within the system coverage could access enough water for irrigation, so farmers' livelihood is improved. After completing the infrastructure, households' average net-income increased from 2.44 to 3.14 million riel per household. There are other income sources such as small business, construction and factory workers, taxi-driver and so on that can be further diversified as the competition for water use is expected due to climate change and an increase in water demand in this Watershed.

Keywords Stung Chinit, irrigation system, effectiveness, climate change

INTRODUCTION

Irrigation system is an artificial construction which ideally can store water and drain in or out the water when it is needed. Currently, construction and rehabilitation of irrigation have become one of the top priorities set by the Government, international organizations, private companies, and other donors. They have actively involved in its development to support farmers and water users to secure water to irrigate their farming in both rainy season's supplementary irrigation and wet season (Sakhoeurn, 2006). Construction of irrigation systems, including their maintenance and operations are supposed to contribute to poverty reduction and achievement of the ambitious milled rice-export target set by the Government (CGIR, 2014). According to the Food of Agriculture Organization (FAO, 2010), the average dry season rice yield has increased from 1.39 tons to 2.07 tons per hectares. However, their

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prospects may be challenged by the current climate hazards and long-term climate change as they have been identified as significant environmental and developmental issues in Cambodia. Climate variability and extremes are presently manifested in ways such as floods, droughts, storms, increased coastal erosion, heat waves, and outbreaks/intensification pests and diseases (MOE 2013). All these changes have both positive and negative impacts on the agriculture including the irrigated farm land. These challenges affect the irrigation system's reliability and effectiveness because of drought and whereas overflow and extreme flood can damage the system (MOE, 2014). For the last 15 years, Cambodia has severely affected by the climate variability and change's events such as extreme flood, windstorms, and droughts. These frequent disasters and poor maintenance and operation damaged many infrastructures such as road, street and irrigation system (FAO/WFP, 2012). Climate change is expected to exert compounded pressure on Cambodia's water resources, which will be significantly altered by hydropower development and withdrawals for irrigation expansion within and beyond Cambodian borders. Prevailing poor infrastructure conditions and operation and maintenance of the system also remain a significant factor contributing to current and future vulnerability of systems to climate change (MOE, 2013).

OBJECTIVE

The research was conducted for the following two main objectives:

1) To identify the potential and constrains of Irrigation System;
2) To compare of farmers' livelihood level before and after constructing irrigation infrastructure

METHODOLOGY

The research was conducted in 3 villages, namely, Khvaek, Banteay Yumreach, and Pleyplo villages. To collect the data, primary data and secondary data (asking households, key informants, related institutes and observation) was implemented. 84 households were sampled for interviews and three Focus Group Discussion were also carried out to validate and obtain more quantitative information. All the collected data was analyzed by Statistic Package for Social Science (SPSS and Excel).

RESULTS AND DISCUSSION

Change in Rice Cultivation Calendars

The result in Table 1 indicates that before irrigation scheme, most of the farmers in the three villages cultivated their rice later in rainy season from June to December, because of concern over the water availability during the early phase of rainy season, as most of them heavily relied on rainfall for 61%, 82%, and 67% respectively in Khvaek, Prey Phlu, and Banteay Yumreach villages. Whereas after the Chinit irrigation infrastructure was put in place, 65% of households in Khvaek and 77% in Prey Phlu started to cultivate the rice from May to November relying on water from the irrigation system. However, the farmers in Banteay Yumreach still continue with old cropping calendar from June to December, because of their higher land elevation, and lack of paddy level irrigation canals through their rice field, and some farmers near the canal do not allow the water to the other fields. Furthermore, because of the canals in the upper-land are deeper than the paddy field, it has to operate by more costly pumping.

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Table 1 Farmers' calendar rice before and after constructing irrigation scheme

Villages	Wet rice before scheme			Wet rice after scheme		
	May-Nov	Jun-Dec	Jul-Jan	May-Nov	Jun-Dec	Jul-Jan
Khvaek	21.70%	60.90%	17.40%	65.20%	34.80%	0.00%
Prey Phlu	11.77%	82.35%	5.88%	76.50%	23.50%	0.00%
Banteay Yumreach	16.70%	66.70%	16.60%	31.80%	61.40%	6.80%

Means for Irrigation

Fig.1 illustrates that there were only 4.34% of households irrigated their farm by gravity, 21.73% by pumping and gravity, and 73.91% by rainfall before constructing irrigation system. Whereas the farmers in Prey Phlu village, there were only 5.88% of households irrigating their farm by gravity, 5.88% by pumping and gravity, and 88.25% relying on rainfall while the farmers in Banteay Yumreach were 27.27% by gravity, 18.18% by gravity and pumping, and 55.55% by rainfall. After construction of the Chinit irrigation system, 100% of farmers in Prey Phlu, 52.17% in Khvaek, and 72.73% in Banteay Yumreach irrigated their farming by gravity, and they stopped relying on rainfall.

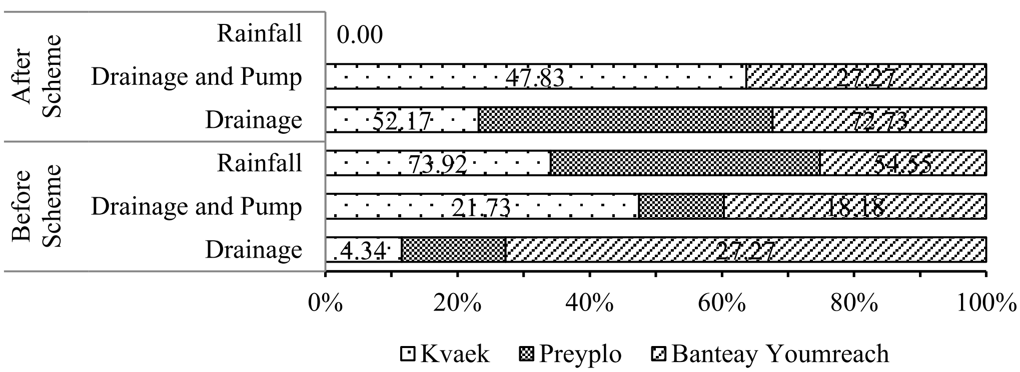

Fig. 1 Ways of farmer for irrigating their farming before and after scheme

Farmland Size Before and After Constructing Irrigation Scheme

Figure 2 shows the paddy field and crop-land size per hectare per household before and after constructing the irrigation scheme. The rice-land of the two villages, Khaek and Banteay Yumreach was slightly increased of 0.04 and 0.12 hectare per household, respectively, whereas the paddy field size of Prey Phlu remained the same. Increasing in paddy field size and production in the two villages were possible because the farmers could get enough water and reclaim available forest land, and increase their outputs to generate more income for supporting the everyday lives of their growing families. In contrast, the other crop-land size of three villages has decreased marginally from 0.55 to 0.122, 0.32 to 0.30, and 0.37 to 0.30 respectively in Khvaek, Prey Phlu and Banteay Yumreach. This was because some of the farmers could not grow vegetables in the cropland and the fields have too much water coming from the canal, and some others grow rice instead of cropping.

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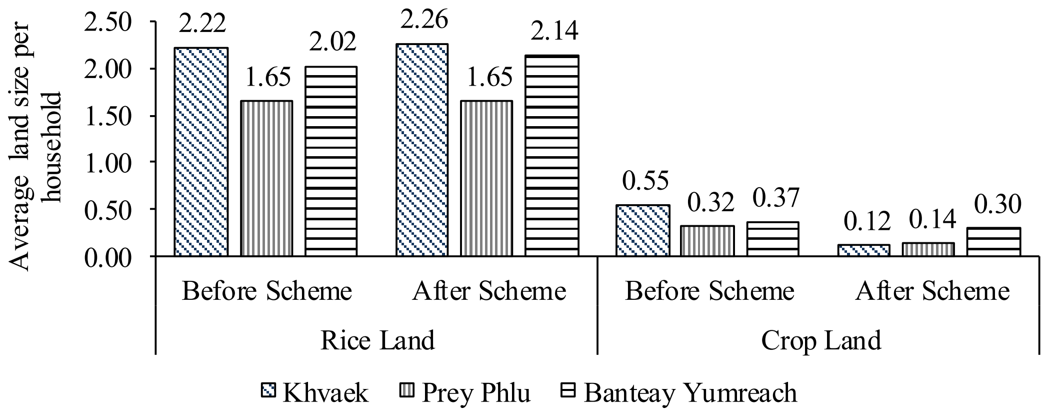

Fig. 2 Average farmland size/household before and after constructing irrigation scheme

Rice Yield Before and After Constructing Scheme

According to the data in the Table 2, farmers do not grow any rice during dry season before irrigation construction. After Chinit system's completion, Banteay Yumreach and Khvaek cultivate dry season paddy rice with a higher yield. But Prey Phlu villagers do not grow any dry-season rice, because the concern over the rampage by domestic animals, insects and so on. Furthermore, because of labor shortage and low profit from rice cultivation comparing to other occupations in urban areas, factory, collecting/working in the forestry, or other countries. After completing construction irrigation system, the average of rainy-seasonal rice yield increases only from 0.24 to 0.69 tons per hectare among the three villages.

Table 2 Average rice yield by seasons before and after scheme

Villages	Before scheme		After scheme	
	Dry-season rice	Rainy-season rice	Dry-season rice	Rainy-season rice
Khvaek	0	1.45	3.95	2.14
Prey Phlu	0	1.59	0.00	1.96
Banteay Yomreach	0	1.66	3.23	1.90

Access to Water Before and After Scheme

Table 3 illustrates the accessibility of water used by farmers among the three villages. According to the table, it showed that after constructing irrigation scheme, 74% of farmers in Khvaek and 88.20% in Prey Phlu villages have enough water for irrigating while the water security for farmers in Banteay Yumreach decrease by 15.90%. It was because the lack of paddy field water distribution canals and arrangement as well as, upland areas, and high water evaporation and seepage.

Table 3 The situation of farmers' accessible enough water use before and after scheme

Villages	Before scheme	After Ssheme	Changes
	Percent (%)	Percent (%)	Percent (%)
Khvaek	30.4	73.9	43.5
Prey Phlu	29.4	88.2	58.8
Banteay Yumreach	61.4	45.5	-15.9

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Causes of Damaging Irrigation System

Farmers around 88% thought that the irrigation system had been broken by three main factors such as operating of transportation including trucks, cattle, mice, and crab, or over flow (heavy rain and flood). Fig.3 indicates that the main canal, distributary canal, release canal and release gates were dramatically damaged by flood and heavy rain. These canals were broken due to heavy rain and over flow from the river and Tonle Sap including cattle stamping, mice and crap digging holes caused the canals eroding and breaking. The sub-canals were severely affected by cattle, mice, and crab; flood and heavy rain while the small sub-canals, 50%, were crucially damaged by cattle, mice and crab, because these canals seemed as dike through the rice field so they were easily affected by cattle, mice, and crabs.

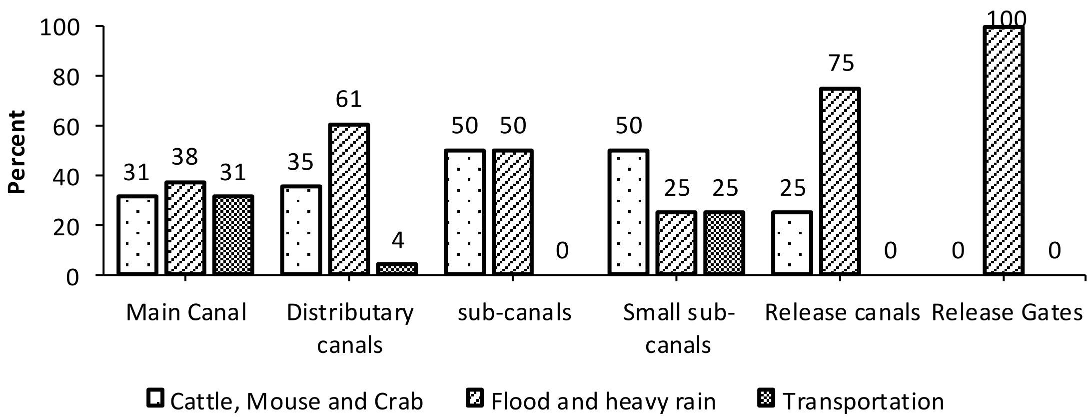

Fig. 3 the causes of damaging irrigation system after constructing irrigation system

The Efficiency of Farmers' Livelihood Before and After Constructing Irrigation Scheme

The farmers generally expended on agriculture products, general expense (food, electric etc.), and farmers' income are mostly from on-farm (cultivation crop, husbandry, fishing etc.) and non-farm income (small business, teaching, wage, factory worker etc.). The changes of average net income increaseed 2.51 million riels/household in Prey Phlu, 2.44 million riels/household, in Khvaek, and 3.15 million riels/household in Banteay Yumreach; however there was no significant difference among the three villages due to P-Value is greater than 0.05 ($p>0.05$). The efficiency of income in Khvaek village before constructing irrigation system shows that the farmers invest 1 riel per unit then they gain income 2.75 riel means that they got profit 1.75 riel. After constructing irrigation system indicated that farmers invest 1 riel per unit then they received income 2.11 riel which means that they gain profit 1.11 riel.

Table 4 Comparison of efficiency before and after construction irrigation scheme

Items	Prey Phlu			Banteay Yumreach			Khvaek		
	Before	After	Changes	Before	After	Changes	Before	After	Changes
TR (MR)	92.33	188.11	95.78	285.83	592.40	306.57	113.04	315.41	202.37
TC (MR)	33.58	89.17	55.59	101.11	306.37	205.26	49.56	177.08	127.53
Π	58.75	98.94	40.18	184.73	286.03	101.30	63.48	138.33	74.85
Aver π/HH	3.46	5.97	2.51	2.33	4.77	2.44	2.84	5.99	3.15
E (Riel)	2.75	2.11	-0.64	2.83	1.93	-0.89	2.28	1.78	-0.50

P=0.84>0.05 (Change in the average of net income/household)
**TR (Total Revenue), TC (Total Cost), π (net income), Aver π (average of net income), * MR (Million Riel), *E (Efficiency)*

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In conclusion, the research demonstrated that even though the average net income of farmers increased in all three villages, but if we look through the efficiency of households decreases 0.64 riel in Banteay Yumreach, 0.89 riel in Khvaek, and 0.50 riel in Prey Phlu village, because farmers heavily pay for agricultural input (fertilizers and pesticide, rice broadcasting or transplanting, harvest, plough etc), on food, children, illness and inflation.

CONCLUSION

Irrigation system is one of the key tools to boost the agricultural products. Most of the farmers could access enough water to irrigate their farm, and double their cropping calendar with higher yield, and cultivate the farm on time. Moreover, after constructing irrigating system, it can ensure minimize vulnerability to flooding and drought. Furthermore, it also sustains farmers' livelihood because most of the farmers rely on agriculture. But there are several problems such as extremely flood, heavy rain, over flow, cattle, mice, crabs, and transportation, as well as lack of adequate fund for operation and maintenance.

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