The Use of Sustainable Livelihood Approach (SLA) to Assess Socioeconomic Sustainability of Bioethanol Crop Production with the Application of Irrigation Technology

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Abstract: Sustainable Livelihood Approach (SLA) was applied for a qualitative study on Livelihoods of farmers producing bioethanol feedstock in Thailand while and adopting and not adopting irrigation technologies. Results indicated that farmers adopting the water technologies had higher yield, profit and farm income. In addition, these farmers were able to reinforce social, physical, human and natural assets leading to improved livelihoods. Ability to access to the technologies was related to possession of livelihood assets, particularly cultivated land area. The investment in the technologies was proved to be cost effective. Relevant policies dealing with alternative energy should highlight the usefulness of the technologies and ways to access them by poor farmers in order to secure the planned amount of bioethanol feedstock.

Keywords: Sustainability, bioethanol, irrigation technology, livelihoods, farmers.

1. Introduction

Feedstock security for bioethanol production in Thailand is of concern. According to the Alternative Energy Development Plan (AEDP), the country has projected its production and consumption of bioethanol from 3.52 million liters/day in 2015 to 11.30 million liters/day in 2036 [1]. Technologies are seen as an integral driver in increasing feedstock yield [2-3]. Among them, irrigation technology has been regarded as imperative and a basis for adoption of other technologies [4]. Recently, Thailand has been hit hard by droughts and irrigation technology has been accessed by farmers able to afford it. In addition, the government has promoted the use of irrigation systems aimed at boosting yield, income and livelihoods of farmers [5]. However, research on the impacts of these technologies on livelihoods is very limited. This paper explored livelihood impacts of irrigation technologies of farmers growing cassava and sugarcane which are the main bioethanol producing crops in Thailand. The results will be useful for policy makers in promoting the use of the technologies.

2. Methodology

The Sustainable Livelihood Approach (SLA), developed by the Department for International Development, United Kingdom was employed for this research [6]. The SLA consists of five related components, livelihood assets, vulnerability context, transforming structures and processes, livelihood strategies and livelihood outcomes (Figure 1). Cassava farmers in Soeng Sang District, Nakhon Ratchasima Province and sugarcane farmers in Phu Khieo District and Kaset Sombun District, Chaiyaphum Province were interviewed in-depth with the use of semi-structured questions. There were 5 groups of farmers, 25 cassava farmers using drip irrigation (C-Drip), 17 cassava farmers relying on rain alone (C-Rain), 14 sugarcane farmers being quota heads and using fountain irrigation (S-Fountain (QH)), 16 sugarcane contracting farmers under quota heads using fountain irrigation (S-Fountain (CF)) and 17 sugarcane farmers relying on rain alone (S-Rain). Quota heads were farmers having a contract with the millers. They were allocated a quota for sugarcane sale. Usually the quota heads had contracting farmers under their umbrella. The QH farmers acted as a representative for the CF farmers in dealing with the millers. They also provided loans and farm services to the CF farmers. Harvested sugarcane of the CF farmers was collected by the QH farmers and sold to the millers. Farmers were asked for their practices, productivity, costs of production, farm income, annual household income and expenses, household debts, assets accumulated and well-being. In addition to taking notes, audio recording was also performed when interviewing key informants for validation via triangulation. Each interview took 45-60 minutes. Data was analyzed by a method of context analysis. Key informants consisting of village heads, village's administrative committee members, public extension officers (for the case of cassava) and extension officers of a sugar company were included.

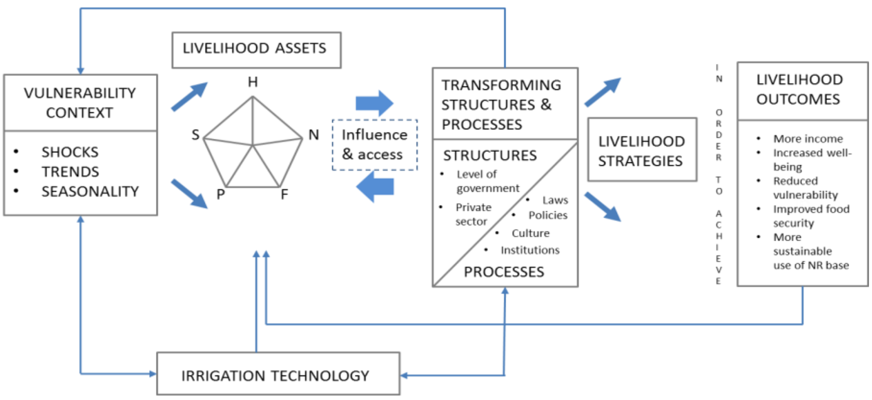

Figure 1. Sustainable Livelihood Framework.

Table 1 Household economics of farmers adopting or not adopting irrigation technologies.

Farmers	HH size	Growing area (rai)	*Production costs (Baht/rai)	*Profit (Baht/rai)	Farm income (Baht)	Total income (Baht)	Total expenses (Baht)	Total debt (Baht)
C-Drip	3.8	45	6,067	7,466	463,672	554,380	455,118	308,960
C-Rain	3.4	6	4,789	1,861	40,606	155,647	211,079	88,824
S-Fountain (CF)	4.6	33	8,501 (5,090)	5,218 (10,437)	396,297	406,925	445,328	264,500
S-Fountain (QH)	5.0	141	7,859 (5,150)	7,465 (11,272)	1,926,038	2,165,163	1,171,958	1,140,875
S-Rain	4.3	11	5,920 (2,695)	3,620 (7,511)	100,452	146,228	195,456	69,653

*Production cost/rai and profit/rai for ratoon cane are in parentheses

3. Results and Discussion

3.1 Household characteristics and household economics

Table 1 provides information about household characteristics and household economics of farmers growing bioethanol crops and adopting or not adopting irrigation technologies. Household size among groups was at 3-5. Those that adopted technologies had higher cultivated areas. Irrigation technologies were shown to contribute to higher profit and farm income. C-Drip and S-Fountain (QH) households had positive difference between income and expenses. It was noted that all households had debt which grew with income.

3.2 Vulnerability context

Droughts, pests and diseases, a slump in prices of fresh root cassava and higher prices of inputs were perceived as threats by cassava farmers. The issues for sugarcane farmers were similar but with a shortage of labor replacing pests and diseases. Droughts were severe in the past two consecutive years. That of 2015 decreased overall sugarcane production in the country by 11.2%. Cassava farmers who initiated growing early but without sufficient rain later were required to regrow the crop. In addition, insufficient rain caused overpopulation of pests such as mealy bugs and termites. This resulted in increased production costs. It was noted that the application of irrigation technology could ameliorate drought effects. Cassava farmers often complained about the falling prices of farm produce were complained very often by cassava farmers. Normally, the total production cost was around 1.7-1.9 baht/kg. Farmers said they required prices higher than 2.0 baht/kg to survive. Sugarcane farmers were more fortunate to have subsidies provided by the Cane and Sugar Fund to compensate for the low prices. Sugarcane farmers who were quota leaders and not owning mechanized harvesters needed to hire workers for the harvest. During the harvest season, workers were specifically scarce.

3.3 Livelihood assets

Farmer groups of C-Rain and S-Rain possessed smaller pieces of land (natural assets) compared to those of C-Drip, S-Fountain (CF) and S-Fountain (QH). Landholding determined farm income (financial assets) and ability in the investment for irrigation technologies. Farmers of all groups adopting technologies were more confident in finding credit (social assets) and managing debt. In addition, they were successful in accumulating more assets such as land, cars and farm machinery (physical assets). C-Drip farmers who had adopted the technology for longer than ten years were classified as rich farmers by neighbors. They preferred building larger and luxurious houses. Annual farm income for C-Drip and also C-Rain farmers was highest in 2010 as the price of fresh roots sharply rose from 1.16 baht/kg to 3.25 baht/kg. However, only C-Drip farmers who possessed more land and had higher yield by the use of technology enjoyed their success. Though C-Rain and S-Rain farmers were also trapped in a cycle of debt, their cases were totally different. A majority of them reported difficulties in their lives desperately trying to make ends meet. They all said that debt was a burden causing considerable stress and tried to avoid it. In contrary, farmers adopting the technologies were more comfortable with having debt because it could be managed. Machinery, mainly tractors and trucks were purchased by C-Drip and S-Fountain (QH) farmers for use in their own farms and also for providing services to other farmers. They could support their children's university education and bought them cars when graduated.

3.4 Transforming structures and processes

Existing government policies and instruments involving cassava and sugarcane were the Strategic Roadmap for Cassava and Cassava-Based Products, the Strategic Roadmap for Sugarcane and Sugar and the Cane and Sugar Act (1984). However, for sugarcane, only the Cane and Sugar Act (1984) played an important role on farmers' livelihoods. Action plans in the immediate phase of the cassava roadmap included a provision of soft loans for investment in drip technology. However, this was observed to benefit the C-Drip instead of the C-Rain farmers only. They used the loans for expanding more irrigated areas or purchasing new equipment replacing the old one. All S-Fountain (CF) and S-Fountain (QH) farmers were having a contract with the sugar plants where they were able to ask for a loan. The S-Rain farmers were apparently marginal to all assisting programs. None of them were members for sugarcane farmers' associations under the Cane and Sugar Act (1984). There were no subsidies from the Cane and Sugar Fund and credit sources except the Bank for Agriculture and Agricultural Cooperatives (BAAC). Nevertheless, the BAAC was unlikely to grant new customers the loan money that was sufficient to cover the technology investment.

3.5 Livelihood strategies

All C-Rain and S-Rain farmers took both farm and non-farm jobs to secure household income. Most farm jobs for C-Rain farmers were growing (cassava), weeding, fertilizer application and harvesting. Those for S-Rain farmers were weeding and fertilizer application. Non-farm jobs included construction working and carrying and moving things. Normally, daily wage was at 300 baht. A majority of C-Drip, S-Fountain (CF) and S-Fountain (QH) farmers did not engage in other employment. However, some of them who were regarded as successful farmers diversified their income sources by growing other crops such as fruit trees and vegetables. Those growing vegetables also used the irrigation technology. The way that sufficient water availability enabled diversification, led to more income and then improved livelihoods, was consistent with the report of Taweekul et al. (2012) [7]. Some C-Drip and S-Fountain (QH) farmers provided farm mechanization services such plowing, harvesting and transporting farm produce to the processors.

3.6 Livelihood outcomes

The irrigation technology was noticed to improve livelihoods of C-Drip, S-Fountain (CF) and S-Fountain (QH) farmers by the increase in yield, farm income and well-being and the decrease in vulnerability from droughts and price instability of farm produce. Food security was not different among groups if determined by number of meals taken per day. However, most C-Rain and S-Rain farmers were likely to have lower food expenses. C-Drip, S-Fountain (CF) and S-Fountain (QH) farmers were more able to reinforce and access capitals than their C-Rain and S-Rain counterparts. Since the irrigation technology consumed more water and additional energy (diesel or electricity), environmental sustainability might have been a concern. However, the increase in yield by the technology and the use of solar energy based water pumps were likely to fully or partially offset the impacts.

4. Conclusion

A qualitative study exploring socioeconomic status of cassava and sugarcane farmers adopting irrigation technology indicates that a sustainable livelihood is could be achieved through an increase in yield and farm income and a decrease in vulnerability. The government may have an alternative policy assisting farmers to facilitate accessing to the technology. Shared artesian wells and irrigation equipment may be affordable by established farmer groups. The SLA may be a useful tool in assessing socioeconomic sustainability at farm level of bioethanol feedstock production.

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