The role of agricultural cooperatives in rice farming sustainability: a case study in Vietnamese Mekong Delta

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1. Introduction

- Viet Nam is one of the top five countries that are most vulnerable to climate change (Eckstein et al., 2020; Hanh et al., 2020; UNDP, 2022).

- The Mekong Delta (MKD) region → 55.7% of the national rice output; 90% of the total export volume (GSO, 2020).

- Agricultural sector in the MKD: unsustainable development (small farm size and overreliance on agrochemicals).

- Collective economic and cooperatives development: priorities in developing a sustainable economy.
1. Introduction

• As of December 31, 2021, Viet Nam has 27,342 cooperatives, nearly 6 million members.

• The Mekong Delta (MKD): 2,546 Acs ⇒ crop cooperatives: 55.1%.

• Cooperatives: not effective and attractive to farmers (ISPARD, 2017).
  ⇒ promoting and improving the capacity of Acs: urgent and necessary policy agenda (Decision 445/QD-TTg March 21, 2016 and Decree 98/2018/ND-CP).
1. Introduction

Paddy cooperatives and sustainable development in the Mekong Delta

Paddy cooperatives and sustainable farming

- Climate Smart Agriculture (CSA) (26.1%)
- Alternative Wetting and Drying (AWD) (130,192 ha (8.5%) through VnSAT project)
- High technology application
  - 295 cooperatives
1. Introduction

• Previous studies: economic benefits that ACs brought to their members (Ahmed & Mesfin, 2017; Dong et al., 2019; Hoken & Su, 2018; Hun et al., 2018; Ito et al., 2012; Ma & Abdulai, 2016; Ma & Abdulai, 2017; Verhofstadt & Maertens, 2014).

• Some other studies: relationship between cooperatives and technology adoption or technical efficiency (Binam et al., 2004; Abebaw and Haile, 2013; Abate et al., 2014; Attipoe et al., 2020; Bizikova et al., 2020; Le et al., 2021).

⇒ Studies on the relationship between farmer’s organizations and sustainability the MKD is still modest.
1. Introduction

This study’s Objectives

- Overall efficiency and inputs overuse
- The role of ACs in improving production efficiency and reducing inputs
- Some policy implications
2. Methodology and data

2.1. Methodology

• Data envelopment analysis (DEA) (Charnes et al., 1978; Banker et al., 1984)

• Slack based measure (SBM) by Tone (2001), considers slacks (inputs overuse).

• 1 output, 10 inputs super SBM model $\rightarrow$ overall efficiency score and input slacks
2. Methodology and data
2.1. Methodology

The input-oriented SBM model:

\[
[\text{SBM-IC}] \quad \rho_1^* = \min_{\bar{\lambda}, S^-, S^+} \frac{1}{m} \sum_{i=1}^{m} \frac{S_i^-}{x_{ih}}
\]

subject to
\[
x_{ih} = \sum_{j=1}^{n} x_{ij} \lambda_j + S_i^- (i = 1, \ldots, m)
\]
\[
y_{rh} = \sum_{j=1}^{n} y_{rj} \lambda_j - S_r^+ (r = 1, \ldots, s)
\]
\[
\lambda_j \geq 0 (\forall j), S_i^- \geq 0 (\forall i), S_r^+ \geq 0 (\forall r)
\]

\(\rho_1^*\) is called the SBM-input efficiency. A DMU \(h = (x_h, y_h)\) is called SBM-input-efficient if \(\rho_1^* \leq 1\)
2. Methodology and data
2.1. Methodology

The second stage tobit model: determine the external factors that have the effects on SBM scores

\[
Y^*_i = \beta_0 + \sum_{m=1}^{M} \beta_m x_{im} + \varepsilon_i, \varepsilon_i \sim IN(0, \sigma^2) \quad (2)
\]

\[
Y = \begin{cases} 
0, & \text{if } \beta x + \varepsilon \leq 0 \\
\beta x + \varepsilon, & \text{if } 0 < \beta x + \varepsilon < 1 \\
1, & \text{if } \beta x + \varepsilon \geq 1 
\end{cases} \quad (3)
\]

where \( \beta_m \) are unknown parameters, \( y^*_i \) is a latent variable representing the efficiency score for field \( i \), \( x_{im} \) represents explanatory field characteristic variables associated with field \( i \), and \( \varepsilon_i \) is an error term.
2. Methodology and data
2.2. Study site and Data collection

(n = 93)

Can Tho
- Nhan Loi (25)
- Khiet Tam (38)

(n = 96)

An Giang
- Vong Dong (33)
- An Binh (9)

(n = 96)

Dong Thap
- My Dong 2 (46)
- Thuan Tien (39)

(n = 95)

Bac Lieu
- Vinh Cuong (51)
- Tien Dat (23)

Agricultural services
- Certified seeds
- Fertilizers, pesticides
- Irrigation
- Output contract
3. Main findings

3.1. Overall efficiency and input slacks

Overall efficiency

- Cooperatives’ members have better efficiency by 7% and lower input slacks (seeds, pesticides, water, land leveling, harvest).

- AC’s members in Bac Lieu: highest efficiency (75%)
- In Dong Thap: members (66%), non-members (52%)
- In An Giang: no significant difference
- In Can Tho city: contrary situation, members efficiency < non-members’ efficiency (Nhan Loi cooperative is new)
3. Main findings

3.1. Overall efficiency and input slacks

**Overall efficiency**

- Most efficient farms belong to Tien Dat (78%), My Dong 2 (76%) and Vinh Cuong (74%) cooperatives.

- Low efficiency: Vong Dong (57%), Nhan Loi (54%) and Thuan Tien (54%) cooperatives.
3. Main findings

3.1. Overall efficiency and input slacks

Input slacks present the excessive usage of inputs and how well the farmers manage their resources.

- AC’s members perform better use of seeds, nitrogen, pesticides and water.
- Lowest slack of seeds, nitrogen and water use: Tien Dat and Vinh Cuong cooperatives (Bac Lieu province).
- My Dong 2 was invested for mechanization (transplanting machines and pesticides spraying by drones) ⇒ lowest slacks of pesticides and land leveling.
- Vong Dong, Nhan Loi and Thuan Tien cooperatives: not focusing on sustainability yet.
3. Main findings

3.2. Factors that affecting overall efficiency and input slacks in rice production

• Efficiency of rice farms: positively affected by cooperative membership, farmland area, access to credit, the applications of AWD and 1M5R technical packages (climate smart agriculture).

• Expanding farm size and practicing CSA could help to reduce slack of seeds.

• Slacks of N could be decreased when the household heads are male and family members are less.

• Water overuse could be controlled if households are ACs’ members, produce in larger scale and practice the AWD technology.
4. Conclusions

• ACs’ members in Bac Lieu and Dong Thap provinces: highest overall efficiency and very low input slacks ⇒ Tien Dat, My Dong 2 and Vinh Cuong cooperatives.

→ Efficiency of smallholders are driven by Acs’ membership, farm size, credit and CSA practice.

• Inputs overuse could be reduced if farmers join in cooperatives and operate in larger farm scales.

• Becoming cooperatives members ⇒ better machinery service and farming technology.

• Climate smart agriculture ⇒ higher efficiency, lower slacks ⇒ sustainable development of cooperatives and small farms in the MKD.
4. Conclusions

Policy implications:
- Land accumulation policy, advanced technology promotion.
- Credit policy: purchasing high-technology machinery for CSA implementation.
- Development of irrigation systems is important.

Shortcomings:
- Comparison of efficiency and inputs overuse in and outside cooperatives; information on water management is unsufficient.

Future research:
- Cooperative could be treated as firms (DMUs) to estimate the efficiency performance and the inputs management
Thank you very much for your attention!
References


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