Measuring the Efficiency of Collective Floodplain Aquaculture of Bangladesh using Data Envelopment Analysis

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1. Introduction

Aquaculture in floodplain water-bodies has emerged as an important food production sector for food and nutrition security in Bangladesh. With the increase in seasonal aquaculture, collectively organized floodplain aquaculture (FPA) was formed in the floodplains that are composed of privately-owned lands of numerous landowners (Belton at al., 2014). An early example of an FPA management system was found in the Daudkandi sub-district where a group of landowners formed an FPA in 1984. Since 1996 an NGO named SHISUK began promoting FPAs in the Daudkandi and other parts of the country by collaborating with different communities adopting this management system. Freshly motivated by the success of NGO-collaborated FPAs (NFPAs), landowners of the neighbouring floodplains established independently formed FPAs (IFPAs) without any external support.

The objective of the study is to compare the FPAs formed under a common management system in terms of their management efficiency using the data envelopment analysis (DEA) and to identity the various aspects of efficiency by measuring pure technical (PTE), scale (SE), mix (ME) and over all efficiency (SBM).

2. Method and Data

DEA is a mathematical model that measures the efficiency of target decision making units (DMUs) by establishing a frontier surface that contains the best DMUs, and envelops the rest (Cooper et al., 2007). We use CCR, BCC (indicating PTE) models and slack-based measure (SBM) for overall efficiency:

$$SBM_\theta = ME \times CCR_\theta,\ SBM_\theta = ME \times SE \times BCC_\theta$$

Input slacks for inefficient FPAs were identified. We also check the returns to scale (RTS) characteristics in terms of increasing (IRS), decreasing (DRS) and constant (CRS) returns to scale.

FPAs are classified into four groups for comparison. Fifteen FPAs were selected from five sub-districts in Bangladesh where NFPAs are operational. Four Inputs were used; *Utilized area of floodplain (UAF)* (ha), *stocked fingerlings* (BDT), *used fish feed* (BDT), and *wages and salaries* (BDT). Output is *Fish sales* (BDT). All FPAs were found to follow the strategy of commoditized bulk production by culturing an almost identical mix of fish species (BDT: Bangladeshi Taka (BDT 80.50 = US$ 1).

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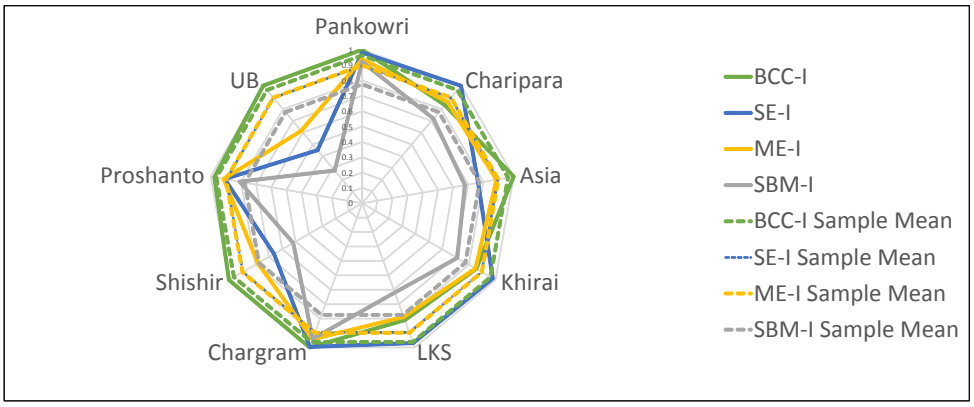

Figure 1: Decomposition of SBM scores for the inefficient FPAs into BCC (PTE), SE and ME scores

3. Results

While eleven FPAs are purely technically efficient (BCC), only six of the FPAs are overall (SBM) efficient. Figure 1 shows the decomposition of SBM scores for the inefficient FPAs into BCC (PTE), SE and ME scores. In some inefficient FPAs, input mix and inappropriate operation scale are contributing to their overall inefficiency (SBM-I).

Efficiency score of NFPAs is, on average, slightly better than that of IFPAs, while 40% of NFPAs and IFPAs are overall efficient. Management of aquaculture operations might be the key to cause differences in their performances, although their aquaculture methods were similar.

Lease management—introduced as a solution to inefficient self-management—has not necessarily ensured overall efficiency as only two FLAs turned out as SBM efficient.

4. Conclusion

Most of the older FPAs, despite their higher fish yield than the relatively newer FPAs, showed overall inefficiency with sub-optimal TE, SE and ME. This resulted from the intensive use of inputs in these FPAs. Given the protein linkage and the mitigating role of aquaculture in the wake of the sharp decline in capture fishery (Belton et al., 2014), along with FPAs being one of the fastest growing aquaculture niches, it may be time for the government to consider efficiency-related aspects—in addition to the usual growth-related emphasis—in its policy formulation.

5. References

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