



# Cooperatives for fruits and vegetables in emerging countries: Rationalization and impact of decentralization



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## ABSTRACT

We develop a (noncooperative) game theoretic model for a decentralized setting wherein *fringe* farmers compete with a two-tier cooperative network involving *network* farmers and a coordinator. We examine the roles of the coordinator and profit sharing in allocating costs/benefits of externalities in enhancing network efficiency and stability. Our main finding is that using profit sharing based mechanism the coordinator can overcome inherent inefficiency and instability of decentralization and noncooperative behavior of the network farmers. The roles of the coordinator and profit sharing are particularly important when it is economical for both network and fringe farmers to supply the product.

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## 1. Introduction and motivation

Competing producers in many industries form cooperative networks to gain competitiveness and to reach out to larger markets (see Nagurney, 2006). These networks incur joint costs and derive joint benefits that are widely referred to as *externalities* (Katz and Shapiro, 1985; Farrell and Saloner, 1985). Allocation of costs and benefits of network externalities to the network producers determines the individual producers' incentives. They are important not only from the perspectives of rationality and fairness, but they also impact competitiveness and stability of the entire network (see Moulin, 2002; Jackson, 2005). For sustainability, network stability is essential such that the producers' incentives for severing ties from the network are completely eliminated. The issue is very relevant when the producers deliberate on whether to adopt a centralized or a decentralized network setting. In the centralized cooperative network, the producers act in the interests of the entire network, typically, using bindings agreements. In the decentralized setting, on the other hand, they act in self-interests while delegating coordination responsibilities to an *external* agent. In both settings, individual interests of the producers may not be in sync with the interests of the entire network as costs and benefits of externalities are allocated in the interests of the entire network. It puts network sustainability at risk. The strategic choice of establishing a cooperative network and adopting a suitable network setting is particularly important for producer-farmers of fruits and vegetables in emerging economies. These farmers are typically *small* or *marginal* such that they individually lack both the access to larger markets and the bargaining power on the supply side.<sup>1</sup> In this paper, we develop a game theoretic model to provide insights

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<sup>1</sup> Technically, small and marginal producers are those farmers that cultivate less than 2 hectares (5 acres) and 1 hectare (2.5 acres) of agricultural land respectively. (Source: [http://www.aicofindia.com/AICEng/Pages/Product\\_Profile/Present\\_NAIS\\_Features\\_P4.aspx](http://www.aicofindia.com/AICEng/Pages/Product_Profile/Present_NAIS_Features_P4.aspx))

into the competing farmers' strategic choice of forming a decentralized cooperative network. We particularly highlight the role of the coordinator and profit sharing in attaining a stable and efficient network while allocating costs and benefits of network externalities to the network farmers.

The motivation for our work presented in this paper primarily comes from recent, yet recurring, events in the Indian fruit and vegetable distribution sector. In protecting interests of the producer-farmers, the APMC – Agriculture Produce Marketing Committee (Regulation) – Act requires the farmers to sell their produce (fruits and vegetables) in centrally regulated *mandis* (auction houses). The APMC Act, however, enables middlemen to exploit both producers and consumers by controlling supply in the market (see Mehta, 2013). It has resulted into exorbitantly high inflation levels in India. As described by Ashok Gulati, former Chairman of the Commission for Agricultural Costs and Prices, “Supply chains for high-value [fruits and vegetables]<sup>2</sup> products are unduly long and fragmented, leading to . . . a disproportionate capture of value by middlemen. This outcome is at the expense of producers, who get a lower price, and consumers, who pay a higher price.” (Gulati, 2014a). For instance, inflation in August 2013 vis-à-vis August 2012 for food articles increased to 18%, and that for vegetables reached the level of 78%. Moreover, inflation in one of the essential commodity products, onion, soared to 244%. To develop efficient and sustainable supply chains distributing fruits and vegetables in the Indian markets, many researchers and policy makers have been particularly recommending a variety of institutional structures (see Gulati, 2014b). In this regard, organizing farmers into clusters to create scale economies and establishing *Anand Pattern* based cooperative networks has emerged as a quite popular institutional form. (Refer Gulati and Saini (2013) and Gulati (2014a) for further details.)

### 1.1. The Anand Pattern: Amul milk cooperative

Amul milk cooperative – the organization supplying India's largest food product brand – introduced the Anand Pattern to the Indian markets seven decades ago. In a multi-tiered network structure, this cooperative involves producer-farmers at the bottom tier and GCMMF – Gujarat Cooperative Milk Marketing Federation – as a coordinating and marketing agency at the top tier (see Fig. 1). GCMMF streamlines activities among 3.25 million member-farmers from more than 17,000 villages to procure and process almost 13.5 million litres of milk on daily basis (<http://www.amul.com/m/organisation>). In the decentralized setting, it has managed to eliminate exploitative middlemen by taking decisions in the interests of the member farmers and directly linking producer-farmers from remote villages to consumers in both domestic and foreign markets. The efforts of GCMMF in the Amul cooperative had particularly created *White Revolution* in India making it one of the largest milk producers in the world (<http://www.amuldairy.com/index.php/white-revolution>). Over years, a number of Anand Pattern based cooperatives have been established in the milk sector throughout the country. The foundation of the Amul cooperative's unparalleled success is developed based on three important operating policies: (i) centralized procurement, processing and marketing of milk and its value-added products, (ii) price and profit sharing based coordination mechanism that aligns interests of individual member producers with the entire network, and (iii) the coordinator's decisions – such as procurement prices to be offered to the member farmers, sales prices of the products, target markets, and product portfolio – are in the interests of the entire network. (Refer Heredia (1997), Sriram (2010), Palsule-Desai et al. (2013) for further details.)

### 1.2. The Anand Pattern: An adaptation

While the institutional setting of the Anand Pattern based cooperative network as suggested in the fruit and vegetable sector is identical to that in the milk sector, they are quite distinct on three operational characteristics related to production, procurement and marketing. Firstly, contrary to milk processing that is centralized in the Anand Pattern based cooperative networks, production of fruits and vegetables is decentralized due to their strong linkages with geographical and weather conditions. Second, the operating costs of linking a number of member farmers with the coordinator are quite disproportionate in the fruit and vegetable sector. For instance, a number of variants of fruits and vegetables and region specific production make it costly for the cooperatives to procure the produce by establishing uniform cold storage facilities and logistics networks throughout the country as that can be done for milk procurement. (Refer Ferrantino et al. (1995), Subrahmanyam and Gajanana (2000), Gandhi and Nambodiri (2004), Rajendran and Mohanty (2004) for further details in this regard.) Third, scale economies are possible in the milk sector at the processing stage. However, economies of scale can be created in the fruit and vegetable sector only in procurement and marketing due to limited production by the small and marginal farmers. Thereby, centralized procurement and marketing of the produce is widely promoted as an effective competitive strategy to counter disadvantages of decentralized production. In this environment, centrally coordinated activities by the coordinator in the cooperative network can benefit the producer-farmers acting in self-interests. Obtaining insights into efficiency and stability of supply chain (also referred to as cooperative) networks while capturing essential features of fruit and vegetable distribution characterized as decentralized production and centralized procurement and marketing with externalities by the coordinator is of particular importance.

<sup>2</sup> For expositional purpose within the framework of the author's opinions, we have added the terms within brackets.

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