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SMALL FARMERS AND DISRUPTIVE INNOVATIONS IN FOOD VALUE CHAINS IN INDIA[1]

N. CHANDRASEKHARA RAO[2], RAJIB SUTRADHAR[3], THOMAS REARDON[4]

INTRODUCTION

Various segments of value chain from consumption to production that includes retailing, wholesaling, logistics, processing and production have been undergoing rapid and unprecedented changes in recent times in the country. This policy brief traces innovations in value chains brought about by new-generation start-ups, and presents an econometric analysis of field data on the impacts of procurement systems of organised retailers (supermarkets) on smallholder cultivators. It contributes to informed debate on this far-reaching transformation in the agri-food system and suggests useful policy interventions to make the transition inclusive.

INNOVATIONS IN VALUE CHAINS WITH NEW-GENERATION START-UPS

In the past few years a new generation of start-ups has emerged (Table 1). Driven primarily by the information and communication revolution, globalisation, and private initiative, these are entirely different from the earlier waves of start-ups. Broadly, they can be shown as rendering either input services or output services in marketing and related jobs. Input-based start-ups disrupt the upstream value chain and connect farmers directly with input suppliers for seeds, fertilisers, pesticides, and machinery. Some such start-ups are BigHaat.com, Flybird, AgroStar, Stellaps, EcoZen, MITRA, EM3, Skymet, YCook, IFFCOKisan, Aarav Unmanned Systems, and CropIn. Output-based start-ups connect farmers with buyers of farm produce. Some such start-ups are Ninjacart, TheAgrihub, SVAgri, Sabziwala, Flipkart, and BigBasket. Some start-ups (such as Ninjacart and BigBasket) buy directly from farmers in collection centres like supermarkets. Besides these start-ups, online retailing companies like Amazon have started buying directly from farmers, replicating the Amazon Fresh model for its grocery business, which started in 2016 in collaboration with 12,500 *kirana* (grocery) stores.

Through disintermediation and provision of quality services, increased start-up activity might benefit the sector in general and small farmers in particular. There are several start-ups in the agricultural sector, but investment in agri-based start-ups, which was only 1 per cent of the total investment in 2015, declined over 2016–17. This indicates the difficulty of attracting investment in agriculture in a developing-country setting and endorses the notion put forward five decades ago by Theodore Schultz: private investment in agriculture is deterred by risk. Against this backdrop of market failure, public support of entrepreneurship is justified for creating a level playing field for the agriculture sector and the farming community.

ORGANISED RETAIL AND SMALL FARMERS

Organised distribution of food began in the 1950s in the public sector and in the 1980s in the cooperative sector, but modern supermarkets or organised retailing of food and groceries started only in the early-2000s. Early in their development, supermarkets started procuring directly from farmers through collection centres. There have been many concerns over the entry of supermarkets with regard to farmer inclusion and profitability, and a huge body of literature is emerging in other countries on

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[2]Professor, Institute of Economic Growth, New Delhi. Email: raonch@gmail.com
[3]Assistant Professor, Omeo Kumar Das Institute of Social Change and Development (OKDISCD), Guwahati.
[4]Professor, Michigan State University, East Lansing, Michigan, USA.

this topic, but few studies have been conducted in India. This study collected data from 245 vegetable growers, some of whom sell to supermarkets and traditional markets in catchment villages of supermarket collection centres around Hyderabad. RelianceFresh, Heritage Fresh, More, and Big Bazaar have collection centres in the erstwhile districts of Ranga Reddy and Medak.

ARE THEY INCLUSIVE?

Farmer households that have access to irrigation are more likely to sell their produce in the supermarket than households that do not. Expectedly, farmer households located further from alternative marketing channels (such as wholesale markets or *Rythu bazaars*) than those near traditional markets are more likely to sell their produce to a supermarket. The access to a supermarket significantly reduces the transaction cost of selling produce for farmer households who live far from traditional markets. Having friends and relatives working in the supermarket network significantly increases the probability that they will supply their produce to a supermarket channel. However, the most significant finding is that farm size does not impede participation in modern marketing channels.

DOES PARTICIPATION LEAD TO HIGHER INCOMES?

The effect of participation in supermarket channels on the net income per acre of vegetable farming is estimated (Table 2) using different methods to control for 'farmer effect' arising out of the fact that better off farmers might self-select into participation in the modern channels. Initially, the dummy for participation in a supermarket channel was used as a treatment indicator. The result estimated shows that the effect of participation in the supermarket channel is positive and significant. The robustness of the result is vindicated by the Heckman selection correction model (Column 4 in Table 2). The estimates of OLS—which assumes that participation in the supermarket channel is random and, hence, selection bias is involved—show that participation in the supermarket channel increases the net income per acre of vegetable farming. However, once we account for selection bias in 2SLS (IVREG), the effect of supermarket participation is magnified. This indicates that farmers with lower returns from vegetable farming are likelier to earn a higher return if they participate in the supermarket channel, probably because supermarket collection centres solve some of their unobserved shortcomings in marketing their vegetable produce. The results confirm that participation in the supermarket channel increases net margin per acre by Rs 22,834.

There are wide variations among those who sell to supermarkets with regard to the share of produce sold to supermarkets. Therefore, impact on net income was estimated using this share as a treatment variable to see if the results vary (Table 2, Columns 5 and 6). The result thus estimated corroborates the earlier estimates obtained when we take participation dummy as a treatment variable, and confirms the robustness of our results. Once selection bias is controlled for, a 1-percentage-point increase in the share of produce sold to the supermarket raises net margin by Rs 378 per acre.

What do we make of the significance of other variables, which are consistent across OLS, 2SLS, and the Heckman selection correction model? It seems that being a large farmer household is not exactly an advantage in vegetable farming, as evident in the negative and significant sign of the lagged farm land. Lack of access to alternative marketing channels such as *Rythu bazaar* negatively affects the returns reported by vegetable farmers. The distance from the *Rythubazaar* has a negative and significant sign; in other words, farther vegetable farmers are from a *Rythu bazaar*, lower their likelihood of return. Access to income from other sources relaxes cash constraints; so, the income flow from off-farm sources positively affects the net margin per acre of vegetable farming.

CONCLUSIONS

The analysis of empirical evidence shows that participating in supermarket procurement systems significantly increases farmers' net income. The limited evidence from the semi-arid region of the country shows that supermarket procurement systems are inclusive of small farmers—subject to the availability of irrigation, higher area under high value crops, and education. New-

generation start-ups have introduced innovations (such as disintermediation and efficient provision of quality services) in value chains upstream and downstream. But start-up activity in food and agriculture is lower than the total start-up activity in all sectors, mainly because of risk and lower market incentives and, therefore, requires state support to overcome market failure.

The policy makers need to encourage supermarkets and new-generation start-ups to procure produce directly from farmers. It is worth considering innovative schemes (like direct farmer purchase scheme, as in China) and incentives (like tax exemption for purchases from farmers' cooperatives and construction of collection centres). Higher investment in irrigation, and a policy framework that enables diversification into high-value crops, will go a long way in this transition. Further research at the pan-India level is needed to dispassionately analyse the impacts of this agri-food system transformation.

Table 1: Start-ups and Innovations in Food Value Chains in India

Input/ output based	*Start-up*	*Innovation*	*Area of operation*	*Year of start-ing*	*Remarks*
Input based	Flybird	Developed low-cost irrigation controller called SIRI by installing sensors in soil	Karnataka, Tamil Nadu	2013	Villgro and Rianta Capital's Artha Initiative joined hands with NAARM's technology business incubator, a-IDEA, and IIM-Ahmedabad's CIIE and CIBA to invest in Flybird
	Agrostar	M-platform to procure inputs by giving missed call	Gujarat, Maharashtra, Rajasthan	2013	Raised $4 million from IDG Ventures along with existing investor Aavishkaar. Accel is leading $10 million Series B funding in 2017.
	BigHaat.com	Provides seeds and other inputs through Android App and partnered with several companies	Karnataka, AP, Telangana, Rajasthan	2015	Partnered with IFFCO eBazar to start pilot stores in Ghaziabad and Karnal to sell seeds
	Stellaps	Developed automated dairy solutions to reduce input costs using advanced cloud-based analytics and activity meters	Karnataka	2012	Funded by Omnivore Capital
	EcoZen	Developed solar-powered irrigation and cold storages. Offers a quarterly lease	Karnataka, UP, HP, Maharashtra	2012	Raised Rs.6.2 crores in Series A funding from Omnivore Capital
	M.I.T.R.A (Machines Information Technology Resources Agriculture)	Develops innovative machinery to suit requirements of farmers	Maharashtra (Nashik), Karnataka, Gujarat, AP	2012	External funding from Unilazer Ventures, the private investment arm of media veteran Ronnie Screwvala. Omnovore Capital also invested.
	EM3[f]	Makes machinery affordable by renting out. Modelled on Machinery Link Sharing of USA	M.P, Bihar, Eastern UP	2014	Raised Series A funding of Rs. 27.5 crores from Soros Economic Development Fund, via Aspada Investments
	CropIn	Uses cloud platform and get details of farms and inputs applied to make every crop traceable for meeting global best practices. Used two applications, SmartFarm and SmartRisk	14 states. Headquartered in Bangalore	2010	Supports several companies including GPI, ITC, Mahindra McCain Foods in managing their farmers and farms
	Aarav Unmanned Systems	Develops products using drones to collect farm related data and information for precision agriculture to topographic surveying and industrial inspection	Kanpur-based	2013	Series A funding from StartupXseed Ventures, 3ONE4 Capital
Output-based	Ninjacart	App-based direct farmer-to-store model. Has collection and distribution centres.	Bangalore and Hyderabad	May, 2015	Raised $3 million in Series A round of funding from Accel Partners with participation by Qualcomm Ventures, M&S Partners (Singapore)
	Agrihub	Fosters agriculture ecommerce ecosystem by bringing together seed providers, agricultural equipment providers, and retailers to improve production decisions of farmers	Bangalore-based. Working in Maharashtra, Gujarat, TN Nadu, KTK, UP	2016	-
	SV Agri	Works with potato farmers by providing better seeds as well as working on supply chain and processing	Maharashtra, Gujarat	2013	Raised Rs 25 crores in Series B funding led by impact venture capital firm Lok Capital

Input/ output based	*Start-up*	*Innovation*	*Area of operation*	*Year of start-ing*	*Remarks*
	Sabziwala	Procures directly from farmers and supplies fruits and vegetables in pre-weighted and pre-priced packs	National Capital Region	2016	-
	BigBasket	Online grocery store as well as supplier to restaurants and *kirana* stores. Started *Farmer Connect* programme to procure directly from farmers with collection centres	Bangalore-based and working in 8 tier I and 17 tier II cities	2011	Raised $ 220 million from investors

Source: Compiled by the authors from various published reports. More details can be seen from original article mentioned in the first page.

Table 2: Regression Result for Net Income per Acre in Different Econometric Specifications

Independent variables	*Supermarket dummy as treatment variable*			*Share of produce sold to supermarket as treatment variable*	
	Ordinary least squares method	Two-stage least squares method	Heckman selection correction model	Ordinary least squares method	Two-stage least squares method
Age of HHH (years)	89.99 (134.10)	105.44 (137.79)	116.03 (136.65)	31.18 (133.42)	15.07 (137.56)
Education of HHH (completed years)	410.97 (659.06)	209.91 (724.84)	60.32 (690.69)	367.25 (655.42)	237.56 (700.60)
Ratio of high value land, lagged (%)	53.45 (58.29)	24.52 (71.51)	2.72 (64.21)	52.20 (58.24)	37.69 (64.24)
Share of plot irrigated, lagged (%)	41.26 (38.89)	24.46 (45.85)	15.36 (41.58)	43.95 (38.45)	34.36 (42.42)
Family size (number of persons)	-132.07 (828.80)	-186.09 (844.58)	-217.68 (841.83)	-7.89 (824.17)	32.54 (833.82)
(Total farm land owned, lagged (in acres)	-2,108.59*** (776.720)	-2,133.2*** (789.12)	-2,164.71*** (788.11)	-2140.07*** (774.13)	-2140.93*** (780.21)
Dummy for co-operative, lagged (1=membership in groups, '0' otherwise)	3,670.73 (3,523.70)	3,410.09 (3,594.87)	3,302.96 (3,578.84)	3,983.76 (3,500.43)	4,001.32 (3,528.06)
Total farm assets owned, lagged (in rupees)	0.06 (0.04)	0.06 (0.04)	0.06 (0.04)	0.06 (0.04)	0.06 (0.04)
Total livestock owned, lagged (in rupees)	-0.01 (0.03)	-0.00 (0.04)	0.00 (0.03)	-0.01 (0.03)	-0.01 (0.03)
Dummy for off-farm participation, lagged (1 = yes, 0 = no)	7,328.22*** (2,814.13)	8,366.43*** (3,199.34)	9,058.47*** (2,984.92)	6,275.80** (2,777.78)	6,534.52** (2,838.05)
Distance from Rythu bazar (in km)	-205.68*** (71.24)	-242.19*** (88.30)	-251.99*** (74.84)	-173.25** (69.59)	-180.18** (71.23)
Dummy for supermarket participation (1 = yes, 0 = no)	10,200.16*** (2,822.31)	17,678.18* (10,768.08)	22,834.05*** (6,958.35)	-	-
share of produce sold to supermarket	-	-	-	256.43*** (63.67)	377.92* (227.90)
Constant	15,284.08 (9,737.89)	14,888.66 (9,899.35)	14,159.98 (9,875.98)	18,573.12* (9,800.77)	19,129.10* (9,928.28)
/athrho	-	-	-0.44* (0.23)	-	-
/lnsigma	-	-	9.93*** (0.06)	-	-
Observations	245	245	245	244	244
R-squared	0.163	0.138	-	0.175	0.162

Source: Calculated from field study data
Note: Standard errors are given in parentheses. ***, **, * denote significance at 1%, 5%, and 10% level of significance.
The selection equations of 2SLS and Heckman model are not presented here.