Agro-Economic Policy Briefs

Aiding the Future of India's Farmers and Agriculture

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For kind attention of:

The Hon'ble Prime Minister's Office,
the Ministry of Agriculture and Farmers Welfare,
and all others interested

On Critical Policy Issues in India's Agricultural Economy

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Creating Unified Pulses Markets to Benefit Farmers

Nilabja Ghosh

Introduction

- Pulses, despite being regular items in Indian diet, were side-lined in India's agricultural policy and Price Support Schemes (PSS) until this millennium. Grown only in a few countries, they always raised a daunting risk of scarcity. However, the significance of pulses for food security grew only when the green revolution exhausted itself. The price rise between the years 2013-2015 brought pulses at the centre of the entire macro-economic discourse. Government began to search for ways to ensure pulses security. The National Food Security Mission (NFSM) launched in 2007 was combined with Integrated Scheme of Oilseeds, Pulses, Oilpalm and Maize (ISOPOM) in 2010-11 to promote pulses production.

- Price policy too became an instrument when in 2014 the PSS, backed by a price support fund, was extended to pulses. Active purchases from producers by Small Farmers' Agribusiness Consortium (SFAC) and the National Agricultural Cooperative Marketing Federation of India Ltd. (NAFED) marked a departure from the cereal-centric public operations. At the end of 2015, pulses prices not only softened but came down.

- A lot of initiatives were taken since then such as the amendments to the Agricultural Produce Market Committee (APMC) Acts, evolution of Information and Communications Technology (ICT), the transformation of telecommunication, introduction of Integrated Scheme for Agricultural Marketing (ISAM). It is expected that all these initiatives would help pulses producers overcome the pressure of excess supply to fetch higher prices that consumers in other parts of the country are willing to pay. It is hypothesized that linking the markets through information transmission can have impact on prices in two ways: (i) official market intelligence helps in the benchmarking of prices based on information received from large influential markets and (ii) known price gradients stimulate price-equalizing trade which involves actual physical flows to markets where excess demand leave prices of same products at higher levels.

- While benchmark prices help buyers and sellers across the country to transact at auction-determined prices that are largely uniform, corrected for transport cost, trade (arbitrage) is the true conduit for the fragmented markets to move towards a 'one' Indian market. Potential product flows unrestricted by barriers such as a lack of efficient trading classes, poor infrastructure, monetary and non-monetary curbs on movements and nexus-based trade relations supplement the access to market information in creating an integrated market in which prices are tied by a long-run relation and prices move in concordance.

- Hence, this study examines the behaviour of prices of Gram and *Arhar* in the post-2010 period, with a focus on changes that followed the recent technological initiatives (2014). The study also examines the role of trade in creating markets for the producing states by looking for co-integrating (long-run) relation between top two producing states and other states' prices. Monthly nominal data reported by the Government of India in the Agricultural Prices in India are used for the study. State level prices are compiled as averages of reported *mandi* prices. For each crop, 10 states are considered for which wholesale prices are reported in the whole sample period of 2010-11 to 2016-17 demarcating two sub-periods: P-1: 2010-11 to 2013-2014 and P-2: 2014-15 to 2016-17 but due to data constraint monthly data of P-2 is truncated at December 2016.

Findings

- For Gram and *Arhar* accounting for respectively about 45 percent and 17 percent of national pulses production, Table 1 shows that Maharashtra and Madhya Pradesh are the major producers accounting for 36 percent of *Arhar*, 57 percent of Gram and 33 percent of all pulses produced in India. Madhya Pradesh has emerged as the second largest producer taking over from Karnataka in *Arhar* and Rajasthan for Gram. The other states covered are treated as consuming states though several other states are also producers especially of *Arhar* whose production is broad-based. Data suggested that NAFED is the leading agency operating in pulses followed by SFAC but procurement of *Arhar* is concentrated in Maharashtra and Karnataka and of Gram in Madhya Pradesh and Rajasthan respectively.

Table 1: Production Distribution of Gram and Arhar Across States (%) in India.

States	Gram		Arhar	
	P-1	P-2	P-1	P-2
Madhya Pradesh	38.2	41.5	10.1	18.7
Maharashtra	13.4	15.1	32.8	27.1
Rajasthan	16.3	13.3	-	-
Karnataka	7.1	8.1	15.7	15.9
Andhra Pradesh	8.3	6.5	7.7	8.0
Uttar Pradesh	6.9	4.9	10.6	7.0
Jharkhand			5.0	6.0
Gujarat			8.6	8.7
Other states	9.8	10.6	9.5	8.6
India (Million Tonnes)	8.57	7.92	2.93	3.41

Note: *P-1: 2010-11 to 2013-14, P-2: 2014-15 to 2016-17. Andhra Pradesh includes Telangana.*

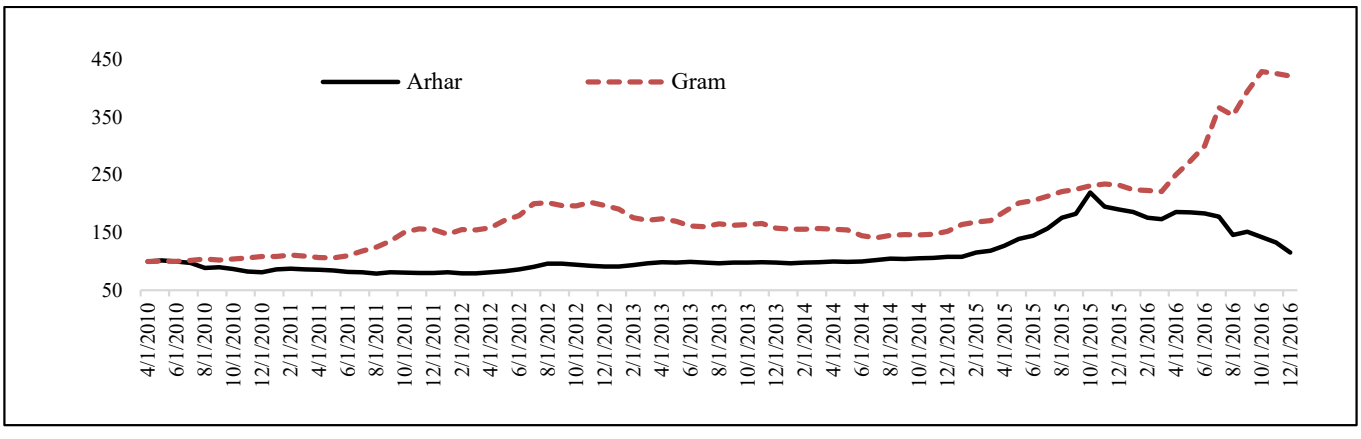
Source: *DES Website (https://eands.dacnet.nic.in/)*

- If government's goals of market reforms for farmer's welfare are to be attained, prices would be moving with a bias towards the states that produce the pulses and an inter-state convergence of prices would be evident. To the extent that trade links up the markets, prices in producing and consuming states would be showing a long-run relation and adjusting to one another in a dynamic framework so that the benefits of both consumer demand and public support would reach farmers uniformly by market processes.

- Figure 1 shows the changes in average price. Relative stability marks *Arhar* price until the end of 2014. A sudden spurt in August 2012 can be a reaction to poor rainfall. Comparatively, Gram price has been much more dynamic with sporadic rising tendencies in 2011 and 2012. Both prices started increasing from 2014, Gram showing more dynamism. Both prices reached a peak in August 2015 but while *Arhar* price fell persistently thereafter, Gram price picked up during the harvest of 2015-2016. The two crop prices continued with divergent tendencies.

- In both crops Madhya Pradesh, Maharashtra and Rajasthan are states with lowest prices despite Rajasthan not being a major *Arhar* producer. States with high prices are Karnataka, Gujarat, West Bengal and Tamil Nadu for *Arhar* and Tamil Nadu, Karnataka, Bihar and West Bengal for Gram. The range of price fell from 148 percent to 74 percent for Gram between P-1 and P-2. Corresponding fall was 113 percent to 86 percent in *Arhar*.

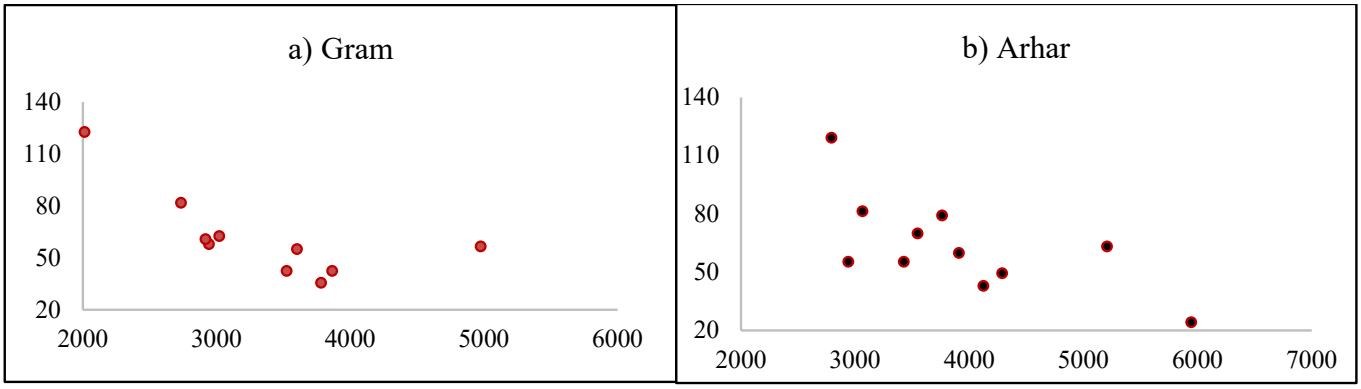
Figure 1: Price of Arhar and Gram in Study Period (Index, Base=April 2010).



Source: *Plotted by the Author.*

- Figures 2(a) and 2(b) plot the growth of average price between P-1 and P-2 against the initial average price level of P-1. Both depict an inverse relation except for a minor departure at Rs. 50 per quintal. This sign of convergence in terms of prices catching up is further supported by figures 3(a) and 3(b) plotting the price variance (CV) over the whole sample period (Figure 3).

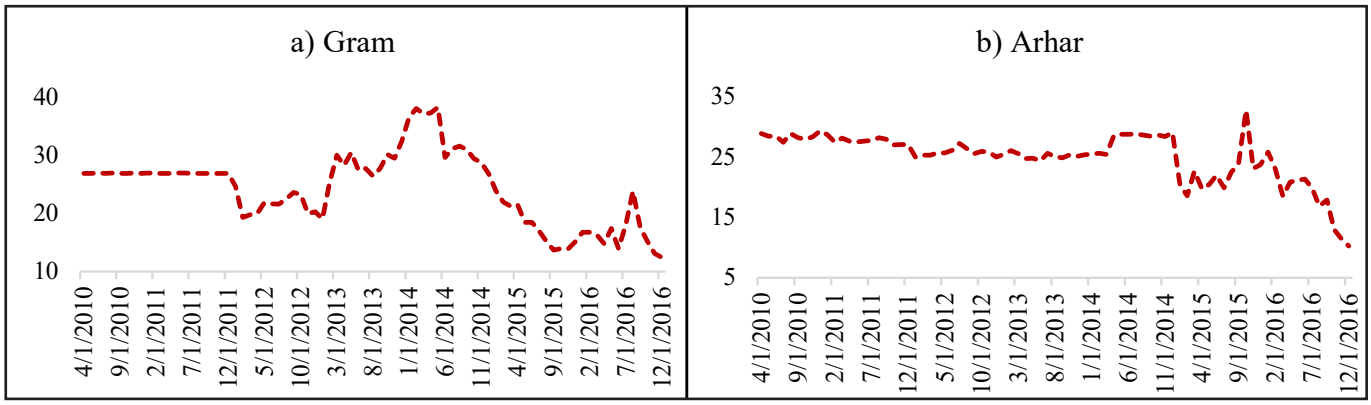
Figure 2: Scatter Diagram of Price Period-1 v/s Price Increase (%).



Source: *Plotted by the Author.*

- Inter-state variation of *Arhar* prices among study states was largely stable until a sudden decline encountered from the start of 2015 but laced with disruptions continuing till October 2015 following which the CV started declining. In Gram, the divergence was also more dynamic than *Arhar* with the CV remaining stable until December 2011 followed by reversals but from April 2014 price differential showed continuous decline. Thus, price convergence is apparent in both crops but that it happened in P-2 is additional information from the CV analysis. In Gram, the movements of CV were more pronounced and the convergence began a year earlier than *Arhar*.

Figure 3: Inter-State Price Variance (CV).



Source: *Plotted by the Author.*

- All prices are examined with sensitivity analysis for unit root using Augmented Dickey–Fuller (ADF) test with Akaike Information Criterion (AIC) and Schwarz Information Criterion (SBC) for choosing lags. Although with ADF test not all price series in P-2 were found I(1), the aberrant cases reduced with SBC, but the PP test found all series to be I(1). The plots did not suggest seasonality. Assuming, though with some caution, that the orders of integration are same, bivariate cointegration analysis was conducted between pairs of states.

- In the case of *Arhar*, linear co-integrating relation was found for Maharashtra only with 3 states in P-1 but with two states in P-2. Apart from Rajasthan, the trading partners seem to have changed. In the case of Gram, the eastern trading partners of Maharashtra seem to be replaced by neighbouring states. In P-2, Maharashtra's *Arhar* market covered other producing states Karnataka, Madhya Pradesh and Rajasthan which could be a response to public procurement. In *Arhar,* two states Bihar and Tamil Nadu are found to be co-integrated with Madhya Pradesh in P-2 whereas no trading partner was identified in P-1. In Gram, there was a notable improvement for Madhya Pradesh over P-1 to three consuming states besides

the neighbouring producing state Maharashtra with which prices in Madhya Pradesh are co-integrated in both periods.

- Error Correction Mechanism (ECM) identifies causality of price changes in P-2. In Maharashtra, no response of *Arhar* price was observed while on the contrary, prices in Bihar and Rajasthan show significant response. Similarly, for Gram, prices in Maharashtra did not react to any other state price but three states responded to its price difference. This was a contrast to Maharashtra's responses in P-1. Though *Arhar* price in Madhya Pradesh adjusts to Tamil Nadu's, asymmetric responses were noted for Gram whose prices respond to Madhya Pradesh only in Haryana and West Bengal. Madhya Pradesh, however, responds to partner Maharashtra in both periods.

Conclusions and Recommendations

- With a number of policies of ICT-enabled reforms, pulses' prices across the states have tended to converge post-2010. However, prices of both Gram and *Arhar* began declining after 2015. The tendency continued in *Arhar* but reversed in Gram. These price trends may be hurting farmers and traders especially in the states of Maharashtra and Madhya Pradesh which are major producers of pulses. While information transmission has helped to benchmark prices creating similar if not 'one' price in the country, a strong role of trade in integrating Indian markets is not confirmed by the study. The producing markets have a highly influential yet exogenous role in bringing down prices with their supply pressure. Hence, greater emphasis may be placed on demand by disseminating prices in consuming states.

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Direct Benefit Transfer in Fertilizers in Tamil Nadu: A Quick Overview

K. Jothi Sivagnanam, S. Vishnuhadevi

Introduction

- Effective targeting by eliminating all possible leakages is one of the challenges of many subsidy programs. This is more in the case of delivering fertilizer subsidy to the targeted farmers. However, the Direct Benefit Transfer (DBT) scheme has been conceived as an alternative precisely to address this challenge.

- Direct Benefit Transfer scheme had been introduced for fertilizer subsidy payments on a pilot basis across 17 districts during Rabi from October, 2016. After the successful completion of pilot phase, the scheme has been extended for the entire country from 1st September, 2017 onwards. At present 25 states/ Union Territories are on live run.

- Unlike most of the subsidy programmes where the benefits are transferred to the targeted beneficiaries, DBT in fertilizers provides a 100 percent subsidy on various fertilizer grades directly to the fertilizer company on the basis of actual sales made at the retail level. The sale and the quantum of the subsidy are tracked through the Point of Sale (PoS) devices installed at the retail shops and the beneficiaries are identified through Aadhaar, Kisan Credit Card (KCC), Voter identity card, and so on. Provisions have been made to link the Soil Health Card (SHC) data with the DBT in fertilizers as well. This ensures that the suggested mix of fertilizers is fully compatible with the soil health of the land and ascertains the appropriate use of nutrients by farmers.

- Under the DBT system for fertilizers, the 100 percent subsidy is directly released to the companies now. Previously, the fertilizer companies used to receive the subsidy on receipt of fertilisers at the district level, but now the subsidy is released after the fertilizers are sold to the farmers by the retailers through the PoS machines.

Figure 1: Farmers Using Fertilisers on their Fields.

Source: *www.bit.ly/2Jz1ON9; www.smedia2.intoday.in*

- Emphasis is given to Aadhar-based biometric authentication as it is linked to land records and SHCs of the farmers. The actual sales of the fertilizer are captured through the PoS devices installed at the retail shops and all the transactions are recorded online in the Integrated Fertilizer Management System (IFMS) on a real time basis. The claims of the fertilizer companies are processed every week and the sum of subsidy is remitted to the companies' bank account through electronic mode. The scheme has been designed in such a way to prevent any misuse or leakage of the subsidy either on the part of the seller or on the part of the beneficiaries.

- The scheme was rolled out in Tamil Nadu on 1st January 2018. Though it is too early to make any comprehensive estimation about the implementation of the scheme and the consequent realization of the intended objectives, some preliminary findings can be inferred from the immediate experience of the scheme's implementation. The study was prepared on the basis of a preliminary survey and consultation with the officials of Department of Fertilizers, Tamil Nadu.

Findings

- The DBT scheme for fertilizers seems promising in comparison to the previous fertilizer subsidy arrangement, as the whole process can be tracked in real-time. The beneficiaries are only the targeted farmers. Since the buyers are required to identify themselves through biometric IDs, and the retailers are required to make transactions through PoS devices, the sale of the fertilizers can be tracked in real-time.

- Tamil Nadu has 13 fertilizer companies, and the PoS devices were deployed in two phases. During phase I, approximately 9,643 devices were deployed and in phase II, approximately 2,601 devices were deployed. Each company had two master trainers to train the retailers.

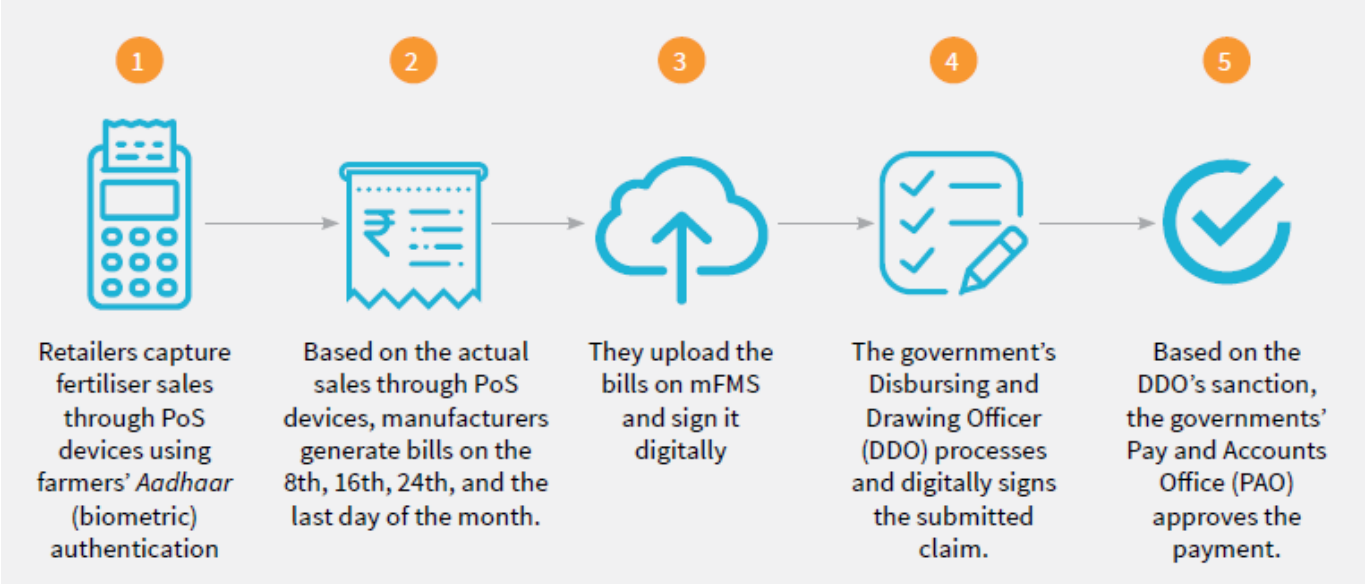
- It was found that initially, there were some problems in the deployment of PoS devices, which was supposed to be provided by the fertilizer companies. However, the situation now has improved a lot. Initially it was also difficult to assemble the retailers for the training of the PoS devices but the situation has improved a lot now.

- The retailers were found to be facing technical issues in the PoS devices such as server problem and network problem which prevented it from responding properly to the inputs given by the retailers.

- Another problem faced was of the runtime errors, that is the devices stopped in the middle of processing a transaction. In some villages of Tamil Nadu, the lack of internet availability and lack of adequate internet speed were the problems to the retailers.

- Another problem being faced by the retailers were shorter life span of battery in the PoS. The PoS also failed to capture the finger prints of aged farmers in one single attempt and this led to authentication failure. Hence, the retailer had to make many attempts to ensure the successful authentication of such farmers. All such technical snags demanded a lot of patience from retailers as this led to considerable delay and a higher transaction time.

Figure 2: Subsidy Payment Process DBT-F.



Source: *Assessment of Direct Benefit Transfer in Fertiliser, MicroSave, April 2018.*

Recommendations

- To overcome the problems related to PoS devices, the government should develop PoS device-agnostic mobile and web applications, which will allow the retailers to use various devices such as laptops, desktops, tablets, and smartphones.
- In order to overcome the issue of high transaction time due to authentication failure in the first attempt, the government should provide iris scanners at the retailer's outlet.
- The sales records in the PoS device are available for access only for a limited period of time, which is for a maximum of one month. The government should ensure that the PoS machines are reconfigured to keep the data at least for a year, so that the retailer would submit them without any excuse.
- PoS devices generate receipts only in English and most farmers do not understand English. The government should enable the provision of receipts in respective vernacular. These minor changes will facilitate to ensure complete success of this program which has clearly made a mark in delivery without leakage.

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Assessment of Dairying and its Potential to Improve the Socio-Economic Status of Milk Producers in Bihar

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Introduction

- Dairy plays an important role in the socio-economic development of the rural masses of Bihar. It produces about 9.2 million tonnes of milk accounting for 5.21 percent of total milk production in the country. However, out of the total milk production, only 9.1 percent and 2.3 percent are processed by Bihar State Milk Co-operative Federation Ltd. (COMFED) and private sector respectively. Milk processing capacity in India has grown at a Compound Annual Growth Rate (CAGR) of 4.12 percent with almost negligible growth in Bihar. The technology being used is now decades old with no primary processing/cooling facility at the farm/village level.
- Animal husbandry is the key sector of Bihar contributing about $1/5^{th}$ of the total rural income. However, livestock contributed 5.3 percent to the state Gross Domestic Product (GDP) in 2017-18. It was encouraging that livestock accounted for 33.52 percent of the total value of output from agriculture and allied activities i.e., almost 4.69 percent higher

than the national average of 28.83 percent. Milk is the most important livestock product in Bihar with a share of 73.38 percent of the total livestock output. Bihar's milk production increased to 9.24 Metric Tonnes (MT) in 2017-18 from 7.20 metric tonnes in 2013-14, indicating an annual growth rate of 6.33 percent during last five years (Economic Survey, Government of Bihar, 2018-19).

- Bihar State Milk Co-operative Federation (COMFED) has been functioning based on three tier co-operative structure in Bihar. Under COMFED, nine Dairy Co-operative Societies (DCS) are functioning and 21,002 milk cooperatives were organized till 2017-18. The number of functional cooperative societies had increased from 14,784 in 2016-17 to 15,203 in 2017-18, registering an annual growth rate of 2.8 percent over the year. Though total milk procurement per functional dairy cooperative society had marginally declined, it had registered an increase in four out of 10 locations of the project.

- In order to explore the status of dairying and its potential to improve the socio-economic status of milk producers in Bihar, a study was conducted, which relied on both primary and secondary data collected from four districts, Begusarai, Bhagalpur, Banka and Nalanda falling under the operational areas of Rajendra Prasad Milk Union Ltd., Vikramshila Milk Union Ltd., Banka Chilling Centre and Vaishal Patliputra Milk Union Ltd. respectively. Four villages (two DCS & two non-DCS) had been selected from each of the sample district. 15 milk producers comprising five each from small, medium, and large milk producers from each selected village were selected randomly. Thus, 60 milk producers from each of the sample milk union were selected for detailed study making the total sample size of 240 in Bihar.

Findings

- Awareness about quality milk production and animal health was low among non-DCS milk producers as compared to the DCS milk producers.

- Among the selected milk unions, Rajendra Prasad Milk Union, Begusarai had the highest share of milk procurement (26.74 percent) and milk holding capacity (19.76 percent) to the total state procurement followed by Vaishal Patliputra Milk Union, Patna.

- Among different products of COMFED, *dahi* was the highest sold product (6,492 MT) in 2014-15 followed by *lassi* (4,412 MT) and *paneer* (3,284 MT). These three products together accounted for 71.01 percent of state's total product.

- While crossbred cow milk was found to be the largest in quantity in the sample districts followed by buffalo milk, it was found that the population of indigenous cattle was the highest followed by crossbred cattle.

- Average yield of milk per day per animal was found higher among DCS milk producers as compared to non-DCS members in all the cases.

- More than one family labour per household was engaged in different activities of dairy while less than one hired labour per household was involved in different activities of dairy.

- Maximum quantity of milk as sold to the cooperative societies by all sample DCS farmers was at the rate of Rs. 27.60, Rs. 32.10 and Rs. 28.15 in case of crossbred cows, buffaloes and local cows respectively. Maximum quantity of milk was sold to consumers, private vendors and sweetshop owners by all sample non-DCS farmers at the rates of Rs. 35.00, Rs. 33.00, and Rs. 36.00 respectively. Non-DCS members received more price per litre as compared to DCS members.

- All the sample milk producers of DCS group confirmed that no advance payment was made for milk by the society to them, while advance payment was seen in case of non-DCS group by the consumers, private vendors and sweetshop owners.

- About 66.67 percent of the sample DCS farmers had reported that delay in payment of milk frequently existed and low prices of milk offered by the society was one of the problems they faced. On the other hand, 73 percent of the sample non-DCS farmers reported that payment of milk was made before or on time.

- In terms of overall average, 36.66 percent of DCS and 33.34 percent of non-DCS members reported that there was unavailability of chilling facilities at village level for the preservation of milk. Moreover, most of the DCS and non-DCS sample farmers had reported that poor livestock extension services existed at village level. However, there were various other major constraints, which intercepted the progress of dairying in the state.

Figure 1: Milk Producers with their Livestock.

Source: *www.benisonmedia.com; www.anthra.org*

Recommendations

- Emphasis should be given on increasing milk processing capacity in Bihar.
- To make the dairy sector attain global competitiveness, inputs' delivery system for the members of DCS as well as non-members needs to be strengthened in terms of quality, desired quantities, prices, and easy accessibility/availability.
- There is a need to strengthen the extension services as majority of milk producers were not aware of all the provisions of different schemes related to their sector.
- There is a need to enhance prices of milk sold (marketed milk) in proportion to increase in the total input costs. Marketing facilities should be made available at village level for outlets of milk and milk products to eradicate irregular sales of milk.
- The procedure for sanctioning loan for dairying should be made easier and free of unnecessary procedural complexities.
- Payment to the members of DCS should be done on time, preferably on fortnightly basis or necessarily at the end of the month. The provision of advance and bonus from cooperative societies should be properly designed to boost up milk producers.
- The costs of veterinary services and medicines should be reduced. There is a need to increase awareness among farmers about insurance of animals.

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Harvesting Solar Power: Farmers' Experience from Western India

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Introduction

- There has been an ever increasing mismatch between the demand and supply of energy in general and electricity in particular. This is posing challenges to farmers, especially small and marginal farmers located in remote areas, making them vulnerable to risks. Indian farmers and the government, both face several challenges with regard to irrigation. Electricity in India is provided at highly subsidized low tariffs, mostly at flat rates, and this has led to widespread adoption of inefficient electric pumps. Farmers have little incentive to save either the electricity, which is either free or highly subsidized, or the water being pumped out, resulting in a wastage of both. Although the government heavily subsidizes agricultural grid connections, grid electricity in rural India is usually intermittent, fraught with voltage fluctuations. Moreover, the waiting time for an initial connection can be quite long.
- Agriculture in India is distressed with an irregular and ill-spread monsoon, which makes proper irrigation a pre-requisite for sustaining and increasing

agricultural output. This is particularly true for Gujarat and Rajasthan, where rainfall is often scanty, uneven and irregular, with perennial rivers being few. Furthermore, in the absence of sufficient and reliable canal water supply, the only other option that remains with the farmers is that irrigation with the help of ground water withdrawn through either electricity or diesel-driven pumps. Provision of power for irrigation and other farm operations therefore, is a high priority area for the states. However, providing farmers reliable energy for pumping is as much of a challenge as is making the availability of water, sufficient. The high operational cost of diesel pump sets are often beyond the means of small and marginal farmers, which forces them to practice deficit irrigation of crops, considerably reducing their yield as well as income.

- Currently, India has 26 million groundwater pump sets, which run mainly on electricity or diesel. Irrigation pumps account for about 25 percent of India's total electricity use, consuming 85 million tonnes of coal annually, and 12 percent of India's total diesel consumption, i.e. more than 4 billion litres of diesel per annum.

- In this scenario, solar power could be an answer to India's energy woes in irrigated agriculture. Solar Photovoltaic (SPV) systems could pump water for irrigation while also saving 9.4 billion litres of diesel over their life cycle, if 1 million diesel pumps are replaced with solar pumps. Using solar pumps for irrigation could also cut the carbon footprint of Indian agriculture and bolster the country's role in the war against climate change.

- SPV panels could be installed on the farm itself, which could be used to generate solar power that runs the pump-set to extract groundwater for irrigation. Solar pumps come with a user-friendly technology and are economically viable.

- The Ministry of New & Renewable Energy (MNRE) has been promoting the solar-off grid programme since two decades. The programme size has increased many folds with the advent of Solar Mission, giving much impetus to various components of the programme in which solar pumping is one of the major components. Solar Pumping Programme was first started by MNRE in the year 1992 and until 2015, around 34,941 of solar pumps have been installed in the country. This number is minuscule, compared to the total number of irrigation pumps. One of the reasons for low penetration was their high costs. However, they are presently hovering around one-fourth of the price in those days. As a result, the programme has become more viable and scalable.

- The present study was undertaken therefore, with an aim to examine the important issues concerning large scale adoption of solar irrigation pumps, its feasibility and problems in adoption of the same. This study explores the status of solarisation of agricultural pumps in Gujarat and Rajasthan in Western India.

- The data were collected from three distinct groups of farmers, viz. i) farmers who had adopted Solar Irrigation Pumps (SIPs) with the help of subsidy by the government, ii) farmers who had adopted SIPs without any support in the form of subsidy, and iii) the farmers who had not adopted SIPs. The first group was of 200 sample farmers (beneficiary farmer households). The second group consisted of nine sample farmers (non-beneficiary farmers). The third group included 40 sample farmers (non-adopters). Thus, the total sample consisted of 249 selected farmers.

Figure 1: A Solar Irrigation Panel Installed in a Farm.

Source: *www.cgiar.org*

Findings

- The solarisation of irrigation pumps has been a successful experiment in both Gujarat as well as Rajasthan. It was found that both the Gross Cropped Area and the Gross Irrigated Area have increased post solarisation. The cropping pattern has also changed in favour of high value crops.

- The SIPs were found to be user-friendly, particularly for women. However, the cost of SIPs was still high for individual farmers. It was felt that community-based SIPs on the lines of cooperative in Dhundi in Gujarat *(Refer: Agro-Economic Policy Briefs – Issue 8, December 2018)*, could be helpful in making this technology accessible to marginal and low income farmers.

- Further, connecting the SIPs to the electricity grid and equipping them with solar power storage cells, could enhance their utility as well as provide the farmers with a supplementary source of income through sale of solar power in much the same way as in the cooperative in Dhundi.

- Both the central and state governments have policies and incentives in place to increase the penetration of SIPs. However, there was a need for raising awareness among farming community and for putting project delivery mechanism in place.

- Majority of the beneficiary farmers in Gujarat as well as Rajasthan suggested that solarised irrigation could be expanded if the SIPs were made more user-friendly in terms of their requirement of space, technical features as well as financing; including that for insurance.

- It was found that there was the absence of large-scale penetration of SIPs and the farmers were unaware about the benefits of solarised irrigation. All in all, solarisation of irrigation pumps in Gujarat and Rajasthan is 'a work in progress', albeit with promising prospects.

Conclusions and Recommendations

- Non-adopters of SIPs underlined the need to increase the awareness about SIPs amongst farmers through concerted efforts for communicating the same. They also opined that the portability of the solarized engines instead of fixation at a certain point would greatly enhance their utility for the users.

- Feasible costing and assistance from state/central government will encourage more farmers to opt for the technology. With partnership of state energy departments, Vidyut Vitaran Nigams, along with private partners, technology can be disseminated at a large scale.

- Large scale adoption and production will lead to cost cutting. Community based projects can reach out to marginal farmers and other low-income group individuals.

- If the individual SIPs were to be connected with the grid in order to evacuate the surplus power generated there from into the grid, it could not only prevent the wastage of solar power but also provide the farmers with a supplementary source of income by way of selling solar power.

- The farmers in both Gujarat and Rajasthan were also in need of assistance for taking insurance against risks of damage of SIPs or theft of their solar panels.

- The procedure for availing subsidy needs to be simplified and the criteria for eligibility should be relaxed so as to include more farmers as beneficiaries in both Gujarat and Rajasthan.

- There is a need of innovative policies for governing ground water level in a sustainable way. There is a need for metering agricultural water use and total water extraction by farmers using solar, electric or diesel pump.

- Solar cooperatives need to be established and individual SIPs in group under cooperative structure can be connected with the grid in order to evacuate the surplus power generated therefrom into the grid. This could not only prevent the wastage of solar power but also provide the farmers with a supplementary source of income by way of selling solar power.

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