Data-Driven Analysis of Food Corporation of India's Operations and Recommendations

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Abstract

Food Corporation of India is one of the largest supply chain management systems in Asia. The budget estimate for the FCI is Rs. 1.51 Lakh Crore which is approximately 5% of India's financial budget for the year 2019-2020 [1]. In the last 5 years, FCI's total debt tripled to Rs. 2.65 Lakh Crore [2]. It is understood that managing a massive supply chain will require huge financial capital as well. In spite of such huge investments, is the ultimate aim of FCI to build a hunger free India on track? While the FCI is enduring great stress financially and on the other side, its operations are far away from achieving its mandate for which it was commissioned. India stands at 116th rank (out of 162 countries) in achieving Zero Hunger by 2030, one of the Sustainable Development Goals from United Nations Development Programme [13]. This short paper attempts to analyze the following questions a) What are the main operations of FCI and their budget allocations b) Are the Indian states/UTs utilising the FCI's operations optimally and the causal factors which explains the utilisation of food grains by the states/UTs c) What could be the set of factors that determine the state's proposal to FCI every year. d) How the inferences can be utilized to predict future consumption for each state/UTs. The findings provide a set of key parameters which explains the operation efficiency of

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FCI in the states/UTs and parameters that could support the predictions about future grain requirements for every state and union territory. These parameters and predictions can further improve operation efficiency of the states/UTs and power the forecasting tool to estimate the FCI's expenditure for the next decade. This paper concludes with recommendations towards improving operations efficiency of FCI for hunger free India, data sets that could be worth collecting on both state and national levels that can help in improving operation efficiency of FCI.

Keywords: Food policy, Food Corporation of India, Below Poverty Line, Public Distribution System

JEL Codes: C10, C12, Q18

Section1: Introduction

The State of Food Security and Nutrition in the World [3] report shows that India retains the dubious distinction of being the country with the largest population of food insecure people. The estimates show that while 27.8% of India's population suffered from moderate or severe food insecurity in 2014-16, the proportion rose to 31.6% in 2017-19. The number of food insecure people grew from 42.65 Crore in 2014-16 to 48.86 Crore in 2017-19. In 2000, India was ranked 83 out of 113 countries and in 2019, India is ranked 102 of 117 countries in Global Hunger Index, behind its neighbours Nepal, Pakistan and Bangladesh [4]. By the global hunger index report, the hunger problem in India is in a serious condition. Though our performance on food security is poor, these rankings provide better lag indicators to measure the efficiency of the operations carried out and the outcomes achieved against the total government expenditure. These facts make us revisit the operations of Food Corporation of India (FCI) and analyse why some states/UTs better utilise the food grains and suggest models for better management of food grains. In this paper, our main contributions are to understand the offtake and allotment of food grains by the states/UTs and predicting the pattern of food requirements of the states/UTs. We suggest data resources which GoI could collect to

better manage public resources. The results of the study have an important implication in improving the operational efficiency and better utilization of public resources by FCI.

The rest of this section is segmented as follows: a) A review of role basic operations of FCI b) How working expenses of FCI operations are channelled. Section 2 provides specifics on the data sets used in the study, the methodology of collection and data cleaning tasks. Section 3 dives deeper into the regression models built for the predictions of FCIs food grains requirements and expenditures based on Minimum Support Price (MSP) of rice and wheat. Section 4 elaborates on the utilisation ratio, establishes the statistically correlating factors explaining utilisation of every state/UTs. Section 5 details the forecasting models built by leveraging the learning from the previous sections. The forecasts can be used for planning purposes of food grain procurements and budgetary requirements. This paper will conclude with notes on the limitations of the study and relevant datasets, future scope and recommendations for better data collection and quality.

The vision of FCI is to ensure availability, accessibility and affordability of food grains to all people at all times so that no one goes hungry. The effective utilisation of food grains released by FCI has an important bearing on providing food security for the nation. The primary functions of FCI are purchase, storage, movement, distribution and sale of food grains. Apart from this, FCI also ensures MSP to the farmers at the time of procurement.

1.1 Procurement, Storage and Distribution of Food grains

FCI follows two kinds of procurement systems - centralized procurement system (CPS) and decentralized procurement system (DPS). In CPS, food grains procured by the state/UTs government agencies are handed over to FCI for storage and subsequent distribution in the same state or for movement of surplus stocks for

other states/UTs. Under DPS, the state government procure, store and distribute rice, wheat and coarse grains within the state through the state agencies. The excess stocks procured by the state agencies are handed over to FCI in the central pool. The expenditure incurred by state agencies in both CPS and DPS are reimbursed by the Government of India (GoI). To facilitate procurement of food grains from farmers, the FCI which is the nodal agency of GoI, along with various state agencies undertake procurement at purchase centres which are established at various mandis and key points. All stocks that are brought to the purchase centre falling within the GoI specifications are purchased at the price support schemes. The price support schemes are decided by the GoI and it is beyond control of FCI. GoI ensures that farmers don't sell their goods below MSP through the purchase centres enabled by FCI. The MSP for paddy stands at Rs. 1868 per quintal and for wheat it is Rs. 1975 per quintal for the year 2020-21.

The storage functions assume paramount importance in FCI because of its requirements to hold huge inventory of food grains over a significant period of time. The storage infrastructure is used to meet the storage requirements for holding stocks (stocks for distribution) and for buffer stock (to ensure food security). There are 2006 godowns owned by FCI that are in operation as of December 2018 and along with state agencies FCI has the total storage capacity of 755.94 Lakh MT [5][11].

FCI undertakes movement of food grains in order to evacuate stock from surplus regions and meet the requirements of deficit regions and to create buffer stocks. FCI moved 420.24 Lakh MT of food grains across the country in the year 2017-18. Around 85% of stocks are moved by rail to different parts of the country. Inter-state movement of goods is done primarily using railways and intra-state movement of food grains is primarily by road transport [6].

Food grains are distributed by FCI through the public distribution system (PDS). In addition, FCI distributes food grains under various welfare schemes like the mid-day meal scheme, Annapurna scheme,

supply of food grains to Welfare institutions and hostels, defense / paramilitary forces, wheat based nutrition program, Rajiv Gandhi scheme empowerment of adolescent girls etc. The FCI issues the food grains at the central issue price (CIP) to the schemes. The CIP is decided by the central government and strives to meet twin objectives of price support to the farmers for their product and supply of food price is different for different schemes under which food grains are distributed. GoI fulfils the objectives of food security through Public Distribution System (PDS). The PDS system is used to ensure an equitable distribution of food grains at reasonable prices to the vulnerable sections of society throughout the year. GoI acting through FCI is also responsible to maintain stability in food grain prices throughout the country during the year, adequate buffer stock of food grains to deal with fluctuations in production and to meet unforeseen exigencies and natural calamities.

1.2 Budgetary Requirements of FCI

The main sources of revenue for FCI are from sale of food grains at PDS shops and food subsidy by GoI. The operation cost of FCI is broken down into two main components i) Economic cost - the cost incurred during procurement, distribution, movement and storage of food grains. ii) Carrying cost - the cost incurred for carrying buffer stock into next year. State and union territories purchase food grains from FCI for various schemes at the CIP and there is a top line operational loss incurred by the FCI when CIP is lesser than MSP. GoI reimburses the operational loss as food subsidy. For the year 2017-18, FCI incurred a food subsidy of Rs. 1, 16, 281.69 Crore and the total food subsidy released was Rs. 61, 981.69 Crore which accounts for only 53.3% of the subsidy incurred. The opening balance of food subsidy for the year 2017-18 to be received stood at Rs. 81, 551.71 Crore and the closing balance was Rs. 1, 35, 933.11 Crore. To meet the budget deficit and for its various short term needs, FCI avails NSSF loans, unsecured short term loans, way means and

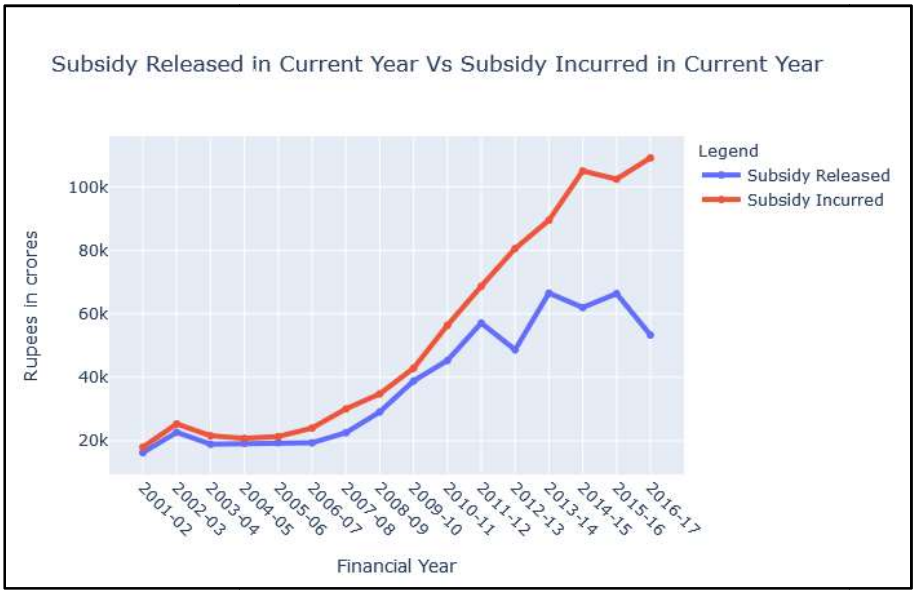

Figure 1.1 Subsidy released Vs incurred since 2001

advances, GoI guaranteed redeemable non-convertible bonds and equity capital subscribed by GoI. The working capital of FCI was met by credit limits secured from a consortium of banks with a guarantee from the GoI. However Figure 1.1 shows that the gap between subsidies incurred vs. released is widening through 2011. There lie a lot of challenges, an economic opportunity and a collective responsibility to reduce the financial burden of FCI.

Section 2: Datasets Collected and Data Cleaning Methodology & Specifications

The state-level data on rice and wheat allotment and offtake for the period 2003-2019 were collected. The total allotment (offtake) was calculated as sum of rice allotment (offtake) with wheat allotment (offtake) for each state-year pair. The allotment-offtake (AO-gap) is the gap between allotment and offtake for each data point in total allotment and the utilisation ratio captures the extent to which allocated food grains are used by the states/UTs and it is calculated as ratio between offtake and allotment.

A number of other supplementary datasets were used in the analysis. The data for the DPS status of states were collected from FCI website. The data on current GSDP of the states/UTs from 2011-2019, state-

wise road length and highway length from 2011-2016 and length of railway networks in a state from 2011-2017 were collected from the Handbook of India statistics compiled by Reserve Bank of India. The data on population of Indian states from 2011 and population projection for 2012 - 2036 of states were obtained from the Office of the Registrar General and Census Commissioner, GoI. Official estimate of BPL data exists only for 2011. For years after 2011, we considered a uniform BPL change rate across all states from -1% to +3% in steps of 0.01. The optimal BPL change rate was chosen based on the minimum error derived from the regression model fitting total allotment.

An utilisation ratio of greater than 1 occurs when offtake greater than allotment for a state-year-offtake-allotment data point. It indicates the presence of unnatural circumstances like drought/flood due to which states might be forced to utilize comparatively more food grains than the allotment as relief materials. In the analysis of AO-gap, such data points were removed. Data points which are more than three standard deviation away from the mean were considered as outliers and such points were also removed. No data point is otherwise removed as noted. Results were rounded to two decimal places.[3]

Section 3: Factors Influencing States' Proposals

The states/UTs run welfare schemes in both state level and nation level like mid-day meal scheme, nutrition programs, Annapurna, SABLA etc. They satisfy food grain requirements of these various programs through FCI and in some cases states also do open market procurement. The states and union territories purchase food grains from FCI whose cost is reimbursed by the government of India as food subsidy. In this section, a detailed study of factors which could explain the state/UTs allotment proposal to FCI which might potentially lead to better food grain logistics is conducted.

[3]The dataset used and analysis made are available at https://github.com/arunpalaniappan/fci.

The following approach is implemented to predict food grain requirements of the states and union territories. The two main factors considered which could explain the food grain proposal of the states are population and below poverty line estimates and it was found that population explains better than BPL estimates. As a next step, linear regression models with population as a primary variable and other factors as secondary variables which could help in improving the prediction were built and studied. One key observation was that not all the states and union territories consume rice and wheat in the same way. The proportion of rice in total allotment of state as a secondary variable for predicting rice allotment and proportion of wheat allotment in total allotment of state as a secondary variable helped us in improving our predictions.

3.1 Population and BPL Estimates as Predictors

Food grains bought by states are primarily used to feed the food insecure population and a majority of food insecure populations are below and around the poverty line and they also happen to be the largest set of beneficiaries. It is a natural choice for the population and BPL estimates to be a good predictor for food grain requirements of states. The key challenge in using BPL data is that the official poverty line data as estimated by the Tendulkar committee exist only 2011 and not available for the subsequent years. This leads us to the null hypothesis that *BPL estimates is a better predictor than overall state Population*. To validate this hypothesis, two regression models were built to find the better predictor. For this part of study, census population and projection data for the years 2011-2019 were used. Along with this, the BPL data for 2011 and BPL estimates for the subsequent years were used. To develop the BPL estimates, a uniform BPL change rate across all states from -1% to +3% in steps of 0.01 was considered. The optimal BPL change rate was chosen based on the minimum error derived from the regression model fitting total allotment across the

years. By this methodology, the optimal BPL change rate obtained was 0.83% i.e. there is a constant increase in BPL population by 0.83% during the period 2011-2019. In both the models, the dependent variable is total allotment of food grains (rice allotment + wheat allotment) to states. In the first model, the independent variable is the population of states over the years and there were 299 data points. The first model is,

$$total\_allotment = A0 + A1\ population \quad \textbf{... (A)}$$

and in the second model, the independent variable is below poverty line population of states and there were 287 data points. The second model is,

$$total\_allotment = B0 + B1\ BPL\_estimates \quad \textbf{... (B)}$$

The official estimates of below poverty line exist only for 2011 and for years after 2011, below poverty line population was enumerated and the method of enumeration has been discussed in section 2. Outliers were removed as points which are 3 times the standard deviation away from mean. The results of the models built are shared below.

	A	B
Constant	8.82E+01	3.69E+02
Population	4.82e-05 *** (6.381e-07)	
BPL Population		1.173e-04 *** (-3.73e-06)
R-squared	0.9507	0.7764
Adjusted R-squared	0.9505	0.7756
Number of observations	299	287

Table 3.1 Model Built for Estimating Total Allotment

The observation is that the model result contradicts the null hypothesis. It was expected that BPL population to be a better estimator than overall population but it turned out the other way. This result has a significant implication because people falling under BPL category are more prone to hunger than the rest of the population and hence, BPL population should explain better than population of state. People under BPL are also more likely to consume food grains from fair price shops. This suggests two possible hypotheses - 1) states and union territories are not well targeting food insecure population 2) BPL estimates are miscalculated. We discuss the implications of the former point here and latter point in further sections and data recommendation.

In the 2014 Global Hunger Index report, India ranked 55 out of 76 participating countries and in 2019 India skipped back to 102nd place out of 117 countries, suffering from a serious level of hunger [4][10]. For the period 2010-2019, average food grain distributed as subsidy by FCI is 6.5 Crore MT. Assuming a constant 300 million BPL population over these years, every individual should have been benefited with 18.06 kg of food grains per month. This suggests that the states and union territories have failed at targeting food insecure population groups and in extension there is very shallow targeting and benefits delivered to the BPL population. It is to be noted that the Rangarajan Committee reported the BPL population to be at 363 million.

A better targeting of the food insecure population will also bring down the food subsidy amount which impacts our nation's budget (6% of budget and ~1% of India's GDP). This will significantly improve India's ranking in hunger index reports. The first low hanging fruit to improve hunger index scores and reduce budgetary strain for FCI is to better target the food insecure population. The states and union territories tend to overestimate the required food grains to reduce the type-1 error of missing food insecure

population. Though overestimation is a potential issue that is to be addressed, the states/UTs should focus and invest heavily on utilising the allotted grains and distribute them to their beneficiaries periodically. The next section details a quick analysis on utilisation ratio of the states/UTs and a set of factors that might potentially impact their utilization capacity.

Section 4: Utilization of Allotted Food Grains

Having studied how the states and union territories can make better data oriented proposals, in this section, a detailed analysis of state-level utilisation ratio and causal factors which might be responsible for low utilisation ratio is done. A state is under-utilizing food grains when it offtake is less than 70% of the allotment and over-utilizing food grains when offtake is greater than allotment. States tend to over-utilize food grains when their actual requirements exceed expected requirements. Natural calamities like drought, flood and cyclone can cause over-utilization of food grains since states require more food grain for relief measures during natural calamities.

4.1: Analysis of State-Level Utilisation Ratios

During the period 2003-2019, 20 states/UTs offtake exceeded allotment in 2014-15 and 19 states/UTs exceeded allotment in 2016-17. The top 4 states which over-utilized are Chandigarh, Punjab, Sikkim and Nagaland each 7 times during the period 2003-2019. The top 3 under-utilizing states are Andaman and Nicobar Islands (17 times), Pondicherry (12 times), Daman and Diu (11 times) and Dadra and Nagar Haveli (11 times). Figure 4.1 shows that the allotment-offtake gap significantly reduced over the years. The efficient utilisation of food grains also bears importance on reduction of poverty in the nation as the poverty rate substantially declined over time. Table 1 in the appendix shows the state-year wise utilisation ratio for the years 2011-2019. The focus is now shifting towards answering questions on what factors might cause low

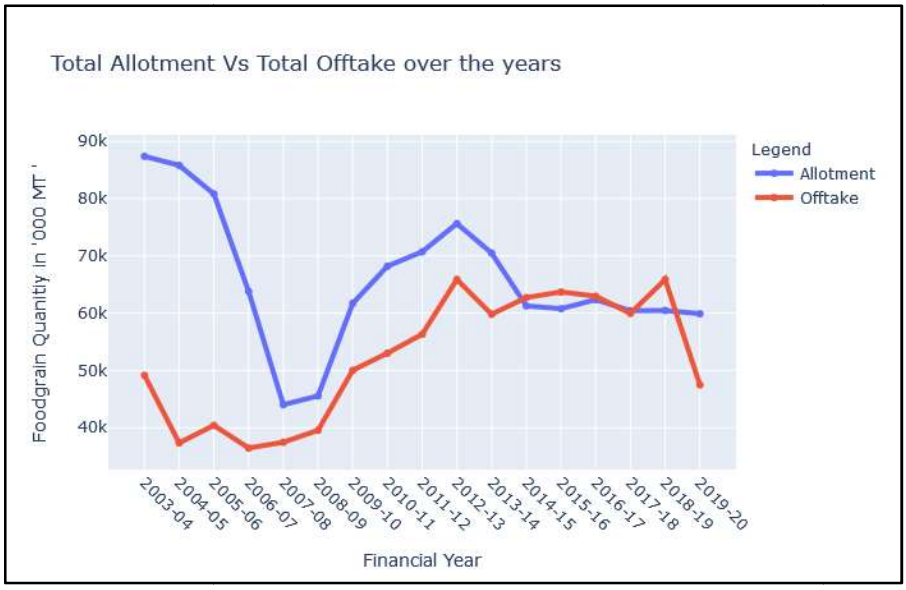

Figure 4.1 Year-Wise Total Offtake vs. Allotment

utilisation of food grains in the state/UTs. The over-utilization generally occurs during extraordinary circumstances like natural calamity or pandemic. The overutilization does not create operational issues as long as the FCI has maintained the minimum buffer stock mandated by GoI.

4.2 Factors influencing Utilisation Ratio

A regression based statistical model is built to find a set of correlating factors which explains low utilization of food grains by the Indian states. A wide range of explanatory variables like road density, length of road, railway length, density of railway network, GSDP of a state, the year in which DPS procurement is introduced to find the extent of fit. The following models are tested for optimal fit to study the effect of each variable on utilisation ratio.

utilisation_ratio = B0 + B1 log(state_road_length) + B2 log(state_highway_length) + B3 log(railway_length) + B4 log(gsdp) … (B)

The residual error and adjusted R-squared values obtained from the model mentioned above are 0.105 with 92 degrees of freedom and 0.322 respectively. Based on these model statistics, the intra-state road length outperforms other variables. It is intuitive that better district and village road infrastructure is required to deliver the last-mile service to the beneficiaries at the PDS centres. The state highways are critical to the movement of food grains between district hubs. However, this variable holds comparatively lesser significance. The railway length and GDSP variables also have similar significance as compared to state highways. In the north-eastern states, the model might under-estimate the effect of the railway network because in those states, rail infrastructure is weak and most goods are transported by road network. On the other hand it might also overestimate the effect of road networks for the same reasons. The states with higher gross state domestic product (GSDP) consume food grains better since those states are expected to have better infrastructure. Here, this applies as proper storage facilities for food grains like godowns and warehouses, stronger distribution networks and better human resources to manage the process.

As discussed earlier, FCI follows two kinds of procurement systems - centralized procurement system (CPS) and decentralized procurement system (DPS). A two sample t-test to test the utilisation ratio of states following decentralized procurement systems and centralized procurement systems to test the hypothesis that whether the DPS allows for better utilisation. We saw a significant difference in the utilisation ratio between the two systems (t-value = 4.453, $P < 0.001$). The States/UTs with decentralized procurement systems are able to utilise the allotted grains better than the states/UTs with centralized procurement systems. For the states/UTs following the DPS system, there will be lesser steps involved in reaching the end

consumer since the food grains are internally managed by state agencies and this enables quicker movement of food grains and less wastage.

To summarize the learning from the previous sections, there is a significant over-estimation which adds to financial stress of FCI and on the other hand, the food insecurity has become even more alarming across the country. There are several factors like the state's road infrastructure that can contribute to better management of allocated food grains by the states/UTs. Motivated by these learning, a forecasting model was built to predict future requirements of FCI.

Section 5 Forecasting FCI's Future Requirement of Food Grains and Budget

Since population was a better estimator than BPL population, population was the primary independent variable used to predict rice allotment and wheat allotment. The analysis suggests that the population of a state/UT along with the proportion of rice/wheat consumed are the influential factors in estimating future requirements. The percentage of rice/wheat allotment in total allotment is taken as a proxy for the proportion of population consuming rice/wheat. The model uses the moving average of rice/wheat proportions of the previous three years since, for prediction, the current year's rice/wheat proportion will not be available. The model built for rice allotment is

$$rice\_allotment = C0\ population + C1\ rice\_moving\_perc + C2 \quad \textbf{… (C)}$$

There were 288 data points over the years 2011 - 2019 input for the rice allotment model. The model used for wheat allotment is

$$wheat\_allotment = D0\ population + D1\ wheat\_moving\_perc + D2 \quad \textbf{… (D)}$$

There were 284 data points over the years 2011 - 2019 input for the wheat allotment model. Outliers were removed as points which are 3 times the standard deviation away from mean. The results of the model are described in the below table.

	C	D
Constant	-8.95E+02	-4.05E+02
population	2.716e-05 *** (8.10e-07)	2.043e-05 *** (6.69e-07)
rice_moving_perc	1.532e+03 *** (9.239e+01)	
wheat_moving_perc		1.128e+03*** (7.504e+01)
R-squared	0.8074	0.8381
Adjusted R-squared	0.806	0.837
Number of Observations	288	284

Table 5.1: Models built for predicting rice/wheat allotment

The model built in this section is used to forecast food grain requirements of the state/UTs for the next 5 years. The rice_moving_perc/wheat_moving_perc parameter was taken to be the historical average of proportion of rice/wheat consumption in the state over the years 2003-2019. Table 5.2 provides the forecasted total grain procurements for 2020-2025. A state-level forecasted value is provided in Appendix Table 2 and Table 3.

Rice & Wheat Procurement Forecasts for 2020 - 2025.
The Unit is '000 Metric Tonnes

Year	Rice Procurement	Wheat Procurement
2020-21	39,743	30,953
2021-22	40,115	31,253
2022-23	40,439	31,514
2023-24	40,772	31,775
2024-25	41,107	32,036

Table 5.2 Rice and Wheat Procurement Forecasts for 2020-2025

The minimum support price for paddy for the year 2020-2021 stood at Rs. 1868 per quintal and for wheat the minimum support price is Rs. 1925 per quintal. Assuming constant prices, throughout the period 2021-2025, we derive at a minimum estimate of FCI's expenditures for grain procurement. The total subsidy can be estimated at an additional 16% of the procurement cost forecasted above since 84% of total cost is incurred at the procurement stage [8]. The estimates through the years are listed in Table 5.3.

Total Grain Procurement & Cost Forecasts for 2020-2025

Year	Total Grain Procurement('000 MTs)	Total Procurement Cost (in Crores)
2020-21	70,695	129515.22
2021-22	71,367	130731.63
2022-23	71,952	131873.79
2023-24	72,547	133015.97
2024-25	73,143	134158.04

Table 5.3 Total Grain Procurement and Cost Forecasts for 2020-2025

Section 6 Conclusion

It is evident that states are not precisely targeting food insecure people. In this paper, the factors that explain low utilization of food grains by Indian states/UTs and predictive models which could help FCI to make future forecasts and planning are developed. The analysis showed that states with better transport infrastructure and GSDP utilize allocated food grains better. Much work needs to be done to get a deeper

understanding of why they consume better. Detailed studies are needed to determine the effect of impact on better warehouses and godowns on the states/UTs utilization. Fair-price shops which are not functioning or at inaccessible locations might also explain the low consumption of food grains in the state. Another direction of future work is to study what happens to the food grains which are not lifted by state. Questions remain whether they are added to buffer stock of FCI or become unfit for consumption or they are sold in the illegal markets.

The predictive models that are built to find future requirements of food grains suggest that population along with proportion of rice/wheat can be good predictors. It is clear that the below poverty line data can be an accurate predictor but it is only estimated once in every 10 years. After a series of economic changes and shocks in the form of demonetization, introduction of Goods and Service Tax and covid-19 crisis, more people would have been pushed back into the poverty line and become food insecure [7][12]. One of the strongest recommendations is to collect BPL data and monitor food insecure localities more frequently at least once in every 5 years to start with. The Household Consumer Expenditure survey by the National Sample Survey Office (NSSO) could also help in finding food insecure populations and it should be continued every year. The NSSO survey data will help in finding the states/UTs or districts that should focus on food insecurity issues. However, it is the primary role of the state, district and local government bodies to collect individual household level data to find food insecure populations and act on subsequent policy making. This will lead to evidence based policy making.

The current implementation of PDS and Targeted Public Distribution System (TPDS) is comparatively simple since the population estimates is assumed to be static. This facilitates operationally simple frameworks for storage and logistics. With the implementation of *One Nation One Ration Card* scheme, the underlying assumption is that the population can migrate across states for work and livelihood and still be a

beneficiary of the PDS/TPDS system. However, the lack of data on migratory population who are also food insecure will impact states proposals for all food schemes. This might also lead the states/UTs to make an even higher estimation of food grains required and ultimately wasted. This will strain the food distribution system and further strain the already strained FCI budget. A universal framework is needed for the states/UTs by which they can request allotment from FCI. The suggestion is to deploy the universal formula to find the required amount of food grains in each state. The next suggestion is the need to establish an independent central auditing body to audit the operations of the FCI and improve upon them. The auditing body should audit the whole process cycle of food grains - from procurement to distribution and provide recommendations to FCI in doing efficient operation. The recommendation of the auditing body could be used to improve process efficiency in procurement, reduce wastage of food grains in storage, quicker movement of food grains with low wastage in transport and to keep a check on whether food grains are reaching the food insecure.

The study also recommends greater awareness on the Food Security Act (FSA) and the benefits they are entitled to be created across the population by the state/UTs and local authorities. It is to be understood that achieving the zero-hunger goal is a collective responsibility of the entire nation. Good policy making needs good quality data. An overall lack of robust data system hamstrings critical studies related to operations of Food Corporation of India. Collecting granular data at each stage of the FCI process - from procurement to consumption will be helpful to do these studies. It also becomes imperative to collect and maintain granular data on food insecure population groups in every state/UTs. Developing a robust migration database can help the state and local bodies to understand the patterns of the floating population and this will largely help in precisely targeting welfare schemes and calculate better estimates of food grain requirements. The use of smart cards and Aadhar cards at fair-price shops is a great step in that direction.

However, there are practical challenges that are to be addressed. Further granular study can be done by analyzing scheme wise requirement and utilisation of food grains by the states/UTs.

The authors strongly believe that India can steadily progress on sustainable development goals agreed at the UN to build a better future for all. This study is expected to provide its minimum contribution towards that goal and the mistakes are owned by the authors alone.

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Appendix

Table 1

Utilisation Ratio by State/UT 2010-2019

State.UT	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
A&N ISLANDS	0.55	0.50	0.27	0.08	0.54	0.61	0.68	0.56	0.59	0.31
ANDHRA PR	0.76	0.74	0.99	0.83	0.96	1.00	0.99	0.95	0.98	0.60
ARUNACHAL	0.75	0.76	0.76	0.73	1.01	0.93	1.04	1.00	0.99	0.59
ASSAM	0.78	0.76	0.90	0.87	1.06	0.97	0.98	0.91	0.96	0.56
BIHAR	0.76	0.70	0.69	0.80	1.00	0.90	0.94	0.97	0.94	0.72
CHANDIGARH	0.47	0.72	0.31	0.32	1.34	2.90	26.63	25.91	82.41	32.18
CHHATTISGARH	0.93	0.86	0.87	0.84	1.01	0.97	0.93	0.97	0.95	0.56
D&N HAVELI	0.19	0.87	0.28	0.32	1.11	0.97	0.96	0.98	0.85	0.62
DAMAN & DIU	0.22	0.71	0.15	0.04	0.43	0.81	0.89	0.95	0.85	0.72
DELHI	0.73	0.71	0.73	0.82	2.01	1.66	1.92	0.99	0.92	0.90
GOA	0.70	0.84	0.54	0.73	1.13	0.98	1.24	0.98	1.22	0.70
GUJARAT	0.75	0.72	1.22	1.30	1.00	0.97	1.00	1.01	0.86	0.73
HARYANA	0.75	0.76	0.73	0.86	1.53	2.40	1.87	0.92	4.50	2.05
HIMACHAL	0.75	0.86	0.85	0.90	1.07	1.01	1.04	0.97	1.00	0.84
J & K	0.76	0.88	0.85	0.87	1.08	1.10	1.48	1.19	1.28	0.81
JHARKHAND	0.71	0.70	0.72	0.70	0.77	0.78	0.91	0.93	0.97	0.62
KARNATAKA	0.78	0.84	0.82	0.90	1.10	0.94	1.02	1.13	1.24	0.69
KERALA	0.84	0.89	0.86	0.81	1.06	0.97	1.06	1.00	1.03	0.67
LAKSHADWEEP	0.89	0.90	0.17	0.12	0.84	0.87	1.26	1.17	0.95	0.42
MADHYA PR	0.86	0.85	0.99	0.85	1.32	1.87	1.10	0.95	1.72	1.02
MAHARASHTRA	0.69	0.72	0.78	0.81	0.95	0.88	0.99	0.93	0.86	0.68
MANIPUR	0.43	0.91	0.84	0.77	0.98	0.65	0.97	0.90	1.03	0.59
MEGHALAYA	0.78	0.86	0.79	0.85	1.05	0.93	1.03	1.01	1.00	0.64
MIZORAM	0.72	0.73	0.63	0.73	0.87	0.88	1.01	0.77	0.54	0.67
NAGALAND	0.92	0.91	0.85	0.80	1.14	1.04	0.96	1.01	1.00	0.62
ORISSA	0.81	0.86	0.92	0.88	0.95	0.89	1.11	1.06	0.91	0.71
PONDICHERRY	0.70	0.79	0.54	0.39	0.24	0.38	7.99	0.67	1.46	1.32
PUNJAB	0.66	0.67	0.71	0.82	1.40	2.30	1.66	1.53	2.17	1.91
RAJASTHAN	0.83	0.87	0.90	0.90	1.07	0.99	0.69	0.80	0.92	1.00
SIKKIM	0.85	0.90	0.63	0.64	1.04	1.05	1.03	1.04	1.04	0.62
TAMILNADU	0.80	0.84	0.95	0.87	1.01	0.98	1.10	1.08	1.03	0.67
TELANGANA					0.88	0.94	0.88	0.97	0.97	0.67
TRIPURA	0.71	0.86	0.86	0.91	1.05	0.96	0.99	0.99	0.99	0.62
UTTAR PR	0.82	0.88	0.92	0.82	0.90	0.98	0.92	0.98	0.95	0.80
UTTRANCHAL	0.69	0.73	0.75	0.81	1.00	0.90	0.90	1.02	1.00	0.83
WEST BENGAL	0.77	0.78	0.86	0.79	1.00	0.93	1.08	1.03	1.11	0.93

Table 2

Rice Forecasts for 2020-2025

The units is '000 Metric Tonnes

State.UT	2020-21	2021-22	2022-23	2023-24	2024-25
A&N ISLANDS	152	152	152	152	152
ANDHRA PR	1,955	1,963	1,968	1,973	1,978
ARUNACHAL	522	522	523	523	523
ASSAM	1,303	1,314	1,323	1,332	1,341
BIHAR	3,306	3,355	3,405	3,455	3,504
CHANDIGARH	0	0	0	0	0
CHHATTISGARH	1,191	1,202	1,211	1,220	1,230
D&N HAVELI	205	206	207	209	210
DAMAN & DIU	0	0	0	0	0
DELHI	0	0	0	10	20
GOA	89	89	90	90	90
GUJARAT	1,421	1,446	1,469	1,493	1,516
HARYANA	0	10	19	29	39
HIMACHAL	0	0	0	0	0
J & K	460	463	466	468	471
JHARKHAND	1,340	1,355	1,368	1,382	1,395
KARNATAKA	2,182	2,196	2,207	2,219	2,230
KERALA	1,247	1,252	1,256	1,259	1,263
LAKSHADWEEP	52	52	52	52	52
MADHYA PR	1,744	1,775	1,803	1,831	1,859
MAHARASHTRA	3,230	3,261	3,288	3,314	3,341
MANIPUR	524	525	526	527	528
MEGHALAYA	527	528	529	530	530
MIZORAM	524	524	524	525	525
NAGALAND	307	307	308	308	309
ORISSA	1,576	1,581	1,585	1,588	1,592
PONDICHERRY	290	291	292	293	294
PUNJAB	29	35	41	46	51
RAJASTHAN	1,318	1,346	1,369	1,393	1,417
SIKKIM	410	410	410	410	410
TAMILNADU	2,483	2,492	2,499	2,505	2,511
TELANGANA	1,584	1,591	1,596	1,601	1,606
TRIPURA	579	580	581	582	583
UTTAR PR	6,573	6,654	6,719	6,784	6,849
UTTRANCHAL	160	163	167	170	173
WEST BENGAL	2,459	2,476	2,489	2,502	2,515

Table 3

Wheat Forecasts for 2020-2025

The units is '000 Metric Tonnes

State.UT	2020-21	2021-22	2022-23	2023-24	2024-25
A&N ISLANDS	0	0	0	0	0
ANDHRA PR	771	778	781	785	789
ARUNACHAL	0	0	0	0	0
ASSAM	520	528	535	542	549
BIHAR	2,647	2,686	2,725	2,764	2,804
CHANDIGARH	623	624	624	624	624
CHHATTISGARH	370	379	386	393	401
D&N HAVELI	0	0	0	0	0
DAMAN & DIU	211	212	213	214	215
DELHI	935	943	951	960	968
GOA	55	55	56	56	56
GUJARAT	1,883	1,903	1,921	1,940	1,958
HARYANA	1,297	1,305	1,313	1,321	1,329
HIMACHAL	381	382	383	384	385
J & K	279	282	284	286	288
JHARKHAND	630	642	652	663	674
KARNATAKA	1,183	1,195	1,204	1,213	1,222
KERALA	591	595	598	601	604
LAKSHADWEEP	21	21	21	21	21
MADHYA PR	2,249	2,273	2,296	2,318	2,340
MAHARASHTRA	2,791	2,816	2,837	2,858	2,879
MANIPUR	0	0	0	0	0
MEGHALAYA	0	0	0	0	0
MIZORAM	0	0	0	0	0
NAGALAND	0	0	0	0	0
ORISSA	698	702	705	708	710
PONDICHERRY	0	0	0	0	0
PUNJAB	1,317	1,322	1,326	1,330	1,334
RAJASTHAN	2,363	2,385	2,403	2,422	2,441
SIKKIM	0	0	0	0	0
TAMILNADU	1,363	1,370	1,375	1,380	1,385
TELANGANA	421	426	430	434	438
TRIPURA	0	0	0	0	0
UTTAR PR	4,643	4,707	4,758	4,809	4,861
UTTRANCHAL	414	416	419	422	424
WEST BENGAL	2,294	2,307	2,318	2,328	2,338