The Extent of Processing of Agricultural products: Towards creating a Statistical database in India

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Abstract

The absence of a data protocol on the agro-processing activities in India is a serious impediment to public policy for promoting the food processing sector. Available data supporting the government is based on perceptions and insider information rather than on any scientific study and uniform methodology and product classification. This paper is an attempt to initiate the process of building up data on processing of agricultural products using methods open to deliberation and further development. Unit level data collected from registered factories by the Central Statistics Office under the Annual Survey of Industries (ASI) are analysed with considerable attention being placed on data validation through cross-checking. Overcoming the inadequacy in the dataset by using the multiple sources of official information, estimates of the extent of processing of a large number of agro-products are worked out and presented.

1. Introduction

1.1 The wide range of topography, soil quality, bio-diversity and climatic conditions prevailing in India makes agriculture advantageous for producing a large number of crops and non-crop products. The possibility of processing some of these products to value added items creates a significant potential for the development of the agricultural sector in India as also for generating employment within and outside agriculture. Food processing industries in India in particular have been accorded the status of a sunrise sector[2] in the recent period.

1.2 A policy focus on the agro-processing sector to strengthen the links between agriculture and industry will require effective monitoring and reformulating of the existing schemes for which it is vital to maintain reliable data relating to production, processing and other aspects of the sector. Unfortunately no systematic and scientific data pertaining to food processing activities based on 'harmonised concepts, definitions and classifications' is apparently available (MOFPI, 2012). The available data supporting the government policy-making process is sourced from different functional departments, business/industry associations, research institutions and NGOs. The data produced by these sources is not

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[2] The Ministry of Food Processing Industries (MOFPI) created in 1988 is implementing a number of programmes to provide the necessary stimulus to the food processing sector. A National Mission on Food Processing (NMFP) is due for implementation soon in order to maintain synergy between the agricultural Plans of the states and development of food processing sector and to decentralize the implementation of the Central schemes to invite state participation.

mutually comparable for lack of uniformity of methodology and product classification. Moreover, the Industry Associations and export groups often rely on insights, subjective projections, and insider information. These methods make it difficult to validate the data and present them in public domain.

1.3 Thus the lack of comprehensive and reliable data base on agro-processing industries, especially the food processing industry and indeed the absence of a unified data protocol is a constraint on research, policy formulation and decision making. Developing a reliable, systematic and official database relating to critical parameters on the food processing sector will be of vital importance as the sector evolves. This paper is an attempt to initiate this process in order to support the Ministry of Food Processing Industries and the Ministry of Agriculture.

2. Agro-processing to Develop Indian Agriculture

2.1 Agro-processing enterprises are seen to have a strategic developmental role in countries where farming and fishing are major productive activities (Abbot, 1994). In India agriculture remains even today the key source of livelihood, supporting more than 50 per cent of the population. Food processing is where business meets agriculture. Agro-processing being a crucial linkage between the large unorganized agriculture on the one hand and the formal industrial sector on the other can be seen as a way to integrate farming with the processing to enhance farm incomes[3]. Delivery of desired quality, quantity, nutritive value, packaging, and the convenience of shopping and of home-preparation to the downstream users are the motley of challenges facing an organized food processing sector. It is foreseen that the growth and development of the processing sector will improve the realization of the Farmers, enhance agricultural production, productivity, elongate shelf-life of products, reduce the wastage of farm products[4], provide diversified food options at competitive prices to consumers and better employment opportunities to communities. High industrial growth attained in the aftermath of liberalization and deregulation (Nagraj, 2004) even as agriculture and the food processing sector is mired by constraints suggests that the development of the agro-processing sector as industry is an unfinished task.

2.2 As farmers move from subsistence oriented to market driven production, shifts in cropping patterns away from conventional food grains are likely. At the same time, emphasis will move towards productivity and quality of output. Income earning capacity of the farm sector will take precedence over the traditional importance placed on food production as a way to food security. A close positive relation observed between the agricultural growth and reduction of poverty by World Bank's the World Development

[3] Agricultural and fish products need to be processed so that they may be stored, transported conveniently over distances, and presented in forms appealing to consumers to extend the markets in which these products can be sold through scientific marketing techniques, enable producer to access markets not otherwise accessible, and to permit sales at higher prices and in larger quantities.

[4] A study undertaken by the Central Institute of Post Harvest Engineering and Technology (CIPHET, 2010), Ludhiana has estimated the wastage in various produce, cereals (3.9 to 6 %), pulses (4.3 to 6.1 %), oilseeds (6 %), fruits and vegetables (5.8 to 18 %).

Report (2008) has vested agriculture with a significance that transcends its conventional role as a food provider and an evolving study by IFPRI (Gulati et. al, 2011) shows a strong and significant relation between agricultural performance on one hand and income, under-nutrition and women's status on the other.

2.3 While processing of agricultural products is generally seen as an essential process that separates production from consumption, much of this is conducted in the domestic domains (kitchen). The informal sector traditionally also takes up a major role where basic and semi-basic processing takes place. However, in this frame of operation, there are large compromises on quality, quantity, nutritive value and efficiency. Lack of standard norms, transparency on the inputs used and social protection of the workers involved in processing in the unorganized sector undermines product quality and production standards with adverse implications for health of the consumers and the welfare of the workers. Increasing health consciousness among consumers emanating from scientific understanding on food and nutrition and transformation of gender roles in household and professional domains create immense market demand[5] for processed food that can be harnessed to benefit farmers as well as the informal processors.

3. Objective

3.1 Agro-processing is done mostly in the unorganized sector in India, estimated to be accounting for about 99% of the units, 80 % of the employment and 21% of the total value of output in the food processing sector in 2004-05. The data on the extent of these activities are recorded by means of sample surveys conducted by the National Sample Survey Office (previously Organisation) (NSSO) in its periodic reports on the unorganized sector. With India's food production especially in emerging subsectors growing phenomenally in the new millennium (Kumari et. al, 2012, Gokarn et. al 2006), the organized sector, though small particularly in terms of number of units and employment, is also growing fast. Many of these products especially animal based products, horticultural products and also some of the traditional crop based products are available for processing into food products or other end uses. Agro-processing, especially in the organized sector has also received little coverage in literature and data protocols.

3.2 In this study we address agro-processing in general with an emphasis on food processing in the organized sector only. The extent of processing of agricultural products is worked out with a view to explore the options, complexities and constraints on data use. Primarily, we use unit level data collected from registered factories by the Annual Survey of Industries (ASI). This source is preferred because the ASI data is based on systematic sampling methodology that is comparable with international standards and has the potential to develop further to meet the data needs of the future. Considerable attention has been been given to data and its validation based on inter-temporal consistency checks and cross-checking with information collected by other official departments.

[5] It is estimated that 300 million, upper and middle class Indian families consume processed food. Ministry of food processing in its Vision 2015 document: has projected that the size of processed food sector will treble its present size. The processing level of perishable food products may increase from 6% to 20 and India's share in global food trade will increase from 1.5 % to 3%.

3.3 Major items under cereals, pulses, oilseeds, milk, fruits, vegetables, spices and animal based products including fish, meat, milk and egg are covered[6]. Food processing is the major user group among agro-processors but certain other industries also have small shares in the consumption of these inputs. We have therefore covered user industries under the categories of tobacco, chemicals, pharmaceuticals, agriculture and animal husbandry besides food processing. A major issue surrounds the specification of the agro-inputs which in reality enters the processing activity in different stages of basic level processing already conducted in the unorganized sector. While this issue merits greater consideration, for simplicity in the present analysis we have specified agro-processing with a reasonably broad perspective but exclusive of any basic minimum processing that may be essential for consumption.

4. Data, Definition and Methodology

4.1 The data used in the study is primarily taken from the Annual Survey of Industries (ASI) which is the major source of industrial statistics published by Central Statistics Office (CSO) under Ministry of Statistics and Programme Implementation (MOSPI). The survey is conducted annually[7] under the statutory provision of Collection of Statistics Act, 1953 that replaced the earlier schemes Census of Manufacturing Industries (CMI) and Sample Survey of Manufacturing Industries (SSMI) in 1960. We have used both summarised data in published form and unit level panel data. The sample period covered in this study is 2001-02 to 2009-10 starting with more vigorous reforms in the food sector and limited by the availability of the most recent data.

4.2 Agro-processing is the transformation of raw materials sourced from agriculture so that their original physical or chemical property is changed and the transformed product has commercial value. Alternatively, agro-processing is defined as a 'set of techno economic activities carried out for conservation and handling of agricultural raw materials (food and non-food) and to make it usable as food, feed, fibre, fuel or industrial raw material and which has storability/nutritive value' (Kachru, 2006). These transformations are not simply the manufacturing processes but include other ways of value addition through increased shelf life, cleaning, grading, dehydrating, shelling, dehusking or rehusking and greater preparedness (semi-cooking) for consumption[8].

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[6] Only agricultural food products will be covered and widely processed products such as cotton, tea and jute are excluded from our study.

[7] Extending to the entire country the ASI covers all factories registered under the Factories Act, 1948, that is employing 10 or more workers using power and those employing 20 or more workers without using power. The frame is based on the list of registered factory/units maintained by the Chief Inspector of Factory and is regularly updated. Thus the primary unit of enumeration is the factory. The data is presented in Volumes I and II in published and electronic forms in recent times.

[8] The ASI reports manufacturing process in the factory sector (defined in the Factories Act, 1948) as any process for: (i) Making, altering, ornamenting, finishing, packing, oiling, washing, cleaning, breaking up, demolishing or otherwise treating or adapting any article or substance with a view to its use , sale, transport, delivery or disposal; or, (ii) pumping oil, water or sewage; or, (iii) generating, transforming or transmitting power; or, (iv) composing types of printing by letter press, lithography, photogravure or other similar process or book binding; or, (v) constructing, reconstructing, repairing, refitting, finishing or breaking up ships or vessels, (vi) preserving or storing any article in cold storage.

4.3 Agro-processing is applicable to various groups of commodities raw or semi-processed but trade classification even at the international level remains highly inadequate (FAO, 1996) till today. Moreover, many of the processes are conducted outside the ambit of the organized industrial sector and part of the products already partially processed in this way feed into the organized factory sector as inputs for further processing. Further, some of the basic processing activities are essential for most consumption purposes making the most inclusive definition trivial and the estimation nearly irrelevant. For instance milling of paddy to rice and crushing sugarcane to sugar are possible activities that can be visualised to be the basic minimum. The coverage of activities under agro-processing thus poses a challenge for analysis.

Select Agro-items for Study

4.4 As already mentioned specification of items as inputs for processing is far from easy especially because in certain cases a basic minimum of processing becomes essential for consumption[9]. We have tried to minimize the chances of both over-estimation and underestimation by following a middle path. In other words the items chosen for examination are allowed to incorporate some degree of basic processing but such transformations as are minimally required for consumption are not considered as processing in our specification. The inputs and outputs of production activities are identified by Annual Survey of Industries Commodity Classification (ASICC) codes.

4.5 Some of the major agro-items amenable to processing include rice, wheat, coarse cereals, pulses, milk, fruits and vegetables, spices and animal products like egg, fish, chicken and fish. Based on data availability and time constraint we have selected the items given in Table A. To exclude cultivation as a processing activity cereals as seeds are not considered[10] as inputs. To avoid triviality of estimates and minimise chances of over-counting items products that enter as inputs after minimum basic processing are also included in the item list such as milled cereals, pulses, crushed sugarcane and powdered spices. Unmilled paddy and wheat not used as (excluding) seeds are not considered among the items.

Coverage of User Industries

4.6 The coverage of activities in this study transcends not only food processing, but also transformation of a product in form. Value added services such as cleaning, polishing and packaging would also enter the coverage. The major organised sub sectors in which the agricultural products are processed (Table B) are identified using NIC codes 1998, 2004 and 2008. Production in primary activities such as crop cultivation and animal husbandry is the first group given in serial 1 to allow for possibility of organized corporate farming

[9] This creates the undesirable possibility of obtaining trivial estimates of close to 100% processing in the entire economy.

[10] It is possible that grains as seeds enter as inputs in the organized sector where corporate or contract farming of crops and dairy take place.

that may require the agricultural products as inputs but not as seeds. Food processing is included in the groups given serial numbers 2 to 6. Crushing of sugarcane to manufacture sugar is excluded as a basic minimum processing activity. Similarly processing and blending of tea and coffee are left out of the processing ambit.

4.7 Although grain milling is included in the activities, milling of wheat into atta, maida and other products and paddy into rice is effectively left out of consideration through specification of items as discussed in the preceding sub-section. Grain milling however covers preparation of breakfast cereals, manufacture of starch products and animal feed under the NIC classification that effectively would be included in our specification. Crushing of oilseeds to fat has been retained in the coverage treating this not as an essential processing because groundnuts and soyabean are amenable to consumption in forms other than oil. We also chose to include tobacco and pharmaceuticals industries as possible users of agro-products.

5. Data Sources

5.1 We subject the unit level data to scrutiny for inter-year consistency and also for consistency with the corresponding data wherever reported by the Ministry of Agriculture. The data on agricultural production is collected from Directorate of Economics and Statistics, Ministry of Agriculture (MOA, website). While production of most food grains and oilseeds have been traditionally reported for a very long time, it may be pertinent to note that the reporting for most horticultural products and animal based products are a relatively recent initiative.

5.2 Data on wholesale prices for dominant crops especially foodgrains and oilseeds are reported by major markets or 'mandis' by the ministry of Agriculture (MOA, 2010). We computed state level price as the average of prices prevailing in the major mandis consideration being given to consistency in the price data to take care of qualitative differences in products. The all India level wholesale price average is computed taking production as weights. In other cases where no such all India level data on wholesale prices can be methodically computed by using disaggregate data, we have deflated the value of output of product reported by the Central Statistical Office (CSO website) by the production to obtain estimates of the wholesale prices. This is specifically the case for spices where the price information is weak. For fruits and vegetables, the averages of prices in growing states are computed where ever Ministry of Agriculture data is available. Similar average price is considered for milk. In a few cases like mango and papaya we had to resort to data imputed by Food and Agricultural Organization of the UN (FAO, website).

Validating Quantity Data

5.3 ASI collects data on various aspects of the factories including both the quantity and the value of the quantity of various materials consumed by the industries as inputs. The value of output and input reported by ASI has been subjected to larger academic review as a large volume of literature on industrial performance (Goldar, 2004, Neogi and Ghosh, 1998) grew out of this data. However the ASI reported data on quantity of inputs

consumed requires intense validation. An assessment of the inter-temporal consistency, suggests that use of alternate sources be considered as an option.

5.4 Deflating the purchase value of inputs by the quantities we can derive implicit prices of inputs consumed based on ASI data. This is the imputed price and signifies the average price at which the factories procure the different agro-inputs. We compare the price data so imputed with the Wholesale Price data (Table 1). The two series are largely convergent but as already indicated by the inspection of quantity data, instances of severe mismatch are not uncommon. While we do expect that the two set of prices would not differ significantly given that processors would rationally purchase at wholesale rates, there are reasons to expect variations also.

5.5 Firstly, processing companies in reality buy at different points of time for storage or from different points in the value chain rather than only from the wholesale markets. Besides the wholesaler, the sellers could be retailing vendors and are more likely to be certain middlemen in the chains. With liberalization direct purchase from farmers is also becoming common in many states. Second, in most cases prices can be pre-decided by contract, reflecting the bargaining strengths and sensitivity to the quality, more relevant in the case of horticultural crops. Thirdly, the average wholesale prices hide regional variation and more significantly quality differences. Fruits and vegetables procured for processing are usually of certain specific grades while the remaining products are sold to final customer to be consumed fresh. The wholesale prices are spot prices and reflective of its average quality only.

The extent of processing is estimated by the formula

Extent of processing = *Processed quantity (derived) /Production in agriculture*

Processed quantity (derived) = *Value of purchased input (ASI)/Wholesale price*

6. Results

6.1 Figure 1 depicts the extent of processing of products in the most recent triennium. Soyabean is the most processed products. Among others, pulses followed by milk and spices lead in their extents of processing, while fruit and vegetable processing is extremely poor at 1.7% and 2.4% respectively. The estimates for horticultural products are not at great variance from some of the conjectures made for policy making and citing but fall considerably short in the case of milk. It may be noted that a large part of grain and oil milling takes place outside the organised factories.

A Disaggregated Picture

6.2 A more disaggregated view is available in table 2 which provides the share of processed product for four different periods as averages of three years. Among the Coarse cereals Maize is the most processed one varying from 19% to 25% and Bajra the least between 0.63% and 1.80%. The processing of Jowar is also trivial. Coarse cereals can be processed into various health foods (nutrient-mix), biscuits, malt for beverages and snacks

after popping or flaking. Animal feed is a major end use. All the three items under the sub-groups Pulses are subject to moderate processing, the highest share being recorded by Arhar (tur) dal followed by Moong and Gram. The three pulses Arhar, Moong and Gram respectively are processed to the extent of 30%, 24% and 15% in triennium ending 2009-10. Pulses are daily items in Indian food habit, eaten cooked with cereals or as sprouted. Processing mostly involves, loosening of husk, preserving, oiling, cleaning, drying and packaging for final home use though many salted snacks (namkeens) also have different pulses as ingredients. Groundnut undergoes moderate processing of 5% mostly as crushing into oil.

6.3 Of the four fruits we considered, 2% of each of three fruits grapes, mango and orange is processed. In the case of papaya, the extent is less than 1%. Of the four vegetable crops only tapioca is processed to any significant extent. Certain fruits are more tasty and nutritious when eaten fresh. The same fruit or vegetable may be suitable both for processing and fresh consumption but at different stages of the ripening period. Although mostly cooked domestically, it is possible to process many vegetables. Potato is becoming popular ingredient for many snack foods like chips and bhujias and dehydrating potato has seen technical advancements. Tapioca is widely used for making traditional health product sago. Tomato juice, sauce and pastes are popular for which pulping is an essential step. Spices are processed to the extent of nearly 30% and all the spices considered in this study have high rates of processing especially turmeric. Hygienic handling and ways to avoid adulteration are part of the process. Traditionally, milk is one of most widely processed agro-products.

7. Concluding Remarks

7.1 Food processing creates linkages between the farmers and the consumers via the organized industry. As government promotes the sector, development of systematic data base for monitoring and understanding the growth of the sector will be crucial. This study is a step to move beyond subjective judgment based estimates to create the necessary statistics but given the complexity and the hierarchical processes involved, further refinements are possible. Greater attention also needs to be given towards the improving the quality of data in tandem with stronger statistical systems for agricultural prices and production.

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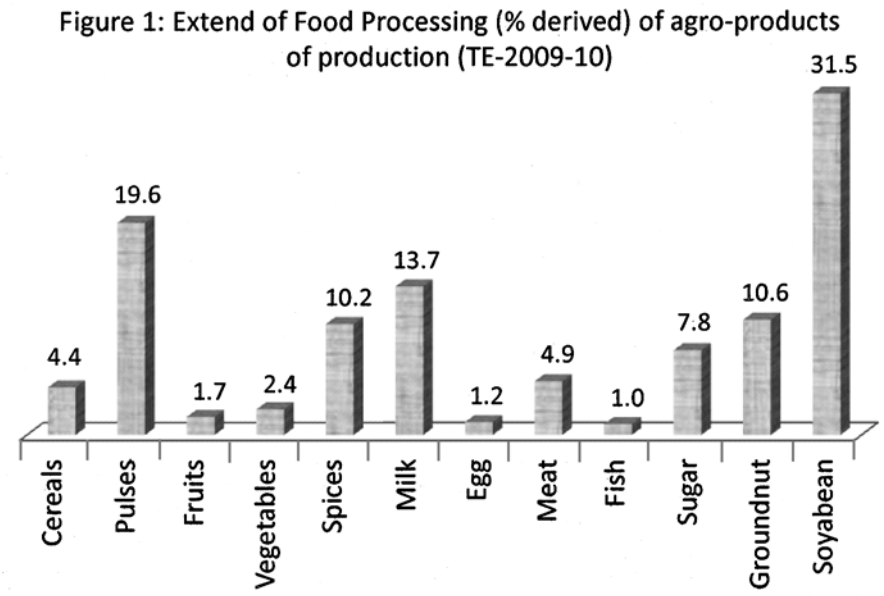

Table A: Selected agricultural products amenable to processing under study

Serial No	Group	Agricultural products
1	Cereal	Rice (raw, parboiled, basmati, broken, powdered, puffed, flakes)
2	Cereal	Wheat (Atta, maida, broken)
3	Coarse cereals	Maize, Jowar, Bajra (milled and unmilled)
4	Pulses	Gram, Arhar, Moong (Milled and unmilled)
5	Fruits	Grapes, Mango, Papaya, Orange,
6	Vegetables	Onion, Green peas, Potato, Squash, Tapioca, Tomato,
7	Spices	Chilli_dry, Turmeric fresh, Coriander (Dhaniya) seed, Cumin seed, Peppper,
8	Milk	Fresh Milk

Table B: Major User industries that process agricultural products and their NIC codes (2004)

Serial No.	NIC Codes - 3 digit	Description
1	014	Agricultural and animal husbandry service activities, except veterinary activities.
2	151	Production, Processing and Preservation of meat, fish, fruit, vegetables, oils and fats.
3	152	Manufacturing of Dairy Products.
4	153	Manufacture of Grain Mill Products, Starches and Starch Products, and prepared animal feeds.
5	154	Manufacture of other food products. (Bakery sugar, noodles, chocolates, confectionary etc). Manufacture of sugar and gur from sugarcane and processing of tea and coffee is excluded.
6	155	Manufacture of Beverages
7	160	Manufacture of tobacco products
8	242	Manufacture of pharmaceuticals, medicinal chemicals and botanical products.

Table1: Prices derived or obtained from alternative sources (Rs/Kg)

Crops	2001-2002		2004-05		2009-10	
	ASI imputed purchase prices	Wholesale prices	ASI imputed purchase prices	Wholesale prices	ASI imputed purchase prices	Wholesale prices
Rice	7.91	9.21	10.79	9.62	13.21	15.11
Wheat	6.79	6.21	6.27	6.85	12.14	11.34
Coarse Cereals						
Maize	5.24	4.78	5.76	5.52	6.76	7.37
Jowar	4.70	5.60	6.36	6.30	9.54	8.12
Bajra	9.69	4.56	5.68	5.81	5.96	10.19
Pulses						
Gram	18.20	17.42	14.17	14.06	19.93	18.54
Arhar	14.56	14.08	17.67	17.37	28.37	39.24
Moong	19.03	19.97	18.24	18.66	32.66	43.93
Oilseeds						
Groundnut	10.65	14.91	17.81	18.45	18.68	30.10
Soyabean	4.55	9.70	8.17	12.80	5.66	21.90
Fruits						
Grapes	9.21	14.71	12.55	17.90	17.32	25.84
Mango	4.93	15.52	8.00	18.89	5.40	27.26
Papaya	1.41	7.84	5.00	9.54	4.89	13.76
Orange	1.14	8.14	14.38	13.24	1.33	19.45
Vegetables						
Onion	3.36	4.19	4.28	4.74	8.98	6.73
peas_green	11.04	12.69	11.90	14.37	15.20	13.62
Potato	6.94	2.99	6.89	3.63	12.94	3.39
Squashes	6.79		76.92		8.14	
Tapioca	4.44	2.22	2.53	3.67	6.23	5.17
Tomato	4.24	6.92	5.41	7.83	4.47	11.18
Spices						
chilli_dry	33.14	35.24	33.38	38.35	61.40	63.65
seed_dhanya	17.58	24.17	27.18	22.99	42.89	76.41
Pepper	68.50	140.82	80.01	79.51	66.46	115.82
Turmeric Fresh	16.87	23.91	34.00	29.46	71.14	42.8
Fish	**32.70**	**77.46**	**41.20**	**86.22**	**32.62**	**46.89**
Milk fresh		**11.86**	**10.50**	**13.18**	**0.08**	**19.55**
Sugarcane*	0.78	0.58	1.27	0.65	0.24	0.89
Egg	23.56	25.32	31.40	25.84		40.63
Meat	34.42	110.42	96.92	122.30	63.89	224.10

Note: For Egg, year 2002-03 is taken instead of 2001-02. *Sugarcane as refined sugar input. Wheat price is for Wheat broken, Rice is for raw rice.

Table 2: Extent of processing of agro-products as percentage of production (%)

Triennium averages	T.E 2003-04	T.E 2005-06	T.E 2007-08	T.E 2009-10
Rice	0.91	1.00	1.40	0.97
Wheat	3.64	3.51	3.44	5.39
Maize	19.12	22.05	21.79	24.87
Jowar	1.32	2.51	2.59	3.61
Bajra	1.80	0.63	0.93	1.22
Gram	7.72	8.94	11.66	14.99
Arhar	29.47	28.22	32.71	30.04
Moong	14.11	20.59	19.01	24.07
Groundnut	6.69	7.11	5.19	5.67
Soyabean	31.66	23.44	14.13	31.49
Grapes	1.48	3.24	4.54	2.24
Mango	0.75	1.03	1.71	1.76
Papaya	0.15	1.04	1.13	0.62
Orange	0.08	0.02	0.01	1.99
Onion	5.46	2.86	2.39	1.31
Potato	0.47	1.00	1.71	1.52
Tapioca	5.03	5.88	6.22	8.59
Tomato	0.51	0.57	0.39	0.24
chilli_dry	6.73	6.53	8.11	13.02
Seed_dhanya	16.25	15.76	26.25	22.21
Pepper	4.36	7.28	18.05	27.04
Turmeric fresh	6.95	8.56	9.71	10.27
Fish	0.61	1.23	2.89	1.89
Milk fresh	11.56	11.99	13.69	13.69
Sugarcane	6.63	12.98	13.78	15.65
Meat	1.40	2.84	5.67	4.94
Egg	2.09	1.91	2.26	1.69

Note: Sugarcane as Sugar and gur only, Rice and wheat as exclusive of bran, meat including chicken.