



# Food Fortification Initiative

Enhancing Grains for Healthier Lives



## State of Haryana, India Wheat Flour Supply Chain Analysis

Food Fortification Initiative  
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## Acknowledgements

The fieldwork described in the following report was conducted by Venkat Subramanian Venkat\_subramanian@outlook.com. The work was funded by the Food Fortification Initiative, through a generous grant by Center For Diseases Control - USA.

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## Objectives

A supply chain analysis of the wheat flour industry was conducted in the state of Haryana, India, for the purpose of developing a comprehensive strategy for flour fortification to improve the public's micronutrient status.

## Scope of work

To achieve the objectives, the following supply chain analysis sought to collect information on the following details of the wheat flour industry in Haryana:

1. Availability of wheat grain
  - 1.1. Identify the sources of wheat grain availability in the state of Haryana.
  - 1.2. Describe interstate wheat grain trade (export/import) quantities.
2. Supply/procurement of wheat grain
  - 2.1. Assess where wheat grain is procured for milling needs.
  - 2.2. Describe storage infrastructure for wheat grain at the state level
  - 2.3. Identify the agencies and traders involved in procurement and distribution of wheat
    - 2.3.1. In particular, understand the flow of wheat from the Food Corporation of India's central pool in Haryana State.
    - 2.3.2. Estimate the quantities of wheat procured and distributed by these agencies and traders within Haryana.
3. Processing of wheat flour and products
  - 3.1. Assess the milling capacity and utilization of roller flourmills and commercial chakki mills to produce wheat flour (e.g. maida, resultant atta, chakki atta, suji, and bran) and end products (e.g. biscuits, bread, etc.).
  - 3.2. Map the geographic locations and clusters of such milling locations.
  - 3.3. Understand how the wheat milling industries classify and group mills according to size, type, technology, etc.
  - 3.4. Understand existing storage infrastructure capacities to store wheat flour.
4. Distribution of wheat flour and products
  - 4.1. Map the distribution of wheat flour, and the resulting wheat products (both within Haryana and interstate trade) to understand where both production (i.e. biscuits, bread, etc.) and consumer market channels exist.
  - 4.2. Assess the quantities of flour available for consumption
  - 4.3. Identify the numbers of beneficiaries reached through government welfare schemes (e.g. PDS, ICDS, MDM, SABLA, TRIBAL, etc.), food processors (e.g. bakers, biscuit manufacturers, etc.), and open market channels.
5. Fortification costs
  - 5.1. Understand the capital investments required for roller flourmills and commercial chakki mills to invest in fortification (e.g. premix, packaging, equipment, etc.).
6. Monitoring and compliance
  - 6.1. Understand existing capacity for QAQC and M&E of quality of flour by millers and the state Food and Drug Administration, respectively.

## **Outcome: Describe existing industrial milling capacities for wheat flour fortification and the availability for consumption**

1. Identify opportunities and challenges to integrating wheat flour fortification in the current supply chain.
2. Estimate costs of fortification for all stakeholders (millers, consumers, state agencies).
3. Identify gaps (and potentially develop monitoring tools, indicators) and strengthen capacity in M&E in the state Food and Drug Administration (and QAQC for millers).

## Terms and abbreviations

### Related to wheat sales or government welfare programs

Mandi:	Government owned grain markets; farmers can sell grain directly to mandis (or via brokers/traders). Mandis are the only official channel for government agencies and millers to purchase grain, in order to collect state-levied taxes
FCI:	Food Corporation of India. Government agency in charge of storing and exporting grain from producing states to deficient states. Also stores the stocks of grain intended for government welfare programs.
MDM:	Mid-day-meal. National school feeding program for children in primary and upper primary (grades 1-8) school
PDS:	Public Distribution System. National welfare program providing staple foods (wheat, rice, oil, etc) to beneficiaries under the poverty line. In Haryana state, PDS wheat is provided in grain form (not already milled in as flour)
ICDS:	Integrated Child Development Services. National welfare program providing supplementary feeding to pregnant, lactating women, adolescent girls, and children 6 months - 6 years of age.
Diversion	The practice of selling PDS wheat grains outside of official channels. Unofficial channels can include 1.) Fair price shops that receive PDS from FCI sell bulk quantities of wheat to roller flour and commercial chakki mills; 2.) Beneficiaries sell wheat back to fair price shops or directly to wheat flourmills, at below market rate.
FPS:	Fair price shops. Privately owned stores licensed to sell PDS wheat to beneficiaries.
Mandi By-Pass sales:	An unofficial channel by which flourmills purchase grain. Mandis are the only official grain purchase channel for millers, in order to ensure that grain taxes are paid. However, by-pass sales are made when mandis do not record purchases, or millers purchase directly from traders or brokers
OMS:	Open Market Sale. Retail market, outside of any government welfare scheme

### Wheat flour products

Maida:	Roller-milled refined white flour, with germ and bran completely removed, most typically used in biscuits and western breads. In Haryana, consumption is relatively low compared to atta. The extraction is usually 45%-50% of the weight of wheat.
Chokker:	Also known as bran; this is about 20-25% if extracted out of roller mills; typically bran is not sifted out of chakki mills. Bran has good value as cattle feed.
Rava/Suji:	Semolina flour. This is extracted only in some roller mills, usually at only 2%–5% containing the germ portion. Suji is used for making desserts such as halwa, and is also used in porridge for young children. Millers that do not extract suji simply grind it into atta or maida flour.
Atta/Chakki Atta:	Stone-ground whole-wheat flour (not reconstituted, a practice where white flour has germ and bran added back in at original ratios), extraction/recovery is usually 100% because bran is not removed. Usually synonymous with "chakki atta", as resultant atta is not true atta. Used primarily for making chapattis (unleavened bread, also called rotis).
Whole-wheat flour:	Whole-wheat flour ground using roller mills (not stones). Usually reconstituted and has flour different qualities (e.g. starch damage, protein, moisture) compared to chakki atta.
Resultant atta:	Roller-milled wheat flour, with a greater proportion of bran and germ than refined white wheat flour (a byproduct of producing maida, as maida extraction is so low). The recovery ranges from 20–25% of the weight of the wheat. This is usually sold inexpensively to restaurants or street stands (dhabas) for making chappati/rotis. Sometimes also referred to as "Dhaba Atta", because of its primary use in these street stands.
Commercial atta:	Retail atta flour sold pre-bagged for consumers. Includes branded and semi-branded commercial atta.
Branded chakki atta:	Branded, bagged chakki flour for retail sale – mills producing branded chakki atta operate on a larger commercial basis than semi-branded commercial atta.
Semi-branded atta:	Locally branded, small-scale bagged chakki flour for retail sale

Flour milling terms

Chakki mills:	Flourmill using stone-grinding technology to produce stone-ground whole-wheat flour, or chakki atta. Usually refers to single stand-alone chakkis, used at the village or household level.
Commercial chakki mill:	Flourmill that has commercialized the stone-grinding of atta flour - involves several chakki flourmills to produce higher quantities of atta flour
Roller flourmill:	Flourmill using roller technology; can produce flour with varying grades of refinement (maida, resultant atta, suji, bran, etc). Roller technology cannot produce atta. However, some roller flourmills have added chakki mills in the plant. These mills are able to produce atta via the chakki lines, not the roller lines.
Industrial atta mill:	Flourmill using roller technology to simulate production of chakki atta, capable of producing atta at industrial production levels. The advantages of industrializing atta production are economy of scale and improved hygiene practices. Currently only one company has developed such a machine for commercial use: Bühler Group calls its industrial atta mill a “Pesa Mill” <sup>1</sup> .

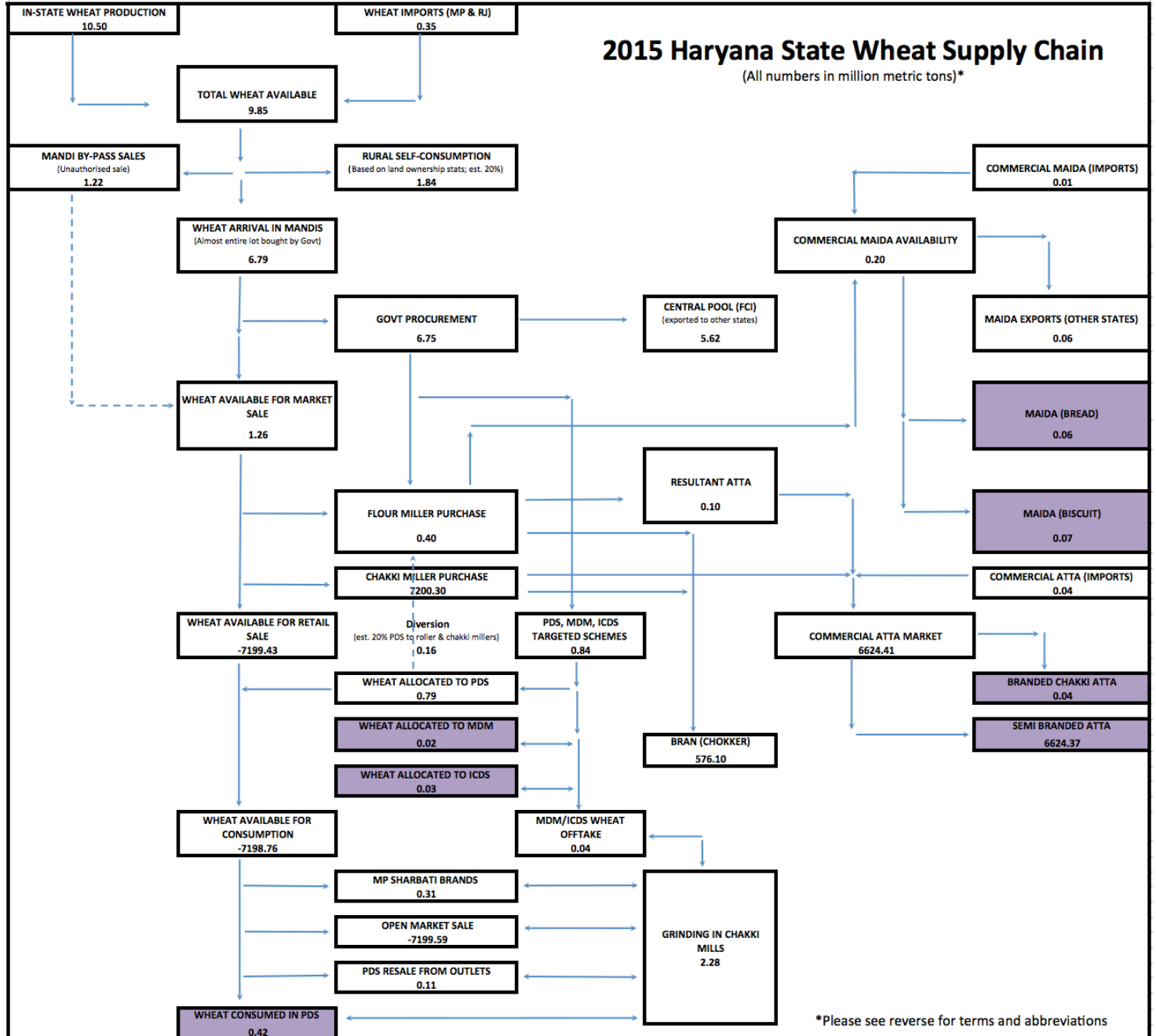
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<sup>1</sup> Disclaimer: Bühler Group is on FFI’s Executive Management Team.

## Methods

In depth interviews were held with key wheat flour industry stakeholders, including industrial flour millers, chakki millers, wheat mandi representatives, roller mill association representatives. Since distribution of wheat to beneficiaries is a large contribution to the population's food supply, Government officials in the Food Corporation of India and Government of Haryana (Food and Civil Supplies) were also interviewed to understand the flow of wheat through government channels.

**Figure 1: Haryana wheat supply chain**





## Part I: Wheat and wheat flour availability and utilization in Haryana

### Background

Haryana State, one of 28 states in the country, is located in Northern India. It borders the New Delhi New Capital Region (NCR) on three sides, and shares borders with five other Indian states (Uttar Pradesh, Rajasthan, Himachal Pradesh, Uttarakhand, and Punjab). It shares its capital, Chandigarh, with Punjab.

Haryana has a population of 25.3 million people<sup>2</sup>, or 2.09% of India. The population is 53% male – for every 1,000 men there are 879 women. As a key agriculture state, only 34.8% of the population is urbanized – however this marks a large shift from previous demographics – since 2001 urbanization has increased 34.8%. Literacy in the state is roughly on par with the national average: 76.6% in the overall population.

Thanks to Haryana's proximity to the rapidly expanding NCR (which include Faridabad and Gurgaon districts) the state is quickly urbanizing, with its growth rate at 19.9% compared to the national average of 17.6%<sup>2</sup>. This has led to economic growth, industrialization, and urbanization that are expected to have impacts on the wheat supply chain scenario in Haryana.

Recent demographic shifts show that Haryana, which was once a largely agriculture-dependent workforce, is now urbanizing quickly<sup>3</sup>. The expected impact will be a reduction in agricultural production, while wheat flour consumption in the state is expected to rise due to increasing urbanization and population growth.

### Wheat production in Haryana

India is a self-sufficient country in wheat, in thanks to wheat surplus states such as Haryana (Figure 2). Although Haryana only comprises 1.4% of India's total geographical area, it produces 9-10% of the country's wheat. In 2014-15, the state was estimated to produce 10.8 million metric tons (MMT) or 100 lakhs (1 lakh = 100,000) of wheat, down 10-15% from previous years due to poor weather<sup>4</sup> (Figure 2). Although forecasts expect a rebound back up to 11.8 MMT in wheat production for 2015-16, production is still well below its 2011-12 peak of 13.1 MMT. In support of farmers, the Government of Haryana lowered wheat quality specifications for the 2014-15 crop year. Haryana is the 3<sup>rd</sup> largest producer of wheat in the country, after Uttar Pradesh and Punjab<sup>5</sup>.

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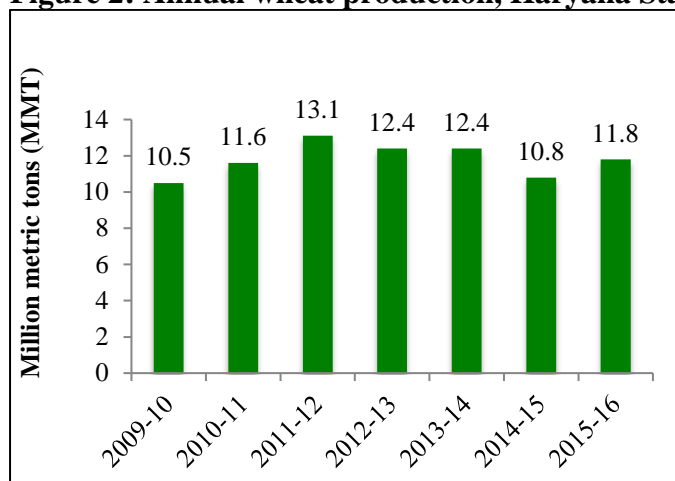
<sup>2</sup> 2011 India Census. [http://www.censusindia.gov.in/2011-common/census\\_2011.html](http://www.censusindia.gov.in/2011-common/census_2011.html)

<sup>3</sup> Vashishtha PS, et al. Chapter: 6. Population and Land Use in Haryana. From: Growing Populations, Changing Landscapes: Studies from India, China, and the United States (2001). <https://www.nap.edu/read/10144/chapter/11>

<sup>4</sup> Hindustan Times. Haryana's wheat output also drops. April 2015. <http://www.hindustantimes.com/chandigarh/haryana-s-wheat-output-also-drops/story-quWmn1vshyJqP1IoO8Q3AO.html>

<sup>5</sup> Kulkarni S. Food and Beverage News. Wheat Production in North India – Brief Review. January 2016. <http://www.fnbnews.com/Top-News/wheat-production-in-north-india--brief-review-38316>

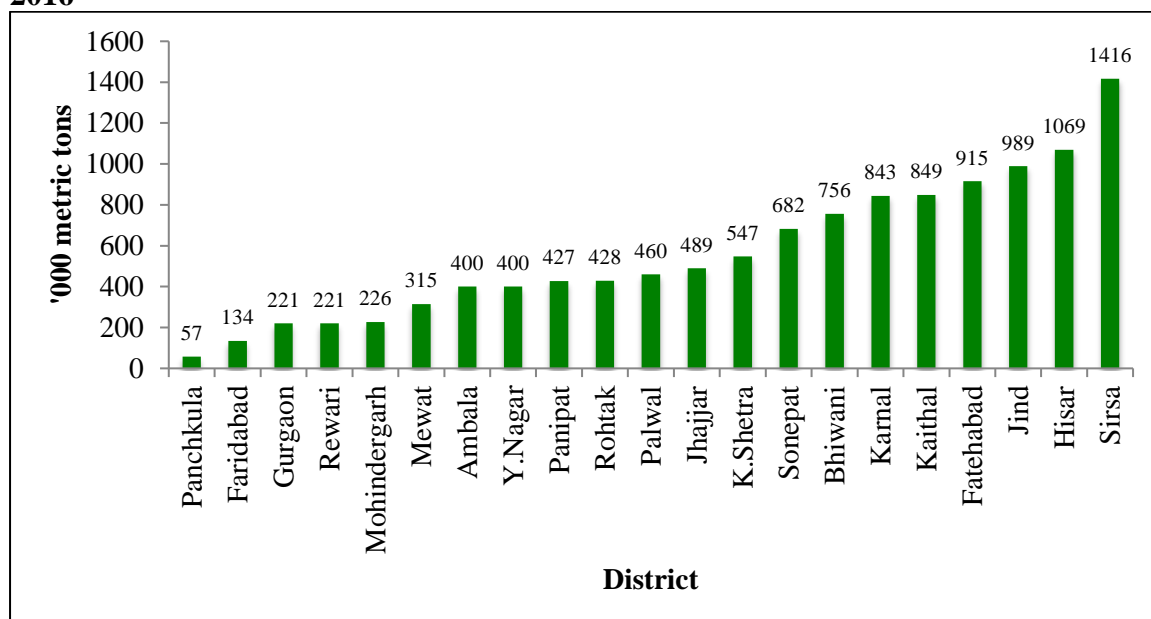
**Figure 2: Annual wheat production, Haryana State<sup>6</sup>**



The state is unlikely to increase production from increasing cultivated land – of its 4.42 million hectare (ha), 3.65 million ha is cultivated, or 98% of the total available cultivatable area of 3.7 million ha<sup>7</sup>.

More than 50% of wheat production falls in six districts: Sirsa, Hisar, Jind, Fatehabad, Khaital, and Karnal<sup>8</sup> (Figure 3).

**Figure 3: Operational wheat production targets for Rabi (spring harvest) season 2015-2016**



The standard hybrid variety of wheat grown by the majority of the farmers is usually sold in mandis at a Minimum Support Price (MSP) of Rs. 14.50/kg. The average yield is in the range of 4-5 metric tons per hectare (t/ha). The Desi variety is considered higher quality; a typical local cultivar sold at a greater premium, Rs. 19-21/kg. Average yield is about 2 t/ha.

### [Interstate wheat trade](#)

<sup>6</sup> Government of Haryana, Ministry of Agriculture

<sup>7</sup> <http://agriharyana.nic.in/>

<sup>8</sup> [http://agriharyana.nic.in/Stat\\_Info/Districtwise%20operational%20targets%20Rabi-2015-16.pdf](http://agriharyana.nic.in/Stat_Info/Districtwise%20operational%20targets%20Rabi-2015-16.pdf)

## Export

As one of the country's main wheat producers, Haryana is a key contributor to wheat stocks in other states. Almost 7.0 MMT of the state's wheat (70%) is purchased by the Government-run Food Corporation of India (FCI)<sup>9</sup>; the bulk of that (5.9 MMT) is exported to other states, primarily for distribution in social welfare schemes such as the Public Distribution System (PDS), Mid Day Meal (MDM), and Integrated Child Development Services (ICDS). Over the last five years, Haryana has provided 23% of FCI's food grain supply; more than 80% of that was wheat<sup>10</sup>.

Haryana State does not export commercially milled chakki atta, although an estimated 40% of maida (refined white flour) is exported to other states.

## Import

Although Haryana is such a large wheat producer, because its domestic production mainly comprises standard hybrid varieties purchased by FCI, there is still a market for imported high quality wheat produced from neighboring states. Sharbati wheat, primarily grown in Madhya Pradesh<sup>11</sup>, is particularly valued for quality and taste. The wheat is cleaned, graded and also color sorted to give a premium look. The price ranges from Rs. 21 – Rs. 29/kg. The primary consumers of this wheat are discerning urban consumers.

Wheat entering Haryana from MP is often traded by centrally located traders in Delhi, who facilitate the trade between MP suppliers and Haryana markets. In particular, the Narela Mandi in Northern Delhi, bordering the Sonapat district of Haryana, acts as the coordinating node for wheat trade in Haryana.

These traders also directly supply stand-alone chakkis that grind mostly MP-sourced wheat for urban consumers; one trader reported directly supplying approximately 200 chakki mills in the NCR region of Haryana.

Wheat from Uttar Pradesh (UP) is also imported into the state, but the quality is considered similar to wheat from Haryana. Imported UP wheat is usually through unauthorized channels to take advantage of lower wheat taxes in UP. Meetings with wheat traders revealed the challenges of dealing with statutory regulations in Haryana. Unauthorized wheat is also brought in from the Delhi region, which is facilitated through the porous borders of the expanding NCR into Haryana.

The NCR consists of development beyond the boundaries of Delhi, such as Gurgaon in the West, Faridabad in South, Noida towards the East, Kundli and Sonapat towards the North. Except the Eastern side, which falls in UP, the remaining areas falls under the administrative limits of the State of Haryana.

## Wheat grain/flour availability and consumption

Although annual production of wheat in Haryana in 2015 was 10.5 MMT, given poor storage infrastructure, it is estimated that 10% of production (~1 MMT) is lost post-harvest due to

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<sup>9</sup> Food, Civil Supplies & Consumer Affairs Department, Haryana. Procurement. 2016. <http://haryanafood.gov.in/detail.aspx?artid=37&menuid=89>

<sup>10</sup> FCI Haryana

<sup>11</sup> Saxenal, D. Rain hits wheat crop in MP, sharbati likely to lose its sheen. March 2015. <http://timesofindia.indiatimes.com/city/bhopal/Rain-hits-wheat-crop-in-MP-sharbati-likely-to-lose-its-sheen/articleshow/46428366.cms>

infestation, weather, or other causes, leaving the total wheat availability in the state annually at approximately 9.85 MMT (including 0.35 MMT imports from MP and Rajasthan).

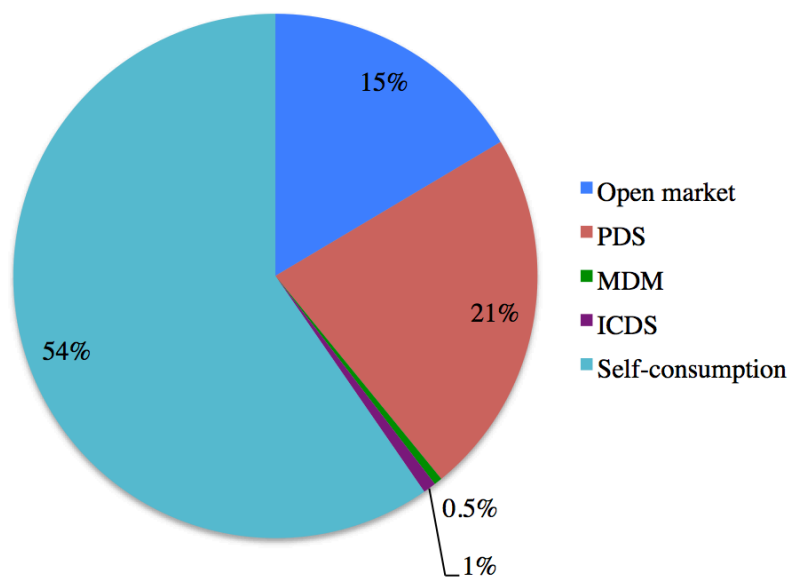
It is estimated that 15-20% (est. 1.6 MMT) of the domestic production does not enter the market and is consumed directly by farmers and landholders. It's expected that a similar proportion (1.4 MMT) is unofficially sold in mandi-by-pass sales, through channels that avoid the mandis and thus do not incur taxes. This can include direct farmer-miller or farmer-broker sales. The remainder of the wheat is almost entirely purchased by FCI (est. 6.8 MMT), and approximately 87% of that FCI purchase is destined for export to other states.

After deducting subsistence consumption and FCI purchase, it is estimated that 1.4 MMT enters the marketplace for sale to millers or to consumers; 0.84 MMT of the FCI purchase remains in Haryana State for distribution in targeted government schemes (PDS, ICDS, MDM)<sup>12</sup>.

Including subsistence farmers, 3.0-3.5 MMT of wheat is available for consumption in Haryana, which translates to 324-378 grams per capita per day (g/c/d) across Haryana's 25,351,462 population<sup>13</sup>. This number is 0.5-1.0 MMT, or ~50-100 g/c/d, less than what is reported by the 2011-12 National Survey of Household Income and Expenditure (NSHIE)<sup>14</sup>. However, it's likely NSHIE is an underestimation of food consumption since the survey only captures quantities purchased by households as wheat flour – wheat flour foods eaten outside the home are incompletely captured under “Beverages, etc.” and or only as household expenses, not quantity.

Of the 2.2 MMT of wheat that is sold in Haryana via the open market or the PDS system, 36% in Haryana is PDS, 32% is purchased by millers (and thus purchased by consumers as wheat flour or wheat flour products), and the remainder enters the retail marketplace. As this indicates, nearly ¾ of the wheat purchased in Haryana by consumers is as wheat, not wheat flour or wheat flour products (Figure 4).

**Figure 4: Wheat grain source**



<sup>12</sup> Total supply (3.2) – self consumption (1.8)

<sup>13</sup> Haryana Population 2011. <http://www.census2011.co.in/census/state/haryana.html>

<sup>14</sup> 2011-12 National Survey of Household Income and Expenditure

Although both urban and rural households are more likely to buy wheat grain rather than wheat flour, the practice is more broadly practiced in rural households, with over 95% of rural households purchasing wheat grain, compared to 65-70% of urban households<sup>15</sup>. It's reasonable to assume that commercially milled chakki atta is more likely to be consumed in urban districts, where subsistence-farming is less prevalent. Consumers who purchase wheat grain usually then take the wheat for grinding at their local chakki mills (for a fee, called “toll milling”) – or grind using their own home chakki mill.

## PDS

In 2013, the Government of India passed the National Food Security Act (NFSA), which broadened eligibility for receiving PDS benefits and dramatically increased the number beneficiaries in the country. Prior to the NFSA, 5.38 million in Haryana were PDS beneficiaries – after its passing 12.6 million people became eligible, about 50% of the state's population<sup>16</sup>.

Government sources indicate that 0.79 MMT of the state's wheat is provided (allocated) to the state PDS<sup>17</sup>, an increase of 0.16 MMT from the year 2013-14<sup>18</sup>. Spread across the state's 12.6 million PDS beneficiaries, this would indicate PDS only contributes 171 g/c/d of wheat<sup>19</sup>. However, there are gaps between provision to PDS (allocation) versus distribution to beneficiaries (offtake) – in 2013-14, it was estimated that only 76.2% of the wheat allocated in PDS was also taken for distribution to Fair Price Shops (FPS). Using this estimate, 0.63 MMT of wheat is sold to PDS beneficiaries.

However, after the wheat is taken for distribution, the wheat may not reach the consumers. NSHIE for example, reported that only 19.3% and 8.9% of rural and urban households respectively had PDS wheat in the house on the day of the survey, which is far lower than 21% of the population that were PDS beneficiaries at the time<sup>20</sup>. There may be several reasons why PDS wheat was not in the household on the day of the survey –e.g. PDS wheat was finished– but inconsistencies could also be due to unofficial sale of PDS wheat in the open market, post distribution. Since FPS are often also retail stores selling wheat themselves, families may sell their wheat back to the FPS at a profit if they prefer alternative sources of wheat. FPS themselves may also sell the wheat to millers. According to sources, 16% of the PDS is sold to millers directly, and 20% of the PDS is re-sold by beneficiaries to take advantage of the steep wheat-price subsidy they receive.

Differences in wheat grain use also exist between allocation and offtake in other government welfare schemes such as Mid Day Meals (MDM) and Integrated Child Development Services (ICDS). However relative to PDS the total quantities of wheat allocated to these two programs are much smaller.

## Government policies and taxations on wheat

Taxation is a key issue that affects all players in the supply chain of wheat. By law, wheat may only be sold at mandis, government wholesale markets managed by the Haryana State

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<sup>15</sup> Inputs from field visits

<sup>16</sup> The Times of India. Food security scheme launched in Haryana. August 2013.

<http://timesofindia.indiatimes.com/india/Food-security-scheme-launched-in-Haryana/articleshow/21948071.cms>

<sup>17</sup> PDS - Haryana

<sup>18</sup> Allocation and Offtake of Rice and Wheat for the Year 2010-2011 Under TPDS

<http://dfpd.nic.in/writereaddata/images/pdf/NormalPDS.pdf>

<sup>19</sup> e-PDS Portal of Haryana. NFSA 2013. May 2015. <http://haryanafood.gov.in/pdsDetail.aspx?artid=96&menuid=120>

<sup>20</sup> 2011-12 National Survey of Household Income and Expenditure

Agricultural Marketing Board (HSAMB), where taxes (cesses) are applied and purchases must be made at or greater than the fixed Minimum Support Price (MSP) set by the state government. While intended to support farmers, the MSP makes wheat procurement more expensive for millers as the price of wheat does not change with supply and demand. The various taxes include a mandi cess to cover operational costs, rural development cess (which funds the state's Rural Development Fund), arthiya commission (i.e. broker fee), and VAT to the state government. Table 1 details the taxes and minimum total cost required for Mandi purchases.

As a result of the taxes and fees, wheat purchased officially through mandis is approximately Rs. 17/kg minimum. In Haryana, the Government of India is the primary purchaser of mandi wheat at these prices- through unofficial channels, wheat usually can be purchased for Rs. 15/kg. Sources of unofficial wheat include imported wheat from neighboring states, mandi-by-pass sales, FPS diversion from PDS, or PDS re-sale by beneficiaries.

**Table 1: Cost of wheat purchased from Mandis**

Minimum support price (per kg)	14.5 Rs
Mandi cess (2%)	0.29 Rs
Rural development cess (2%)	0.29 Rs
Arthiya commission (2.5%)	0.3625 Rs
Mandi labor costs (per kg)	0.13 Rs
Gunny bag cost (per kg)	0.8 Rs
VAT to Haryana State (5%)	0.725 Rs
<b>Total minimum cost/kg of wheat</b>	<b>17.10 Rs</b>

According to a Government of India notification dated 24<sup>th</sup> April 2015<sup>21</sup> for procurement of wheat from Haryana, the total cost ex-mandi (before VAT) is Rs. 16.81/kg; the final acquisition cost, including delivery at the warehouses, comes to Rs. 17.30.

Because Haryana has the second highest wheat taxes in the country after Punjab, Haryana-grown wheat is less competitive compared to wheat from other producing states. This has opened the market for some unofficial wheat import from UP. Table 2 compares state mandi taxes.

**Table 2: Comparison of wheat taxes (cess) in wheat producing states in India<sup>22</sup>**

	Punjab	Haryana	MP	Rajasthan	Delhi	UP
Arthiya commission		2.5%	--	2%		1.5%
Mandi cess		2%	--	2%		2%
Rural Development cess		2%	--	--		--
Value-added tax (VAT)		5%	1%	--		4%
Other Taxes		--	--	--		0.5%
<b>Total Taxes</b>	<b>14.5%</b>	<b>11.5%</b>	<b>9.2%</b>	<b>4%</b>		<b>8.5%</b>

Madhya Pradesh, MP; Uttar Pradesh, UP

<sup>21</sup> (Ref:6) PDS Haryana

<sup>22</sup> <http://www.dnaindia.com/money/report-states-not-in-favour-of-uniform-tax-on-wheat-and-rice-food-ministry-2090848>

Although millers continue to demand reduced taxes to facilitate wheat procurement, the objective of the current mandi system is to provide farmers a MSP for wheat while also covering the operational cost of the Mandis. Under this system, Haryana farmers depend on the government's procurement of wheat.

### Wheat handling

Wheat begins to arrive in mandis from farmers in late March, peaking by April. Smaller amounts arrive in May. Sirsa & Fatehabad, remote, high production districts, are also among the largest procurement districts. Karnal Mandi, being on the highway and conveniently located, has also been a good source for movement of wheat to other states. Almost 80% of the procurement is done in 5 districts.

Farmers bring grain to mandis directly using tractors or through their agents. The grain is stored in heaps as shown Figure 5 (Note: Picture not during season). Once grain has been purchased, it is transferred to 50 kg gunny sacks. The gunny sacks are then loaded into trucks and most of them transported to FCI or state warehouses.

**Figure 5: Karnal Mandi**



### Storage

Except for a small silo with storage capacity of about 0.2 MMT (2 lakh MT [LMT]) at Khaital (operated by Adani Group, an integrated infrastructure company, for FCI) wheat is more or less stored in covered warehouses or open cover and plinth<sup>23</sup> (CAP) storage areas in 50 kg gunny bags (Figure 6).

The total closed storage availability in the state is about 11 MMT, of which FCI operates about 4.6 MMT; state agencies operate 6.4 MMT<sup>24</sup>. The wheat stock has reached the covered storage capacity of 7.3 MMT; the remaining 3.7 MMT storage capacity is still relatively exposed, which opens the stock to management problems and high storage losses, mainly during the rainy season.

There are recent public-private-partnership (PPP) efforts to modernize grain storage capacity. Adani Group built and operates government-owned silos to store Punjab & Haryana wheat purchased by FCI. The silos have 0.6 MMT (6 LMT) capacity and are distributed across both states. At these modern silos, grain is transported via a built-in system of direct tractor dumping into the weighers and conveyors. When wheat is allocated, it is loaded into rail cars in bulk for transportation all over the country.

**Figure 6: Storage at Karnal Mandi**



**Figure 7: CAP storage**



Currently, the national wheat stock is about 7 MMT; rice is also stored but comprises less than 5% of the total storage utilization.

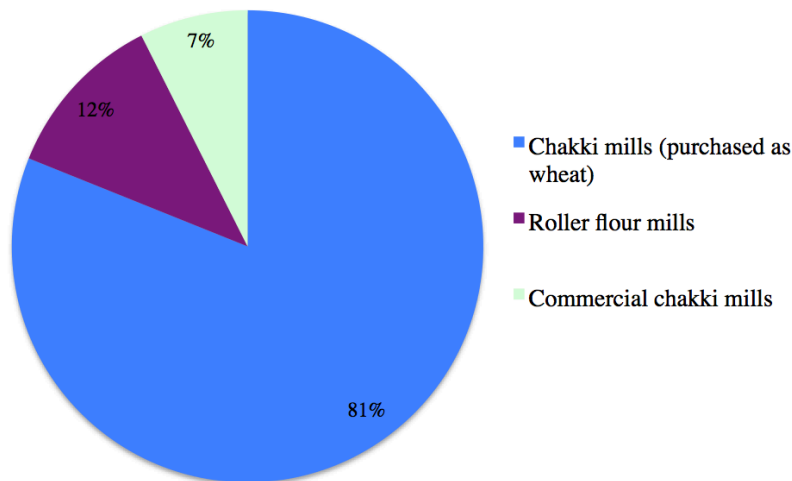
<sup>23</sup> Cover and plinth refers to outdoor stacks of bagged grain, covered with some waterproof material.

<sup>24</sup> FCI - Haryana

### Wheat processing

Because almost half of the wheat consumed in Haryana is self-consumed by farmers and wheat flour consumption in both rural and urban households is still dominated by home-made chapattis/rotis using locally-milled flour (rather than industrially processed wheat flour products), wheat flour is produced in Haryana by mills at varying grades of sophistication.

**Figure 8: Wheat flour milling market share**



### Domestic home chakki

**mills:** These stone-grinders are typically small units with a very small capacity, approx. 40 – 50 kg/h and usually with 12” grinding stones. They are usually made by rural fabricators, and cost about Rs. 4,000/- or less. Landlords and rural households engaging in subsistence production value the flexibility and convenience of self-grinding their wheat in

small quantities.

### Figure 9: home chakki      Stand-alone village chakki mills

These stone grinding chakkis are usually operated with a commercial electricity meter (which have rates that are almost double that of domestic meters). Customers bring whole-wheat to millers, and are charged a Rs. 2.0-Rs.3.0/kg toll fee to mill wheat. The atta is not sifted to remove bran, so the extraction is 100%; the flour given to the customer as-is. On an average it’s estimated that every village has about two stand-alone village chakkis; using this estimate there could be 10,500 total village chakki mills in Haryana.

Tractor-driven mobile chakki mills also exist to services to some rural populations. However given the cost of transportation per km for a tractor (Rs. 12/km) these are not widely used except in very isolated locations.





## **Commercial Chakki Mills:**

### **Single commercial chakki:**

Although there are several similarities between commercial chakki mills and village chakki mills used for toll milling, here commercial chakki mills are also defined as equipped with graders and a pneumatic line to lift the wheat to the grinders. These modifications increase milling efficiency. Commercial chakki mills usually grind wheat for commercial purposes (e.g. selling branded or semi-branded atta flour), although some also provide toll or custom milling services. However, in the latter case, because a pneumatic line is used, customers are not able to visually confirm 100% extraction of the wheat-in, flour-out process. Customers using commercial chakki mills often complain of receiving incomplete orders.



**Figure 10: Single Village chakki**



Approx 3000 (both single unit as well as with system, breakup not available)



**Figure 11: Commercial chakki mill**

Commercial chakki millers generally operate with little oversight regarding safety and hygiene standards. Although these mills are technically capable of adding equipment to fortify wheat flour, they would require extensive capital and resource investments to bring the mills up to quality standards necessary to monitor production of fortified wheat flour. Additionally, individual mills will not be able to maintain laboratory capacity to assess wheat flour specifications, although a regional laboratory serving a cluster of mills may be more feasible.

#### **Roller Flour Mills:**

There are about 60 roller flourmills in the state but only 34 are known to be operational to at least 25% or higher capacity. Approximately six roller flourmills also operate more than one commercial chakki line in parallel with their roller mill lines.

Almost all the roller flour mills extract flour at similar rates: maida at 45%-50%, suji (if extracted) about 2%-5%, resultant atta about 20%-25% and chokker (bran) about 20-25%.

#### **Commercial chakkis with multiple lines:**

Commercial chakki mills with multiple chakki lines often have an official industrial registration. There are an estimated 110 – 140 operating in Haryana. They are usually fitted with 3-6 chakki lines, all running in parallel, as well as sifters or graders to separate the flour and the bran.

Some have their own commercial packing lines or pack for other brands. Many commercial chakki mills are registered with the FCI for the purchase of wheat, although they also depend on other wheat sources to maintain supply.

One of the main issues currently being faced by these commercial chakki millers is the lack of a coordinated industry, there is no commercial chakki association but there are also indications of some industry collaboration.



**Figure 12: Roller flourmill (L), chakki mill integrated with roller flourmill (R)**

As a whole, roller mills are operating at a far less utilization than ideal for business sustainability. The main complaint is that the tax structure for wheat procurement has made Haryana millers less competitive compared to those in neighboring states and territories. Flour millers report that they are unable to buy wheat at competitive prices and described many mills on the verge of closing, unable to compete with millers in Delhi.

### Industry structure

Currently the industrial or commercial flour milling industry accounts for a fraction of the state's flour milling needs. As Table 3 indicates, the current industry maximally has 240,000 MT of atta production capacity, and 900,000 MT total maida+atta production capacity per year. Total wheat flour use by the total population in Haryana is estimated at 3-3.5 MMT annually – considering that Table 3's estimates use 100% utilization as an estimate when milling sources reported 20% utilization, it's clear that the state's wheat depends on stand alone village or domestic chakkis.

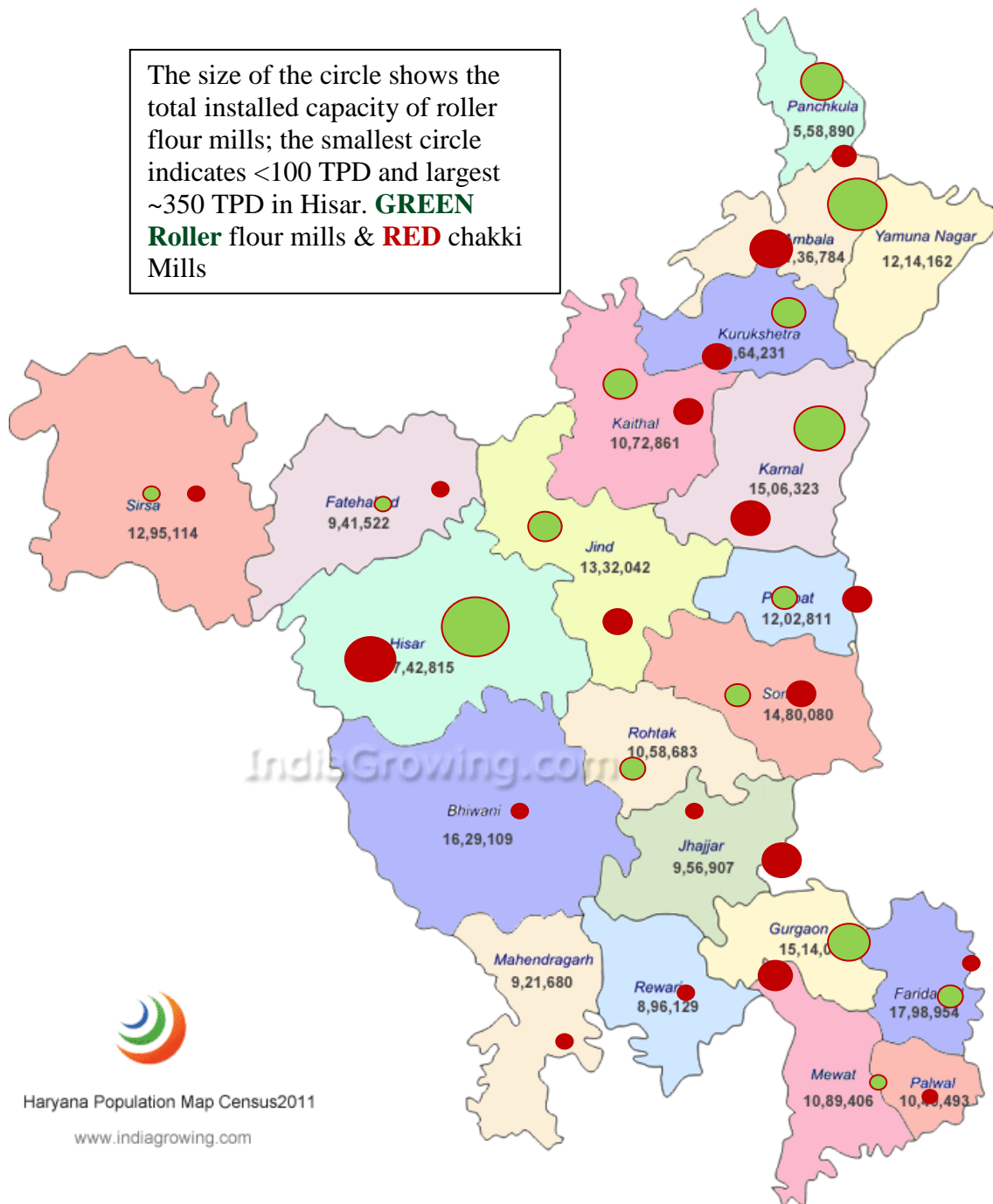
**Table 3: Total milling capacity across industrial and commercial milling enterprises<sup>a</sup>**

	Capacity assumption	Maida annual capacity	Atta annual capacity
Roller flour mill	34 mills at 66 MT/day average capacity	672,000 MT	
RFM chakki mills	6 mills at 4 MT/day average capacity	N/A	7,200 MT
Commercial chakki mills	110-140 mills at 5.5 MT/day average capacity	N/A	181,000-231,000 MT
<b>Total capacity</b>		<b>672,000 MT</b>	<b>~240,000 MT</b>

<sup>a</sup>100% utilization assumes 300 operating days per year.

The roller flour milling industry operates isolated from the rest of the industry. The market for maida flour is predominantly bread and biscuit manufacturers. Because most of these manufacturers are not located in Haryana, approximately 40% of maida is exported to other states.

**Figure 13: Flour milling locations on the basis of installed capacity of input wheat.**



## Retailing and utilization of wheat

Wheat grain, and wheat flour retailing can be categorized as following:

**Table 4: Wheat grain and flour sale and distribution**

Wheat Grain:	Wheat Flour:
Branded wheat	Branded atta/maida
Semi-Branded wheat	Semi-Branded atta
Loose sale of wheat	Loose sale of atta

### Wheat grain

MP's Sharbati wheat is a popular variety marketed by both branded wheat and semi-branded wheat brands. Relatively upper income consumers who are aware and willing to pay a premium for wheat grain typically purchase branded and semi-branded wheat. These households prefer to see the quality of the grain prior to milling<sup>25</sup> and typically have domestic chakki mills. Lower-income households still purchase wheat at traditional small retail shops and open air markets and pay for toll-milling at village chakkis. PDS wheat is purchased from designated Fair Price Shops; beneficiaries pay a subsidized price of Rs. 2/kg for the wheat and toll-milling costs of Rs. 2-3/kg.

Outside of PDS subsidies, the price of wheat grain is in the range of Rs. 19 – 21/kg (including toll milling costs).

### Wheat flour

Pre-milled wheat flour is typically considered a greater convenience, particularly for urban consumers who do not want to go to the effort of taking their wheat for toll-milling. Growth of branded atta flour<sup>26</sup> is growing quickly, specifically in urban areas<sup>27</sup>, but still remains a small proportion of the market share for atta flour, estimated 1%. ITC's 'Aashirvaad'



**Figure 14: Branded atta**

brand is the market leader nationally at 35% market share, while smaller regional brands collectively hold 40% market share. Other national brands such as Shakti Bhog, Pillsbury, Nature Fresh and Annapurna make up the remainder<sup>27</sup>.

Semi-branded atta is consumed in 25kg and 50kg packages, usually through wholesale distributors rather than retailers. Hotels rely on the semi-branded atta, which is predominantly produced by commercial chakki mills.

Loose bulk wheat flour is sold in both in supermarkets as well as by local chakki millers or in local markets.

<sup>25</sup> Field inputs from retailers in Panipat & Ambala

<sup>26</sup> Although many branded attas are 100% whole-wheat flour, some products may also include a mixture of legumes, maize and pulses, such as ITC's Aashirvaad. <http://www.aashirvaad.com/products.aspx>

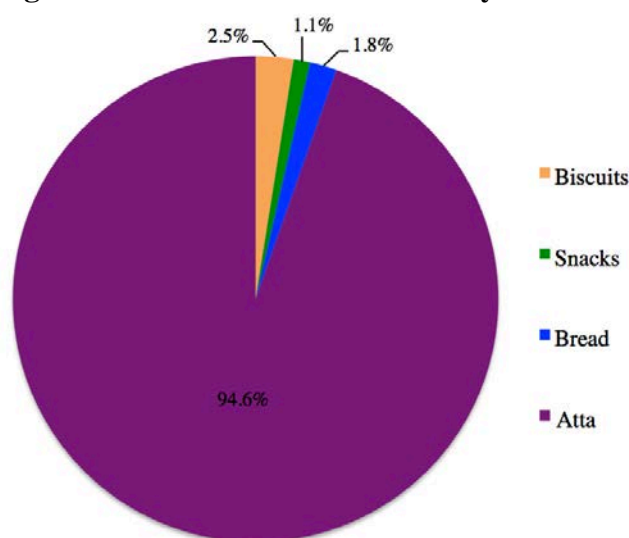
<sup>27</sup> Indian packaged wheat flour market growing at 19% to touch Rs 15,500 crore by 2019-20. NuFFoodS Spectrum. July 2015.

[http://www.nuffoodsspectrum.in/inner\\_view\\_single\\_details\\_print.php?page=2&content\\_type=panel&vrcl\\_panel\\_nm=LAT EST%20NEWS&ele\\_id=NOR\\_55a78702d65c87.46940678](http://www.nuffoodsspectrum.in/inner_view_single_details_print.php?page=2&content_type=panel&vrcl_panel_nm=LAT EST%20NEWS&ele_id=NOR_55a78702d65c87.46940678)

### Wheat flour use

95% of wheat is consumed in Haryana as atta, stone-ground whole-wheat flour used to make chapatti/roti<sup>28</sup>. Local foods utilizing maida include naan, a leavened oven-baked flatbread, and fried snacks such as samosas. It's expected that only 3% of total wheat flour is used as bread and biscuits (combined). Use of flour in traditional snacks, such as samosas, is also estimated to contribute only 1% of wheat use.

**Figure 15: Wheat utilization in Haryana**



Major bread and biscuit manufacturers use maida; none are directly made in Haryana; manufacturers that service the state are located in the state of Punjab: Kitty, Bonn (both near Ludhiana), and Britannia. Bread is transported in smaller goods carriers; the high cost of transportation and limited urban market restricts industry growth.

The growth of the bread/biscuit industry is primarily in surrounding areas of Delhi, with four biscuit manufacturers in Sonapat (Kundli) region and few others in Bahadurgarh areas, which are largely urbanized. The major manufacturers are

Parle, Britannia, ITC, Priya Gold and Anmol.

The overall urbanization in Haryana hides the regional differences in urbanization (and thus demand for bread/biscuits) by districts. The average urbanization for Haryana is only ~35% but districts neighboring Delhi, such as Faridabad and Gurgaon, over 70% of the districts are urbanized.

Resultant atta, a by-product of producing low-extraction maida, is another type of flour produced by roller flourmills. More colloquially called “dhaba atta”, this flour is sold cheaply primarily to street stands (dhabas) or restaurants for the production of high-turnover chapattis/rotis. Although resultant atta contains greater proportions of germ and bran compared to maida, since it is not produced by stone grinding it has different sensory properties than chakki atta. Anecdotally, resultant atta is said to make chapattis with different pliancy and mouth-feel than chapattis made with chakki atta.

Suji or rawa (semolina) is also produced by roller flourmills but because this is predominantly used for specialty desserts, not all mills extract this flour. Estimates for suji/rawa production are too low to estimate.

### Technical requirements for milled wheat flour

Wheat flours are not all the same. The specific milling technologies used (e.g. roller mills versus chakki mills) impart specific organoleptic (sensory) characteristics to the foods made with those flours. As such, wheat flour millers can mill flour to meet the specific needs of

<sup>28</sup> Based on calculations removing total wheat milled in flour mills for flour

pastry makers, instant noodle manufacturers, or home cooks. To ensure that they are producing flours that meet customer needs, modern mills have in-house quality assurance and quality control (QAQC) laboratories capable of assessing specific wheat flour characteristics, while also using third party laboratories for validation.

**Table 5** compares the specifications of maida, chakki atta, whole-wheat flour, and resultant atta from leading flour milling companies in India. As shown, the different flours have different acceptable specifications. Most importantly, the percent of damaged starch (a result of the high-heat grinding during chakki milling) is double for chakki atta than for maida and whole-wheat flour. Granulation (the wheat flour particle size) also differs across the wheat flours.

Chakki atta cannot be substituted by whole-wheat flour milled by traditional roller flourmills because the two methods do not result in the same kind of flour. Indian flour millers responding to tenders for fortified atta must be required to demonstrate through lab analyses and verified documentation that they meet specifications for atta.

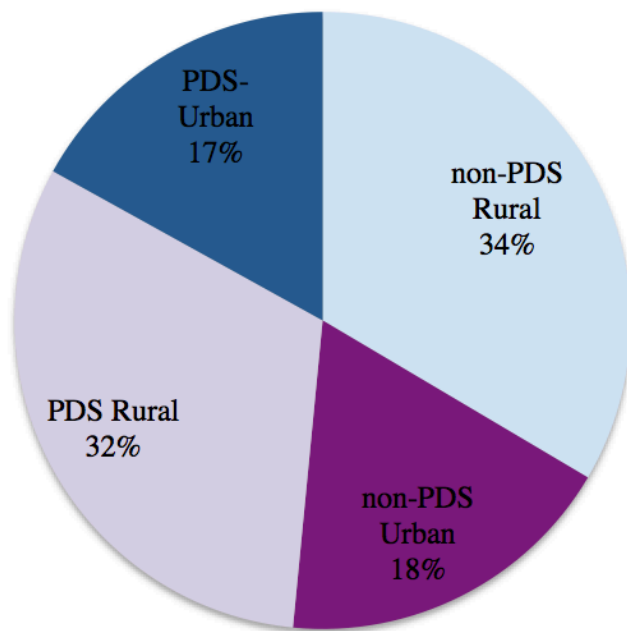
**Table 5: Specifications for different types of wheat flours**

	<b>Maida</b>	<b>Chakki Atta</b>	<b>Whole-wheat flour</b>	<b>Resultant atta</b>
Ash (%)	0.4-0.6	1.2-1.6	1.2-2	<2.0
Protein (%)	9-14	9.5-11.5	14-18	--
Gluten (DB)	--	>7	--	>6
<b>Damaged starch</b>	<b>8</b>	<b>16-19</b>	<b>&lt;8</b>	<b>&lt;12</b>
<b>AACC (%)</b>				
Moisture (%)	<14.0	8.5-9.5	14-Sep	<14.0
Puffing (%)	--	100	--	--
<b>Granulation +210 micron (%)</b>	<b>0</b>	<b>15-25</b>	<b>10-25</b>	<b>--</b>

#### Consumers and wheat access channels

The total population of Haryana is distributed as shown in Figure 16. The non-PDS rural population is largely considered subsistence farmers, milling wheat at home or at toll-mills. Subsistence farmed or toll-milled wheat is not considered a “fortifiable” market. The PDS beneficiary population, 49% of the population, could benefit from fortification if PDS wheat is converted to atta prior to distribution at FPS. It is estimated that approx 0.9 MMT of flour (atta and maida) is fortifiable through maida, commercially milled atta, and atta distributed as atta.

**Figure 16: Proportion of the population by PDS beneficiary status and urban/rural**



#### Conclusions

- Wheat is a key staple grain in Haryana for its population. As a fortification vehicle fortified wheat flour is likely to reach 100% of the population (i.e. high coverage)
- The primary source of wheat for the population is PDS: 49% of the population receives wheat through the PDS channel
- 95% of wheat is milled into chakki atta flour for roti/chappati production at the household level
- 79% of wheat is milled at the local chakki level rather than purchased, commercially milled atta.
- The current wheat flour milling industry heavily relies upon local

chakki mills.

- Maida, chakki atta, resultant atta, and reconstituted whole-wheat flour have different sensory characteristics and cannot be substituted interchangeably for all wheat flour food applications.



## Part II: Opportunities for wheat flour fortification

There are two options for fortifying wheat flour in Haryana: open market wheat flour and social welfare scheme wheat flour:

### Open market wheat flour

Wheat flour can be considered purchased on the open market if manufacturers and consumers purchase through traditional retail mechanisms – wheat flour millers, local shops, markets, etc. – without government intervention in the wheat supply chain. Open market wheat flour includes branded and semi-branded atta, loose bulk atta, and wheat flour (usually maida) made into end-consumer products, such as biscuits, snacks, and bread.

As Part I discussed, 94% of wheat flour in Haryana is used as atta, rather than wheat-flour products typically made with maida, such as biscuits, bread, and snacks. Open market atta flour is limited to branded and semi-branded atta, and limited quantities of loose bulk atta. However, branded and semi-branded atta currently only 14% (0.41 MMT) of market share for atta flour. The remainder (79%) of atta is supplied as wheat milled by service chakkis.

Thus, the fortification opportunity of open market wheat flour is limited to 0.14 MMT of maida and 0.41 MT of branded and semi-branded atta produced and consumed in Haryana. Fortifying only these two flours will have limited public health impact due to the low per capita availability of maida and limited number of urban, upper-income households that depend on branded or semi-branded atta.

Technical options for fortifying open market flour:

- Fortification of maida flour sold on the open market would take place at roller flourmills.
- Fortification of branded and semi-branded atta sold on the open market would take place at commercial chakki mills and roller flourmills with dedicated chakki lines.

Wheat purchased in the open market for toll-milling at chakkis is not considered an option for fortification.

### Social welfare scheme wheat flour

As previously described, there are three major social welfare schemes in Haryana that provide wheat to beneficiaries: PDS, MDM, and ICDS. Currently wheat is provided to beneficiaries; beneficiaries then take the wheat to local chakkis for milling. This analysis considers fortification at chakki mills *technically* feasible but not *logistically* feasible for a long-term sustainable program. However, other states in India directly provide atta to beneficiaries, rather than wheat.

If wheat provided through PDS, MDM, and ICDS were converted to atta prior to distribution, it would be expected to have the following impact: coverage to 12.6 million PDS beneficiaries (average availability 171 g/c/d), 2.1 million MDM beneficiaries<sup>29</sup> (average availability 26 g/c/d). Precise numbers of ICDS beneficiaries are unknown but the allocated quantity (0.03 MMT) is similar to MDM and suggest limited per capita availability. Converting PDS atta to fortified atta is the clear social welfare scheme opportunity.

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<sup>29</sup> <http://harprathamik.gov.in/mdm.html>

Converting wheat to atta for distribution will require bids from mills with the capacity to produce atta – not just reconstituted whole-wheat flour. If the distributed atta does not have the same characteristics of chakki-milled atta then beneficiaries may reject the flour.

If the Government of Haryana decides to convert wheat to atta for welfare scheme distribution, options for sourcing fortified atta are the same as above for the open market system – commercial chakki mills and roller flourmills with dedicated chakki lines. However, as the next section will discuss, the current milling infrastructure will require extensive investments to modernize milling all PDS wheat is converted to atta.

### Conclusions

- Half of the state does not participate in the open market system, instead consuming wheat on a subsistence-basis, i.e. retaining wheat grown or receiving wheat as payment from landowners. These individuals are unlikely to be reached by fortification since they are most likely to use their own chakki mills in the home.
- Fortified atta must have the same qualities of chakki atta or consumers will reject the flour
- Half of the state is PDS beneficiaries, i.e. receiving wheat grain from the government at subsidized prices. If the state were to provide wheat flour instead of wheat grain to beneficiaries, this could be a channel for distributing fortified wheat flour. Fortifying OMS-only flour would neglect lower-income households that stand to benefit from fortification.
- 15% of wheat in the state is purchased in the open market as wheat grain, and milled in stand-alone chakki mills for toll fees. Given the same logistical challenges in enforcing fortification at individual chakki mills, this wheat flour is also considered not fortifiable.
- Converting PDS wheat into fortified atta would have the greatest opportunity for improving public health through fortification in Haryana.
  - An estimated 50% of the population in Haryana consumes 171 g/c/d of PDS wheat and could be expected to benefit from fortification.

## Part II: Technical options for fortifying wheat flour

There are essentially four options for fortifying wheat flour in Haryana, three relying on extensive expansions of the existing flour milling infrastructure, and one that would require building completely new milling infrastructure (Table 7):

1. **Single chakki mills** upgraded with a basic grader to remove bran & single lift pneumatics. Current toll-milling chakkis do not operate under FSSAI norms and are not checked for hygiene specifications. But if chakkis were expected to convert wheat into atta for PDS distribution, production must be improved to meet FSSAI requirements. Likely these mills can produce a maximum of 2 MT/day, based on a 24” chakki operating at an average of 200 kg/hr for a maximum of 10 hours/day
2. **Commercial chakki mills** with at least 4-5 chakki units, upgraded to meet hygiene standards and potentially access to a regional laboratory to serve a cluster of mills’ quality control needs. One such sized mill running about 20 hours a day could produce 20 MT/day of atta. Such mills should also have storage capacity for 200 MT of wheat (sufficient for 10 days of milling)
3. **Hybrid mills of roller-chakki lines** capable of producing simulated atta<sup>30</sup>. Currently 36 roller flourmills are operating in Haryana, six with parallel chakki lines in order to produce chakki atta. However, in order to meet the needs of converting PDS wheat to atta flour, these mills require a hybridized modification to integrate chakki mills into production, while maintaining greater production capacity than traditional chakki mills. No roller flourmills currently produce simulated atta using these processes, so significant investments are necessary to adapt mills for this purpose and ensure that they can produce quality atta with chakki atta characteristics. Additionally, roller flourmills also have hygiene and quality control gaps that should be addressed in order to meet government specifications. An estimated 60 MT/day of simulated atta could be produced.
4. **A modern atta line** using fully automated systems and an internal laboratory for quality control procedures. Currently there are no such mills existing in Haryana, although they operate elsewhere in India and Bangladesh. Such mills are capable of producing quality atta with chakki atta characteristics under strict hygiene standards. Since these mills do not currently operate in Haryana, the government would have to find an investor to build such plants to meet PDS atta demand, or invest in milling production directly. A single line can produce 130 MT/day, or four lines can be combined in a milling plant to produce 520 MT/day.

Each of these options have markedly different operating costs. **Figure 17** displays the operating cost per kg of each milling option. Each of the milling options achieve lower costs per kg as milling utilization increases due to improved economies of scale. Small chakki mills are only able to operate at a maximum of 10 hours per day, so at most their utilization only reaches 40%. Up to 30% utilization, the cost differences between the milling options do not vary greatly; however as utilization increases the modern atta mills score better than the conventional options of commercial chakki and hybrid roller-chakki options. Figure 18 breaks down those operational costs by inputs – utilities and packaging costs, manpower costs, and costs of amortization or maintaining investments. As shown, at the highest possible utilization rates, the differences

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<sup>30</sup> Simulated atta here is not referring to reconstituted whole wheat flour produced by roller flour mills, but a combined approach using both roller mills and chakkis to produce a traditional-quality atta.

between small chakki mills and the largest 150 MT/day modern atta line is a 62%, 96%, and 45% decline in utilities, manpower, and investment costs respective.

While economy-of-scale is one of the key factors that allows reduced operation costs in modern atta milling, another reason traditional chakki mills have high operational costs is greater manpower needs – for supervision and monitoring to address issues and prevent inconsistencies in the final milled atta product.

These per kg costs in the context of the PDS program’s annual volume shows that the investment expenses of using a modern atta mill to convert wheat to atta are quickly recouped in lower operating costs. In 2015 0.79 MMT of PDS wheat was distributed. Using the estimated per kg milling costs by option, a modern atta mill would cost 33% less to operate than the roller flour mills (Table 6).

**Table 6: Cost to mill PDS supply of 0.79 MMT of wheat**

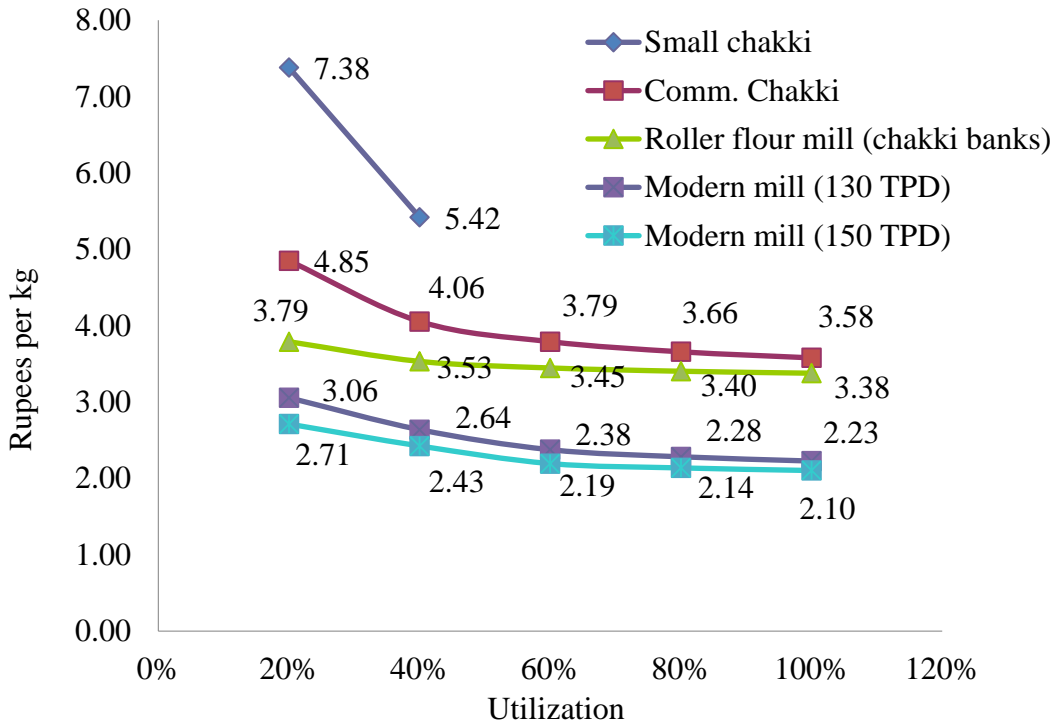
<b>Milling option</b>	<b>Cost per kg (Rs.)</b>	<b>Annual cost (Rs.)</b>	<b>Annual cost (USD)</b>
Chakki mill	5.42	4,281,800,000	65,873,846
Commercial chakki mill	3.66	2,891,400,000	44,483,077
Roller flour mill	3.40	2,686,000,000	41,323,077
Modern atta mill	2.28	1,801,200,000	27,710,769

\*add conversion assumptions

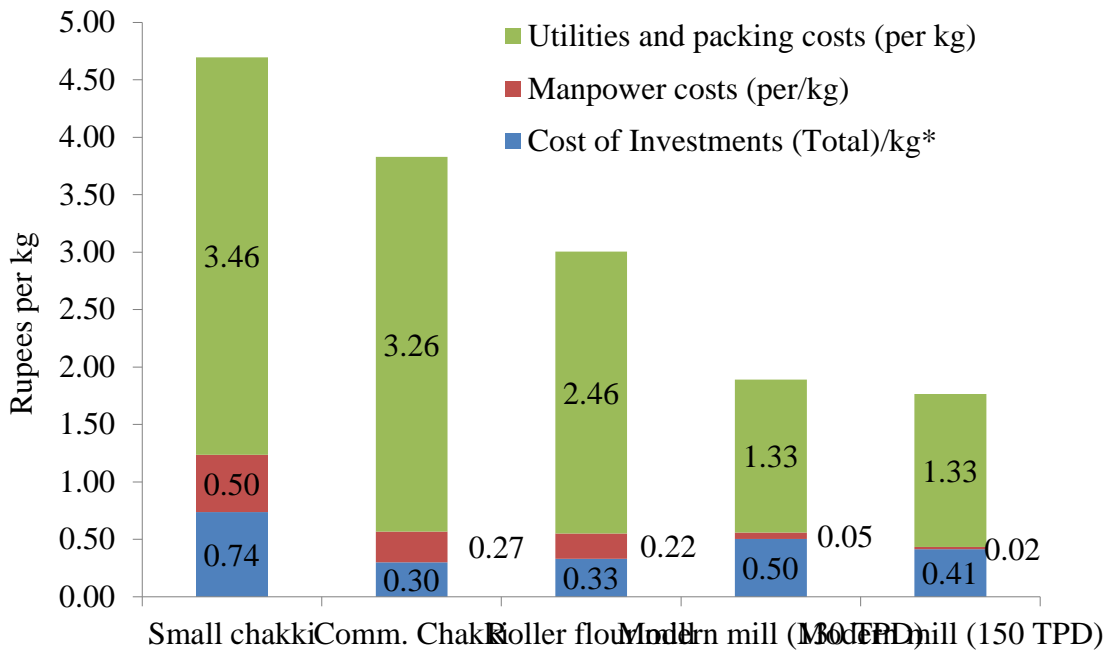
**Table 7: Technical options for fortifying atta flour**

<b>Milling option</b>	<b>Local chakki mills</b>	<b>Commercial chakki mills</b>	<b>Hybridized roller-chakki mills</b>	<b>High capacity modern mills</b>
<i>#of mills necessary</i>	At least 5,000 mills (currently 13,500 exist)	At least 500 mills (currently 110-140 exist)	At least 167 mills (currently only 6 of 34 mills able to produce chakki)	5-20 mills (none currently existing)
<i>MT/day atta capacity</i>	2 MT/day	20 MT/day	60 MT/day	130-520 MT/day
<i>Needs</i>	<ul style="list-style-type: none"> <li>• Financial assistance to procure premix and equipment</li> <li>• High government ability to monitor a large number of mills</li> <li>• Miller training</li> <li>• Developing laboratory capacity not possible</li> </ul>	<ul style="list-style-type: none"> <li>• Possibly financial assistance to procure premix and equipment</li> <li>• High government ability to monitor a large number of mills</li> <li>• Miller training</li> <li>• Investments to expand milling infrastructure</li> <li>• Laboratory capacity at regional cluster level</li> <li>• Improvements to hygiene and sanitation practices</li> </ul>	<ul style="list-style-type: none"> <li>• Possibly financial assistance to procure premix and equipment</li> <li>• High government ability to monitor a large number of mills</li> <li>• Miller training</li> <li>• Investments to expand milling infrastructure</li> <li>• Laboratory capacity at regional cluster level</li> <li>• Improvements to hygiene and sanitation practices</li> </ul>	<ul style="list-style-type: none"> <li>• Requires investments to develop state-of-the-art milling infrastructure</li> </ul>

**Figure 17: Operating costs per kg by milling option**



**Figure 18: Operating costs by inputs, by milling option**



The advantages of the commercial chakki and hybrid roller-chakki systems are that they take advantage of an existing milling industry (although at marginally higher costs). However, field visits to mills in Haryana revealed the current milling industry in Haryana is operating at sub-optimal hygiene and quality standards. Extensive investments to improve operating standards in the existing milling industry are needed if these options are expected to convert PDS wheat to atta. Logistically, utilizing the existing milling industry also provides options to begin fortifying atta for distribution in the short term to a limited number of districts. However, for a long-term sustainable option, a modern atta mill provides an integrated solution that can be scaled up for the entire state.

#### [Analysis of quality monitoring & controls](#)

The present mills in Haryana are not sufficiently equipped to monitor production of quality atta. Table 8 presents a comparison of the options for improving quality control and quality assurance practices across the four milling options. Specifically, most commercial chakki mills and likely all small chakki mills will not have any established quality assurance practices and they are likely not regulated to ensure they meet FSSAI standards for atta production. None of these have laboratory facilities to assess the quality of their atta, and it's unlikely that they refer to a third party lab for verification. Roller flourmills may have quality assurance practices but laboratories are equally lacking. As such, most mills will require extensive support and auditing to develop processes and laboratories to ensure quality atta consistency. However, implementing quality control audits for a high number of small chakkis, particularly those in remote locations, poses several challenges. In general, modernized milling technology allows for greater improvements in quality control.

#### [Potential consumer access to milling options](#)

Atta produced by each technical milling option will have differing abilities to reach consumers, particularly those purchasing wheat or atta in the open market (Table 9). Rural open market consumers (largely subsistence farmers) will be the most difficult to reach using industrial milling options. Due to the challenges of ensuring chakki-milled atta is fortified per national standards, chakki mills are not included in further comparisons with commercial chakki mills, hybrid mills, and modern atta mills.

**Table 8: Comparison of operational characteristics by milling option**

	2 MT/D chakki	20 MT/D Commercial chakki mill	60 MT/D Hybrid roller – chakki line	Modern atta mills (130 & 520 MT/D)
<b>Nature of operation</b>	Manual	Semi-automated	Automated	Automated
<b>Flour weighing</b>	Manual	Manual	Attached weigh scales possible	Integrated with milling system
<b>Dosing accuracy</b>	Manual & highly variable	Mechanical	Automation possible	Automated
<b>Operational sanitation</b>	Highly variable due to individual mill practices	Requires heavy investments to improve sanitation practices	Requires heavy investments to improve sanitation practices	N/A – new construction
<b>Product Sanitation</b> (potential for contamination)	High potential for contamination Manually handling	Moderate potential for contamination: line operated, bagged manually	Lowest potential for contamination: automated – no human handling	Lowest potential for contamination: automated – no human handling
<b>Presence of lab quality control</b>	Not possible	No labs present. One lab could serve a mill cluster.	Limited labs available: new labs and upgrades needed	Standard with modern mills
<b>Raw material quality</b>	Toll-milling – inconsistent supply of wheat grain	Wheat is purchased in small lots, 10-20 MT etc.	Relatively more consistent, at FCI quality	Wheat purchased in high quantities, grading possible
<b>Personnel training</b>	Personnel currently untrained	Personnel currently inconsistently untrained	Requires skilled personnel	Requires skilled personnel
<b>Compliance to standards</b>	Not feasible to check for compliance	Standards exist but rarely checked for compliance	Standards exist but rarely checked for compliance	Small number of large mills will facilitate enforcement

**Table 9: Potential consumer access to milling options**

	2 MT/D chakki	20 MT/D Commercial chakki mill	60 MT/D Hybrid roller – chakki line	Modern atta mills (130 & 520 MT/D)
<b>Rural PDS</b>	Rural PDS consumers rely on chakkis to mill their wheat. However as urbanization increases, rural populations are declining and future use of local chakkis will likely as well.	Commercial chakki mill products typical do reach rural areas due to logistical constraints	These will require a large and effective distribution system to reach the rural households.	These will require a large and effective distribution system to reach the rural households.
<b>Urban PDS</b>	In the future urban consumers may prefer the convenience of receiving atta over personally taking wheat to chakkis for grinding	Commercial chakkis could be equipped to serve the urban PDS provided they can meet the requirements and standards	These mills are more logistically feasible options for urban locations as their volumes are larger	5-20 modern mills can produce enough atta to serve the entire state’s PDS supply.
<b>Rural open market system</b> (subsistence farmers)	Wheat is typically ground in home or village chakkis	Rural open market consumers do not purchase loose or branded atta.	Rural open market consumers do not purchase loose or branded atta.	Rural open market consumers do not purchase loose or branded atta.
<b>Urban open market system</b>	Urban consumers purchasing quality wheat for home or local chakki milling will not be reached by fortified flour	Fortified loose or branded atta will reach urban open market consumers	Fortified loose or branded atta will reach urban open market consumers	Fortified loose or branded atta will reach urban open market consumers



### Product quality and specifications

It is not simply enough for a milling system to convert wheat to atta; mills will also need to convert wheat to atta while adhering to national FSSAI standards for atta and milling practices. None of the currently existing milling systems in Haryana are able to support fortification of wheat flour without extensive improvements and adaptations (**Table 10**)

1. Quality of raw input: the quality of atta millers produce will depend largely on the quality of the wheat provided or procured by millers. Millers should have processes in place to monitor the quality of incoming grain, to ensure that only grains of adequate quality and moisture content are used for milling.
2. Production process monitoring: mills should have record systems with checks and documentation for ensuring consistent, standardized operations. Such record systems are also necessary for the auditing of fortification practices at the mill over time.
3. Product quality monitoring: mills should have internal methods and capacity to check whether atta meets required specifications, for example moisture, ash, granulation, etc. Lacking internal laboratories, mills should have access to a regional lab or third party lab to ensure specifications are met or internal lab results validated.
4. Weighing and packaging: automated systems are preferable where possible, in order to prevent system tampering, consistent operations, and reduced waste or losses.
5. Expected external support needs to integrate fortification with existing milling operations: mills will likely need technical assistance to incorporate fortification. Needs across milling options will differ

Adhering to quality standards is important to ensure that PDS atta maintains stability after milling, during storage and distribution, and at the beneficiary level. Improved hygiene practices will reduce pest infestation and contamination and allow the flour to maintain freshness for as long as possible after milling. Technically it may be possible to achieve at least a 3 month product stability by maintain the following features:

1. A high quality cleaning system capable of removing infested grains through screening, gravity separation, etc.
2. A uniform and controlled system of tempering that prevents excessive moisture in the grain prior to milling.
3. A high quality impact detacher to kill insect eggs to greater than 99% so as to obtain a keeping atta free from infestation for up to 3 months.
4. Maintenance of flour moisture to 12% or less in the final finished products.
5. Good packaging material that will prevent moisture and air entry, while also withstanding external pressure stress during handling.
6. Ideally, use of an inert packing system that will dilute the oxygen concentration to retarding insect and microbial infestation.

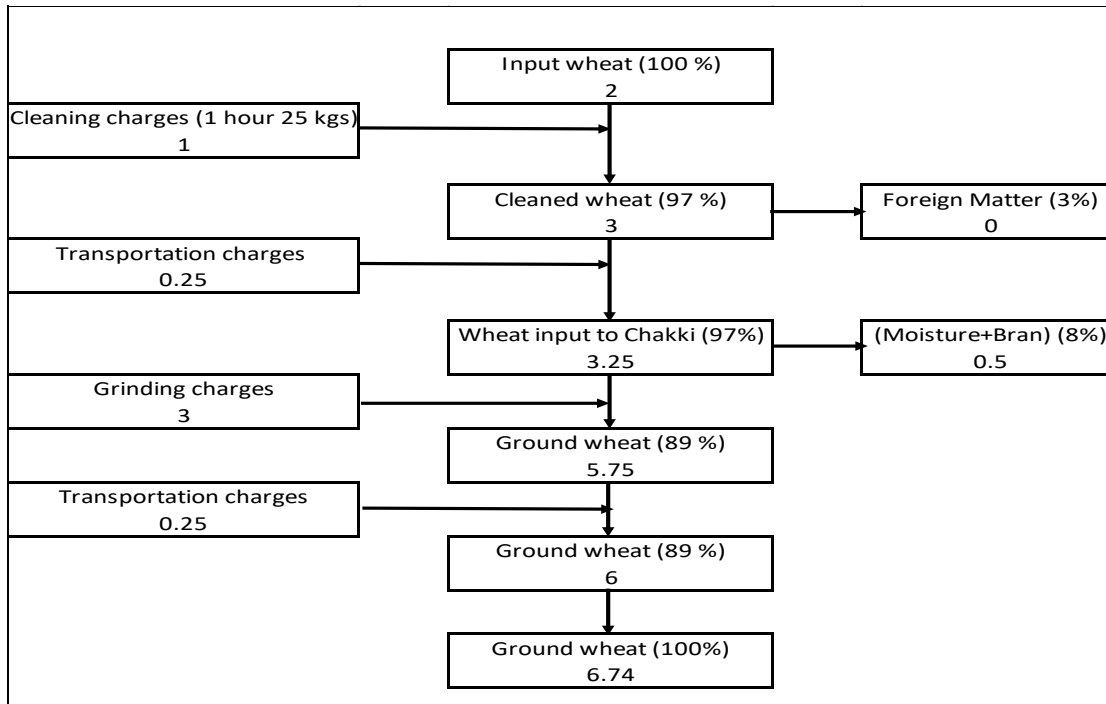
**Table 10: Product quality and specifications**

	<b>20 MT/D Commercial chakki mill</b>	<b>60 MT/D Hybrid roller – chakki line</b>	<b>Modern atta mills (130 MT/D &amp; 520 MT/D)</b>
FSSAI Product Compliance	Most not milled to meet FSSAI requirements	Some product compliance to meet FSSAI requirements	Default state-of-art
FSSAI Mill Compliance	Requires support to ensure milling practices meet FSSAI requirements	Some milling compliance to meet FSSAI requirements	Default state-of-art
Laboratory Infrastructure	Nonexistent - a cluster laboratory could be installed to service a group of mills	Existing labs need to be updated and additional labs installed	Newly equipped
Milling Infrastructure	Weighing & dosing controls require external monitoring by milling personnel	Weighing & dosing controls require external monitoring by milling personnel with impact detacher	State-of-art facility will have integrated automated features
Product Shelf Life	Maximum 2 month shelf life (if stored appropriately)	Maximum 3 month shelf life (if stored appropriately)	Maximum 6 month shelf life (if stored appropriately)
Transportation & Handling	Can only service regional areas of the state	Can only service regional areas of the state	Could provide atta to the entire state, with centralized control

**Table 11: Operational aspects**

	<b>Considerations</b>	<b>20 TPD Commercial chakki mill</b>	<b>60 TPD: Hybrid roller – chakki line</b>	<b>Modern atta mills (130 TPD &amp; 520 TPD t/h)</b>
Growing Location (Fatehabad, Sirsa)	Improves inbound logistics, better grain management	Very highly distributed in the State and hence not an advantage	Can improve storage to mobilise raw material	Location close to growing will be a great logistical and cost advantage
Centralized procurement	First the grain is consolidated in one pool and distributed again	Will be required to redistribute	In some cases direct procurement can be encouraged	Centralized pooling and warehousing can be completely avoided
Personnel supervision	Chances of lapses high and extensive people monitoring	High level of personal supervision	Reputed millers can be partially entrusted	Fool proof & automated systems can be placed with least manual involvement
Local distribution	Respective mills can be given the directives to locally distribute	Monitoring & tracking needs to be effective	Monitoring & tracking needs to be effective, lapses can be expensive	Can be regionalized
Remote distribution	Where products have to be dispatched to far off destination	Not an economically feasible option	Feasible in bulk	System will be designed to address remote distribution
Keeping quality control	Assurance of keeping after distribution	Tracing challenges if the number of mills involved is very high	Outward tracking feasible, however challenges of raw material effects may be hard to observe	Traceability systems can be implemented, even the respective farms and supply locations can be tracked

**Table 12: The existing cost structure in PDS**



**Table 13: The evolving cost structure after fortification**

		BLOCKS	DISTRICT	STATE
Procurement & Sourcing		HAFED (90 days)	LOCAL MILLS	130 TPD (1 Year)
	Wheat purchase quantity in kg	2,000,000	40,000,000	800,000,000
	Pack size	5/10 Kg/25	50 Kg	25 Kg
	Pickup distance Radius for wheat to mill (range)	100 km	25 km	40 km
	Delivery distance radius from mill to depots (range)	100 km	25 km	40 km
	Loading Charges	14.5	14.5	14.5
	Mandi (2%) and rural development (2%) cess, total 4%	0.58	0.58	0.58
	Broker commission (2.5%)	0.36	0.36	0.36
	Filling charges, heaping and bagging	0.13	0.13	0.13
	Gunny bags	0.8	0.8	0.8
	Transportation Charges to nearest warehouse (averaged)	0.2	0.2	0.2
	VAT applicable to all purchases including FCI (5%)	0.725	0.725	0.725
	Total Procurement Charges at FCI Warehouse (Rs/kg)	17.30	17.30	17.30
	Purchase price paid by PDS to FCI (considered exempted from taxes)	2	2	2
Lifting Charges	Loading Charges at FCI warehouse	0.054	0.054	0.054
	Transportation Charges to the Mill	0.5	0.2	0.3
	Unloading Charges at the Mill	0.054	0.054	0.054
	Total Charges for Loading / unloading / transport/kg	0.608	0.308	0.408
Milling Charges	Wheat lost (screenings / wastage 3%), Bran is compensated	0.52	0.52	0.52
	Investment costs (infrastructure costs)	0	0.3	0.5
	Operation costs (Power, labour and maintenance)	2.5	2.2	1.8
	Premix costs (Only B12, Fe and Folic acid)	0.2	0.2	0.2
	Administration and other costs including margin / service tax (15%)	0.5	0.25	0.25
	Moisture loss (Based on level of conditioning) in %	0.50%	0.50%	0.50%
	Moisture loss (Based on level of conditioning) in Rs/kg	0.09	0.09	0.09
	Total cost of Milling	3.29	3.04	2.84
Packing & loading cost	10/ 25 / 50 Kg poly bag with lamination (Rs. 12 - 18 / bag)	1.4	0.6	0.6
	secondary packing costs if applicable (only Model 1)	0.25	0	0
	Total cost of Packing	1.65	0.6	0.6
Delivery costs	Loading costs at the mill	0.054	0.054	0.054
	Distribution costs within a radius of 30 km from the mill	0.5	0.2	0.3
	Unloading costs (generally to the shop owner)	0	0	0
	Total cost of delivery	0.554	0.254	0.354
Margins	Present Margin (covered already by the present schemes)	0.48	0.48	0.48
	Additional margin recommended per kg	0	0	0
	Total margins presently	0.48	0.48	0.48
	FINAL COST ESTIMATES / KG OF FORTIFIED ATTA (PACKED)			
Total landed costs at t	Total cost of 1 kg of Atta presuming State compensates for 3% loss	9.50	6.68	6.68
	Total cost of 1 kg of Atta presuming Miller buys for the compensation	10.02	7.20	7.20
	Cost already borne by Food Supply Dept.	1.09	0.79	0.89
	Amount charged to the consumer (with 5% VAT)	2.00	2.00	2.10
	Extra cost on account of fortification & supply for 1 Kg of wheat)	6.42	3.89	3.69
	Cost paid by the consumer			2.06
	Total cost to the consumer			5.75
	Break even retail price for the consumer / beneficiary	6	6	6
	Net gain / loss in sale of fortified atta	-2.42	0.11	0.25

## Conclusions

This supply chain analysis focused on where population reach for fortified wheat flour exists in Haryana, and presented a comparison of the four technical options for producing fortified wheat flour. In summary:

1. Wheat is primarily utilized by consumers as atta, rather than other wheat flour products (e.g. maida and semolina). It's clear that for fortification to provide a public health benefit, atta will be the key vehicle for fortification.
2. Current consumer practice is to purchase wheat for milling into atta at local chakki mills. Fortification at local chakki mills, while technically feasible, is not logistically feasible to maintain long-term sustainability, given the intense monitoring and financial resources necessary. However, currently open market atta is a small proportion of the existing market for atta.
3. PDS beneficiaries make up 50% of the population. Beneficiaries receive PDS wheat and take this wheat to local chakkis for milling. In order to reaching the rural population (as well as the urban poor) with fortified atta, government welfare schemes should consider distributing fortified atta rather than wheat grain.
4. There are three potential technical solutions to convert PDS wheat to fortified atta:
  - a. Engaging the existing commercial chakki mill industry to supply fortified atta, which will require extensive improvements in milling infrastructure, quality, and standards.
  - b. Engaging the existing roller flour mill industry to install large chakki banks in their plants will similarly require extensive capital investments, improvements in milling infrastructure, quality, and standards.
  - c. Engaging the government of Haryana to consider investing in modern, state-of-the-art modern atta mills, which would allow for rapid scale-up of fortified atta production, while achieving the greatest quality control measures and adherence to FSSAI standards.

The cost summary as shown in tables 12 & 13 show that it would be feasible to achieve a cost structure involving fortified atta supply to a value lower than current system of wheat distribution, justifying the economics of fortification over the long run scaled up at State level.

