India and Fortification

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Food Fortification Initiative

Enhancing Grains for Healthier Lives

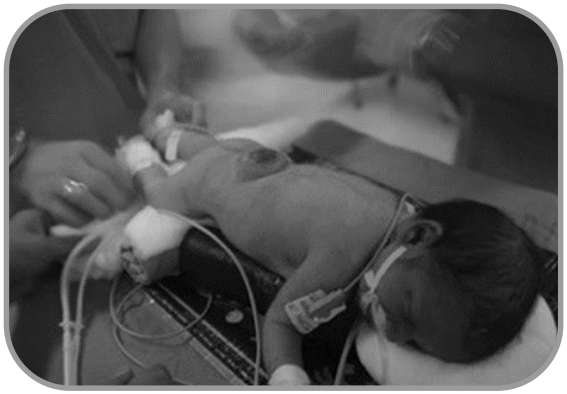
What is fortification?

- Fortification adds vitamins and minerals during milling so that foods made with flour are more nutritious.

Vitamins and minerals are combined in a powdery premix to add to flour during the milling process.

Photo from Mühlenchemie

Global problems from vitamin and mineral deficiencies



233,300 preventable birth defects of the brain and spine each year

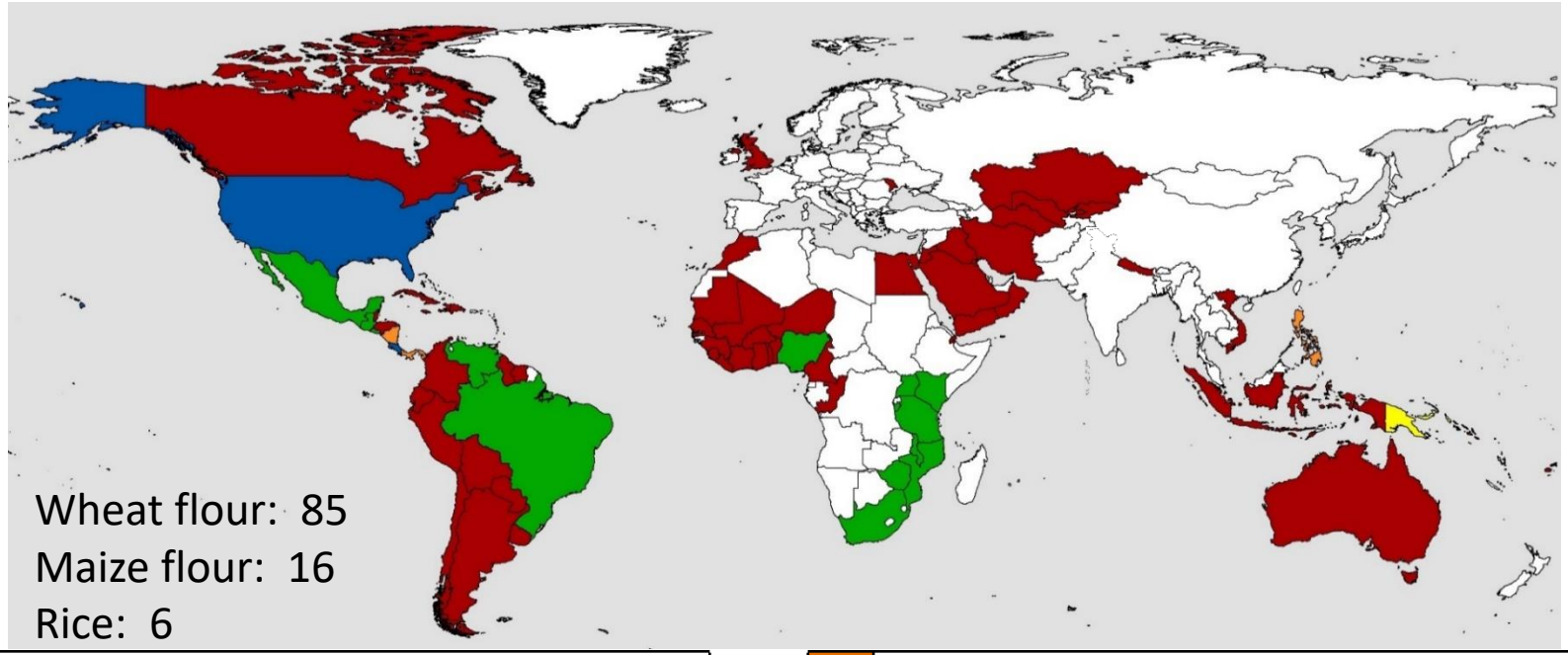
Anemia contributes to **20% of all maternal deaths**

17% lower productivity from iron deficiency anemia

Arth et al. 2016, WHO, n.d., Horton 2003

Photos: International Federation for Spina Bifida and Hydrocephalus and Flickr Creative Commons

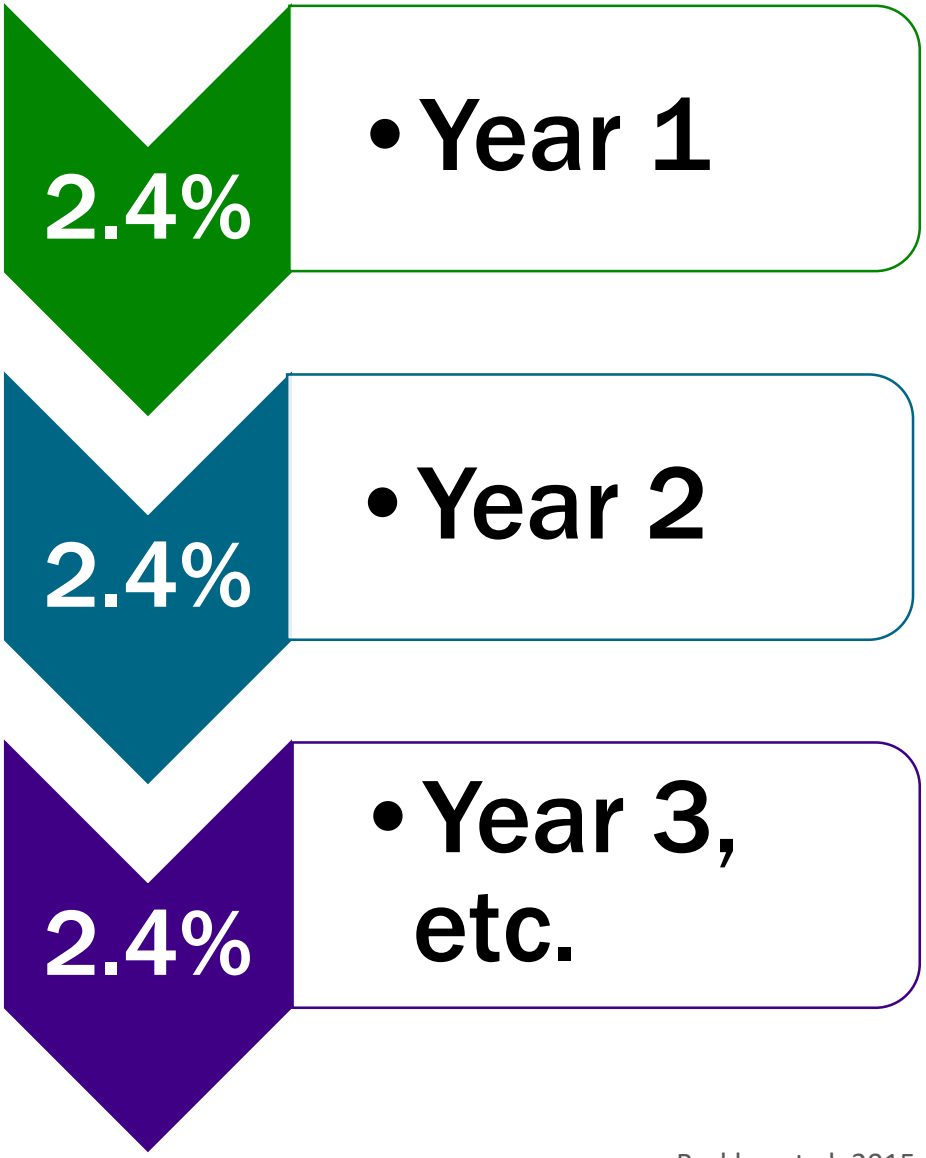
86 countries require fortification of flour and/or rice



	Wheat flour – 66 countries
	Rice – 1 country (Papua New Guinea)
	Wheat flour and maize flour –14 countries
	Wheat flour and rice – 3 countries (Nicaragua, Panama, Philippines)
	Wheat flour, maize flour, and rice – 2 countries (Costa Rica and the United States)
	No grain fortification legislation

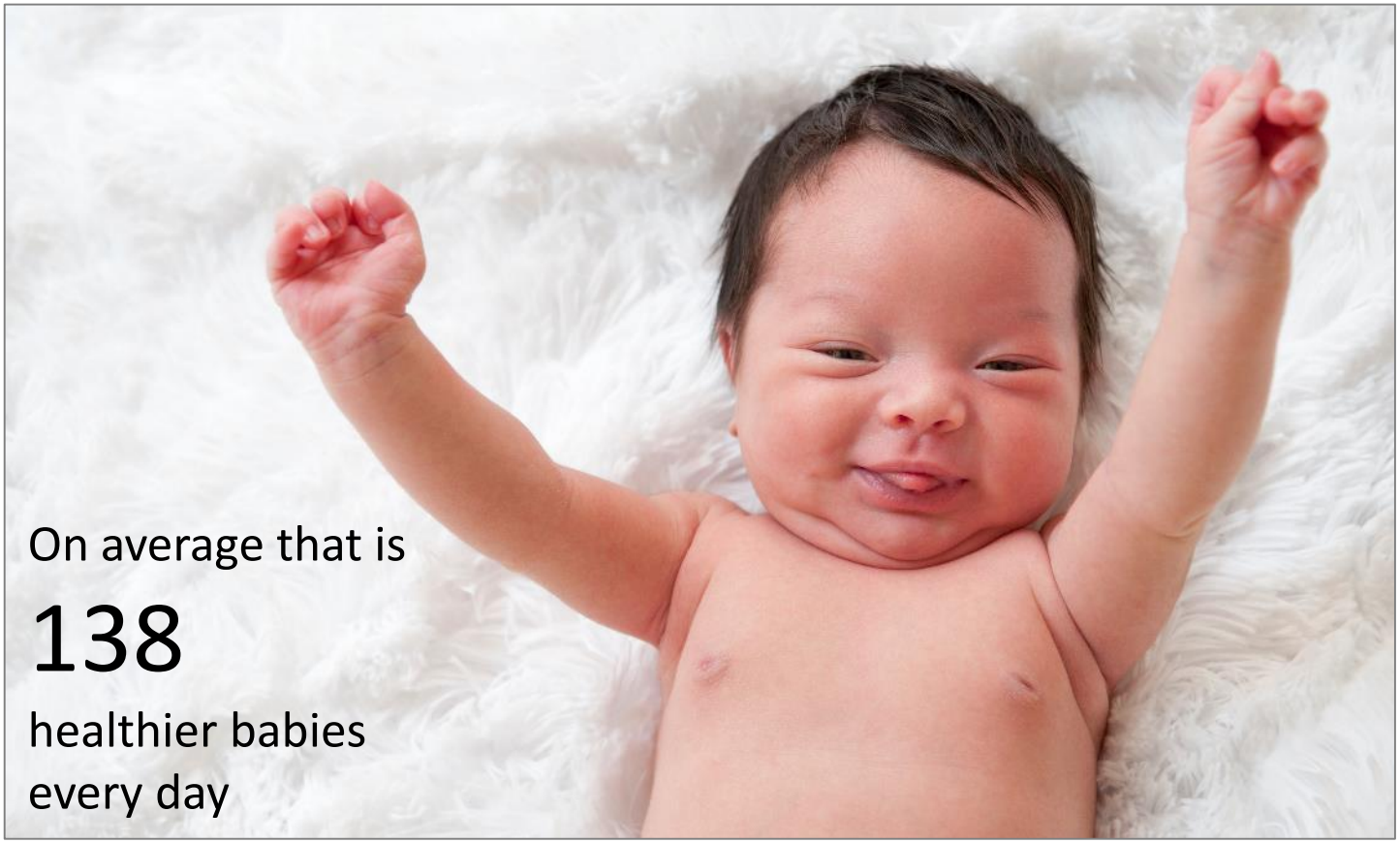
* Legislation has effect of mandating grain fortification with at least iron or folic acid.
Legislation status from the Food Fortification Initiative (www.FFInetwork.org) October 2018

Each year of flour fortification is associated with a 2.4% decrease in anemia.



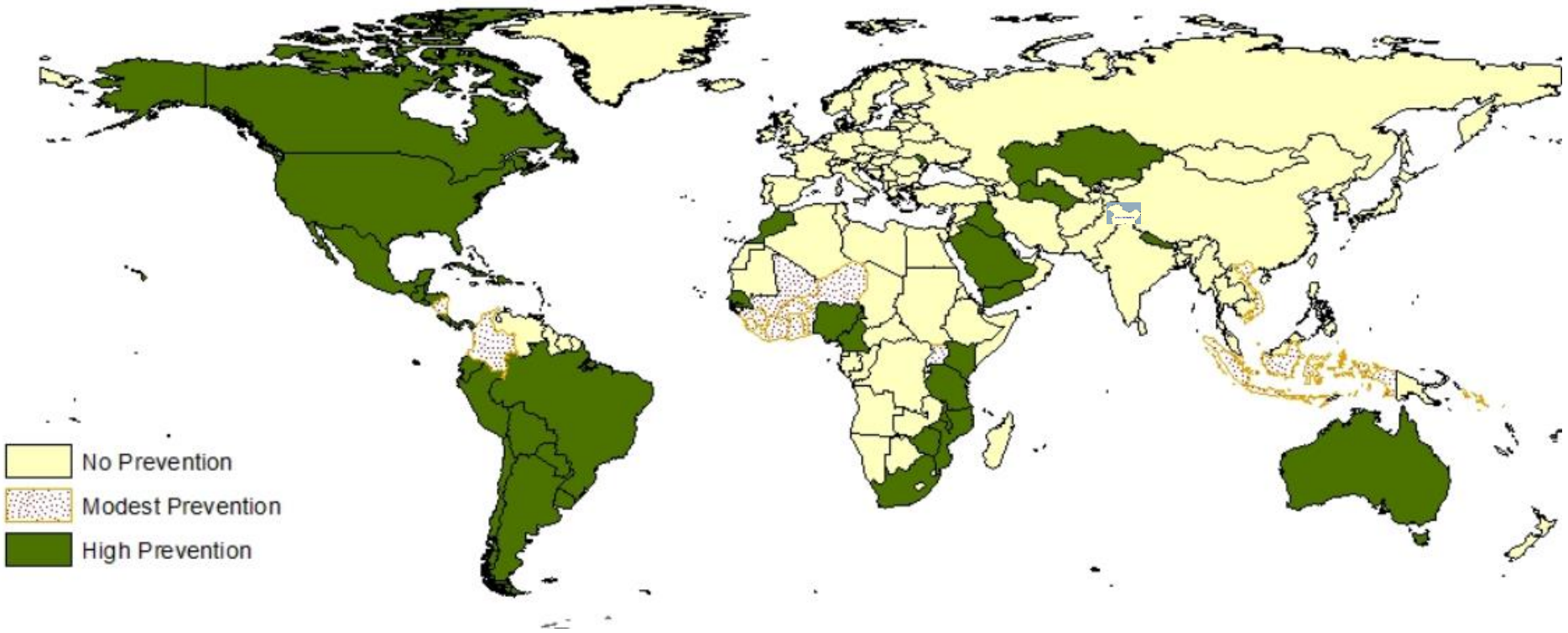
Barkley et al. 2015

Globally, fortifying flour with folic acid prevented about 50,270 brain and spine birth defects in 2017



Kancharla et al. 2018
iStockphoto

Only ~18% of NTDs are prevented by fortifying flour with folic acid



Kancherla et al. 2018

Fortification in India

2012: India opportunities by market channels, grain and population

Blue: High priority due to higher matrix scores
Green: intermediate priority.

State	Wheat Market Channel				Most # of Channels	Priority Rice State	Top 5 Reachable Population
	PDS Atta	CCM Atta	RFM Atta	RFM Maida			
Maharashtra							
Rajasthan							
Madhya Pradesh							
Uttar Pradesh							
Gujarat							
West Bengal							
Himachal Pradesh							
Bihar							
Jammu & Kashmir							
Orissa							
Andhra Pradesh							
Tamil Nadu							
Jharkhand							
Chhattisgarh							
Kerala							
Karnataka							
Punjab							
Haryana							

Ongoing Fortification Program in Haryana

Assessed the wheat supply chain in the state of Haryana, developed a comprehensive strategy and approach for fortification, currently supporting implementation

Current prevalence of preventable birth defects is incredibly high

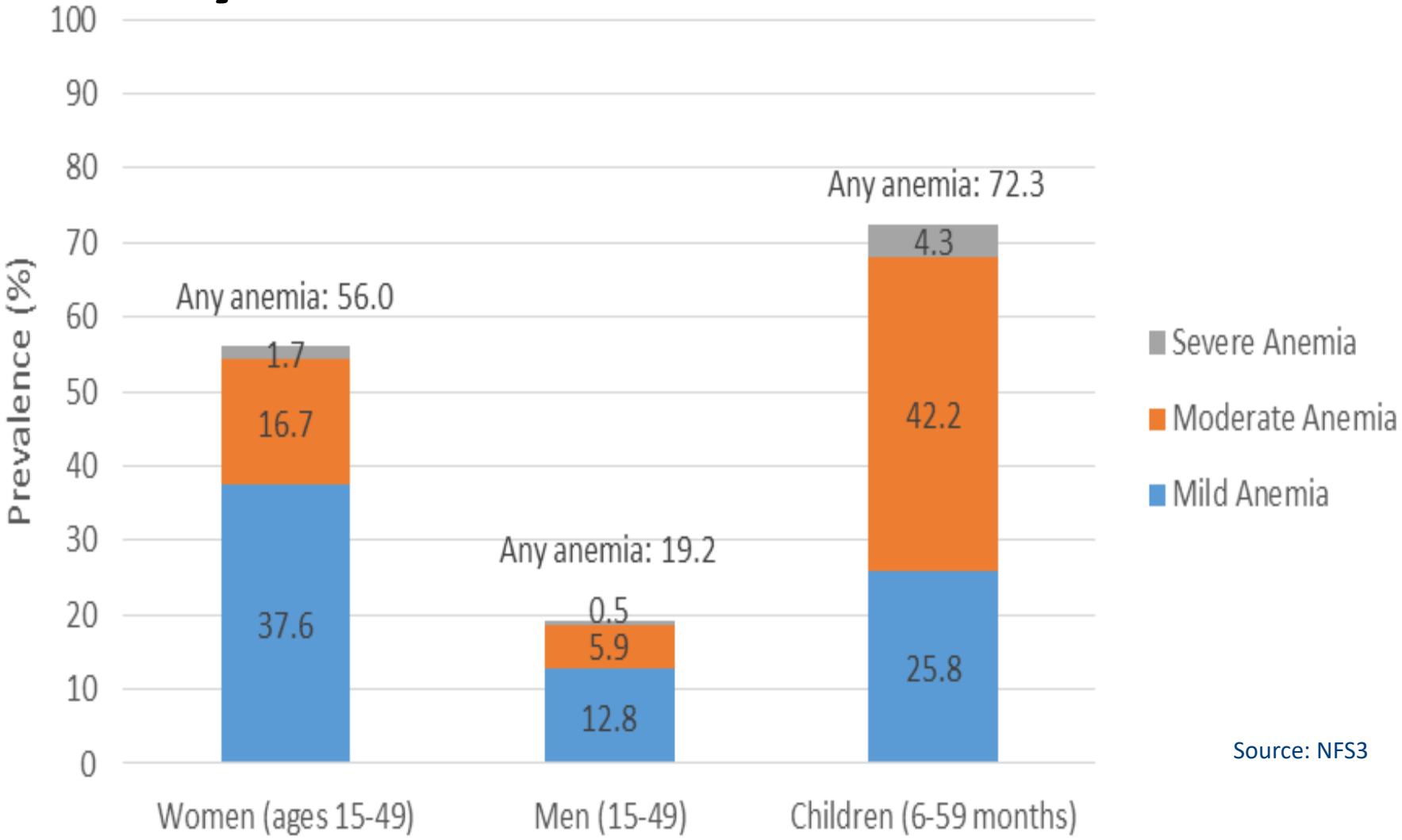
- About 2,400 babies with brain and spine birth defects annually
  - 41 per 10,000 live births[1]
- Enough folic acid consumption could lower this to 350 brain and spine birth defects annually or 6 per 10,000[2]

[1] Bhide, Birth Defects Research (Part A), 2013; Annual Report on Working of the Registration of Births and Deaths Act, 1969--Haryana, 2013

[2] Crider, British Medical Journal, 2014; Annual Report on Working of the Registration of Births and Deaths Act, 1969--Haryana, 2013

Photo by Ankur P on Flickr

Anemia prevalence is also high in Haryana



Source: NFS3

74% of pregnant women in Haryana have vitamin B12 deficiency

- Leads to:
  - Neurological deterioration
  - Megaloblastic anemia
  - Developmental delay in children
- Vitamin B12 is not easily found in vegetarian food sources

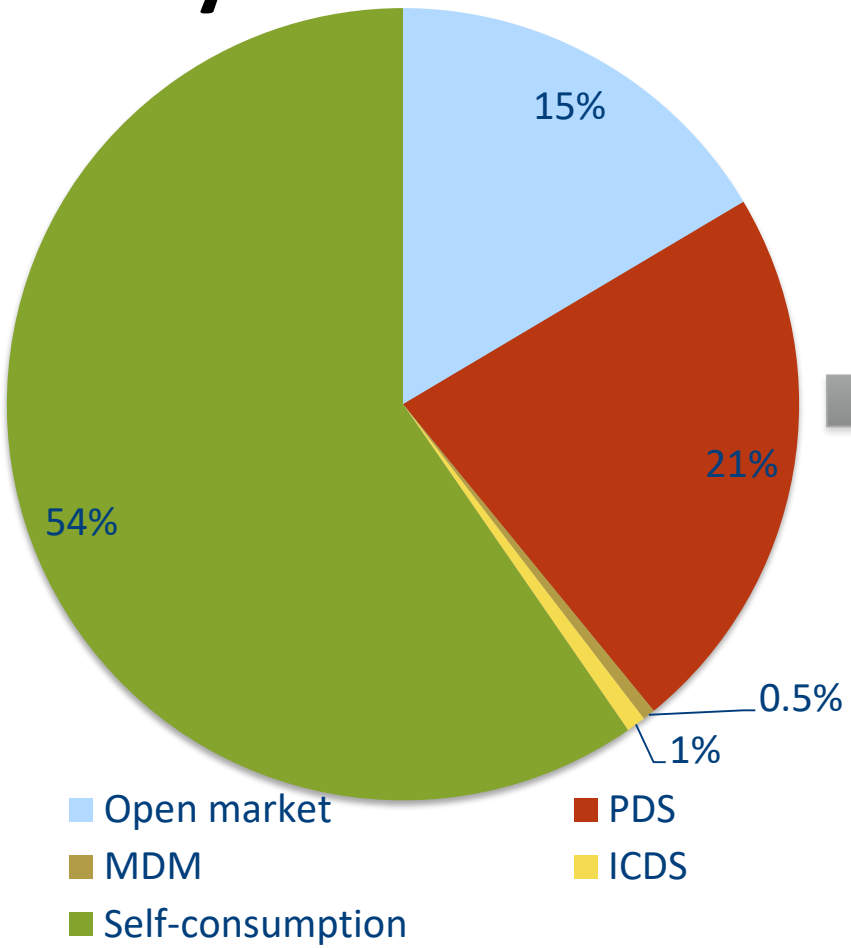
Sources: Cordero et al., Food and Nutrition Bulletin, 2008
Pathak, Food and Nutrition Bulletin, 2007

95% of wheat flour is consumed as atta products such as chapati and roti

5% of wheat flour is consumed as maida or atta in snacks, breads, biscuits

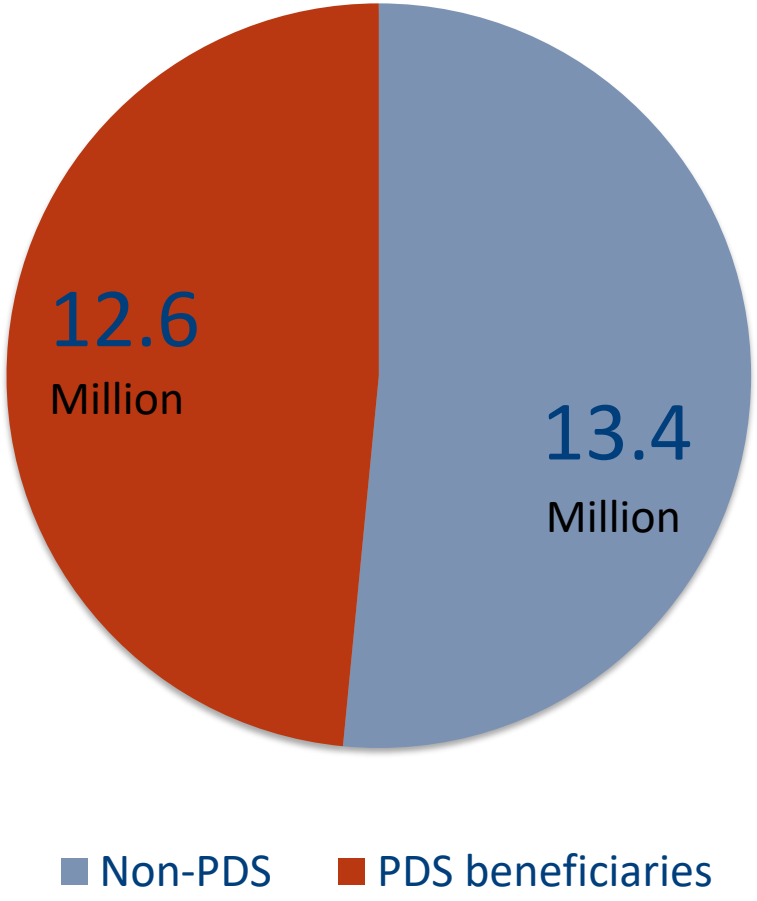
Source: Household Income and Economic Survey 2012-13, Food processing interviews

Wheat consumption in Haryana: ~3MMT



Source: Civil Supplies Department, Department of Education, Department of Women and Child Welfare; PDS, ICDS, MDM estimates are offtake

Fortifying PDS wheat will achieve the greatest impact on public health.



Fortifiable wheat atta

- PDS Beneficiaries make up 48% of the Haryana population
- ICDS and MDM can also be fortified to reach young children and women but will have limited reach
- Maida and retail branded atta can also be fortified but market is small

Not fortifiable atta

- Open market wheat (ground at local chakkis or at home)
- Self-consumption wheat

Source: Department of Civil Supplies and Services

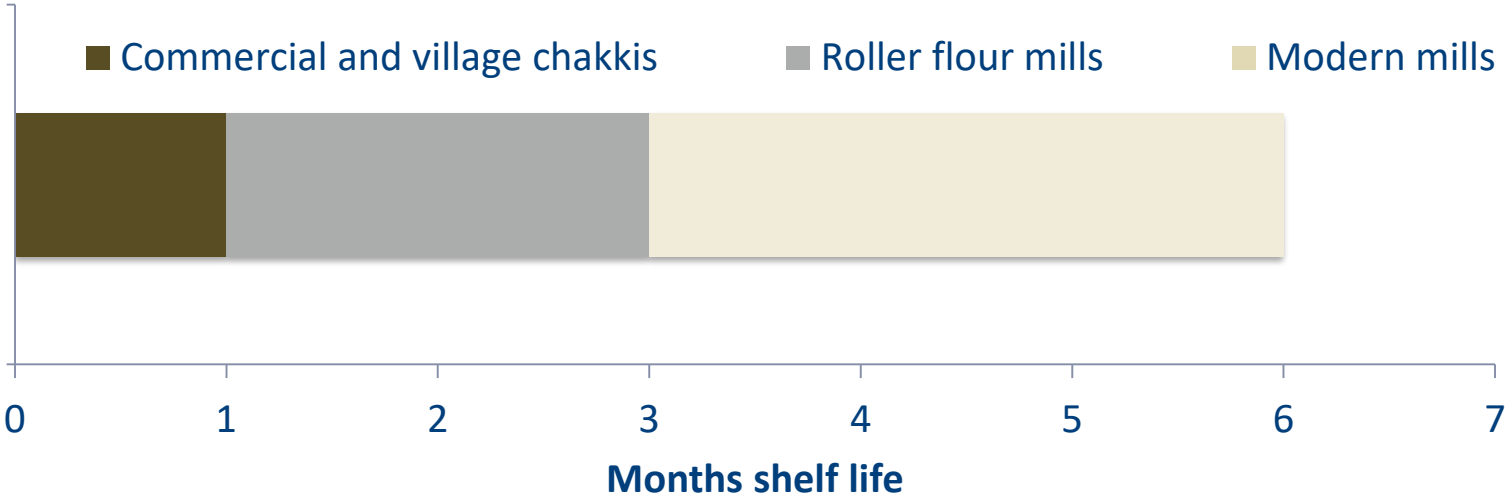
Requirements to fortify atta

- Quality chakki atta
  - Past failures: using resultant atta, whole wheat flour (non-stone ground), high moisture content
- Private industry invests in capacity to meet those specifications
  - Laboratory capacity, food safety standards
- Enforcement of specifications
  - Regulatory monitoring
- Government sets specifications for atta
  - Ensures shelf life, consumer acceptability, public health impact (i.e. bioavailable fortificants, appropriate levels)

Fortified atta must have same qualities of chakki atta or consumers will reject the flour

	Maida	Chakki Atta	Whole wheat flour	Resultant atta
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
Damaged starch AACC (%)	**8**	**16-19**	**<8**	**<12**
Moisture (%)	<14.0	8.5-9.5	9-14	<14.0
Puffing (%)	--	100	--	--
Granulation +210 micron (%)	**0**	**15-25**	**10-25**	**--**

Shelf life depends on milling practice



- Atta will store longer if mills use:
  - High quality cleaning systems to remove infested grains
  - Controlled tempering (water addition) during grain preparation to prevent excessive moisture
  - Equipment to kill insect eggs and prevent infestation
  - High quality packaging to prevent excess moisture and air entry

Options for Atta milling in Haryana

Small Chakki Mill

Roller flour mills with chakki lines

Commercial chakki mill

Modern high-capacity mills

Milling capacity to convert wheat to atta

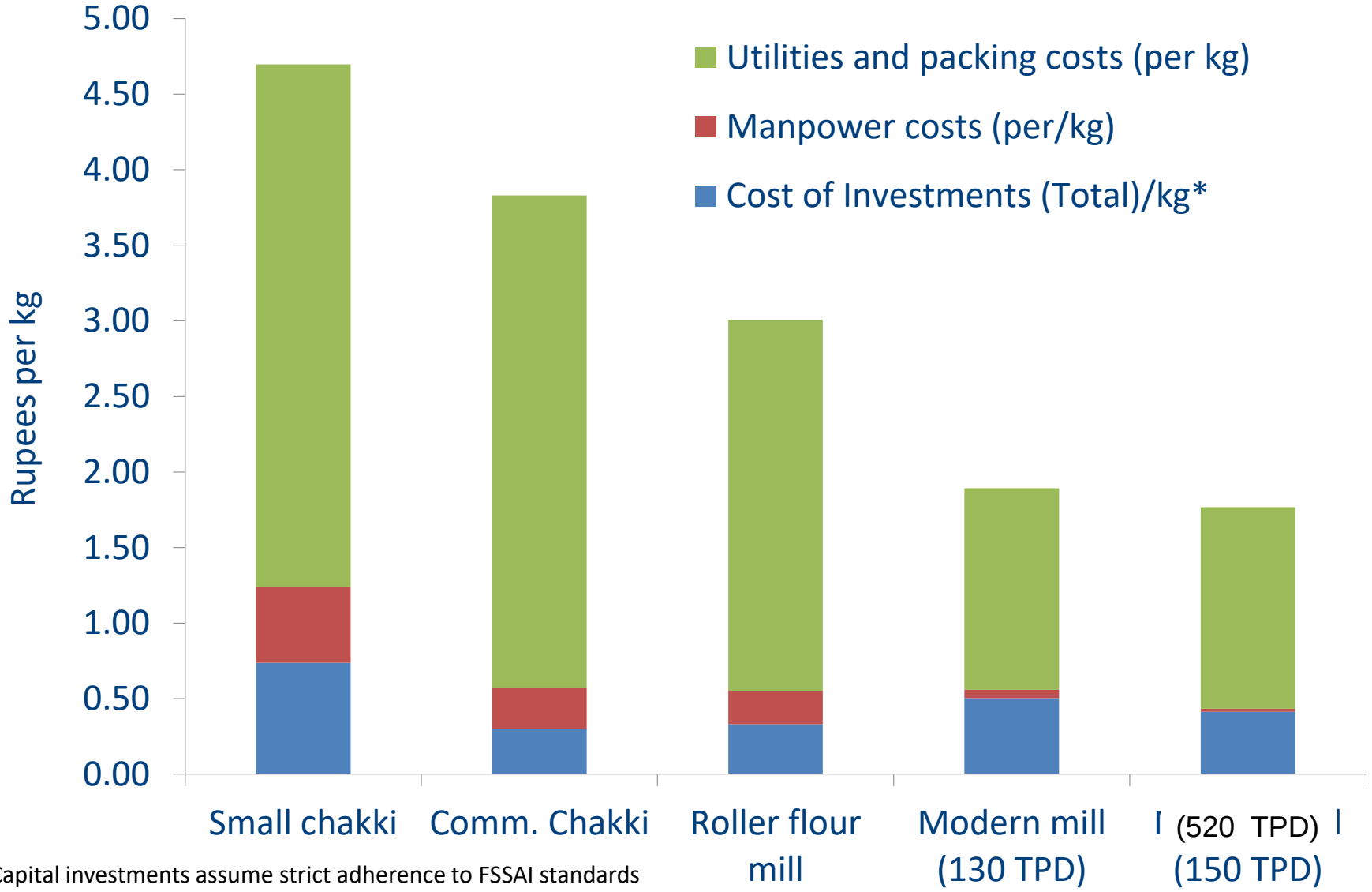
13,500 Small Chakkis (2 T/D)*	140 Commercial Chakkis (20 T/D)*	34 RFM with Chakki Lines (60 T/D)*	20 Modern Mills (130 T/D)	5 Modern Mills (520 T/D)
Require training, financial support for premix and blending machinery, and strong enforcement oversight	Require additional milling capacity, laboratory capacity, improved hygiene standards		Currently not in existence and requires state-of-the-art milling investment	

Industrial options to mill targeted scheme wheat (PDS, MDM, ICDS) into atta:

- **Upgrade commercial chakkis and roller flour mills to improve capacity and atta quality**
- **Invest in high capacity modern mills**

*Currently existing milling infrastructure

Cost comparison of milling options



*Capital investments assume strict adherence to FSSAI standards

Fortification costs to PDS system

Rs. per kg	2 TPD	2 TPD	20 TPD	60 TPD	130 TPD	520 TPD
Wheat paid to FCI	2	2	2	2	2	2
*Transportation**	0.5	0.5	0.5	0.5	0.5	0.5
Processing & Packing	0	5.42	3.58	3.38	2.23	2.1
Incremental cost to transport wheat and flour §	0	0.2	0.2	0.2	0.2	0.2
Toll grinding cost	2.5	0	0	0	0	0
System Cost	**5**	8.12	6.28	6.08	4.93	**4.8**

Not fortified

Fortified

Estimated 16 crore Rs (2.5 million USD) systems saving between non-fortified 2 TPD and fortified 520 TPD options (annual)

Exchange rate: 65 rupees = 1USD
*TPD, Tons per Day; *Estimate*
§ Cost estimate for 60 TPD option from Haryana FCSD; applied across all options except 2/20 TPD will likely be more and 130/520 TPD will be less

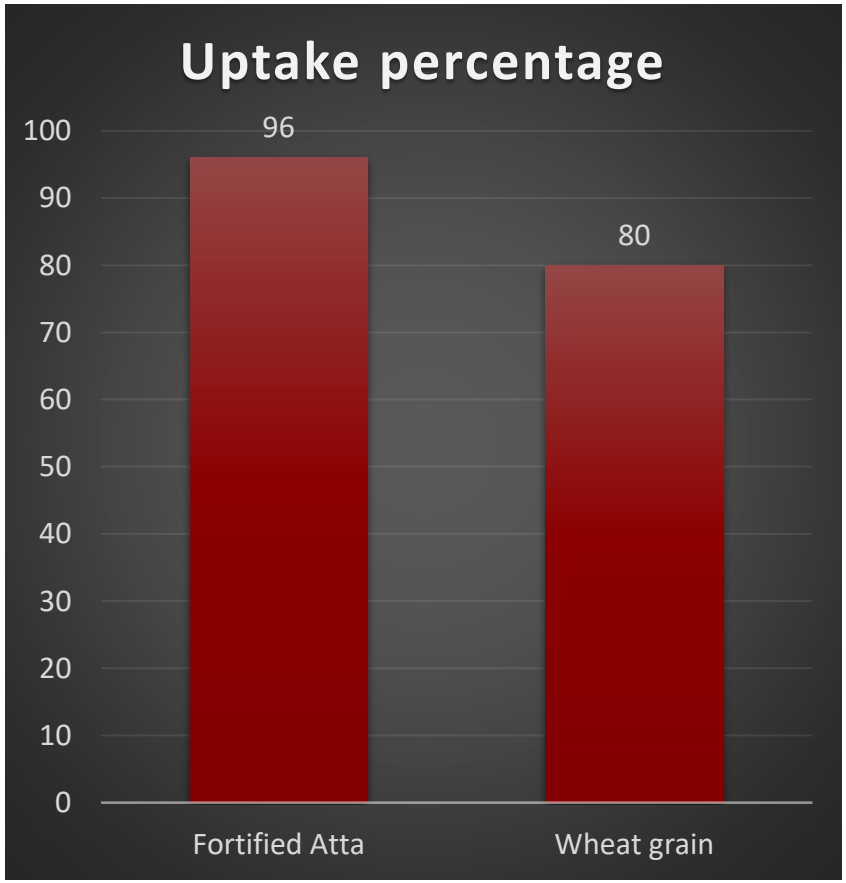
Distribution of fortified atta started in March 2018

Distribution of 1000 MT/month

40 fair price shops (FPS)

Reaching 177,000 beneficiaries

Fortified atta in Haryana pilot project has high uptake



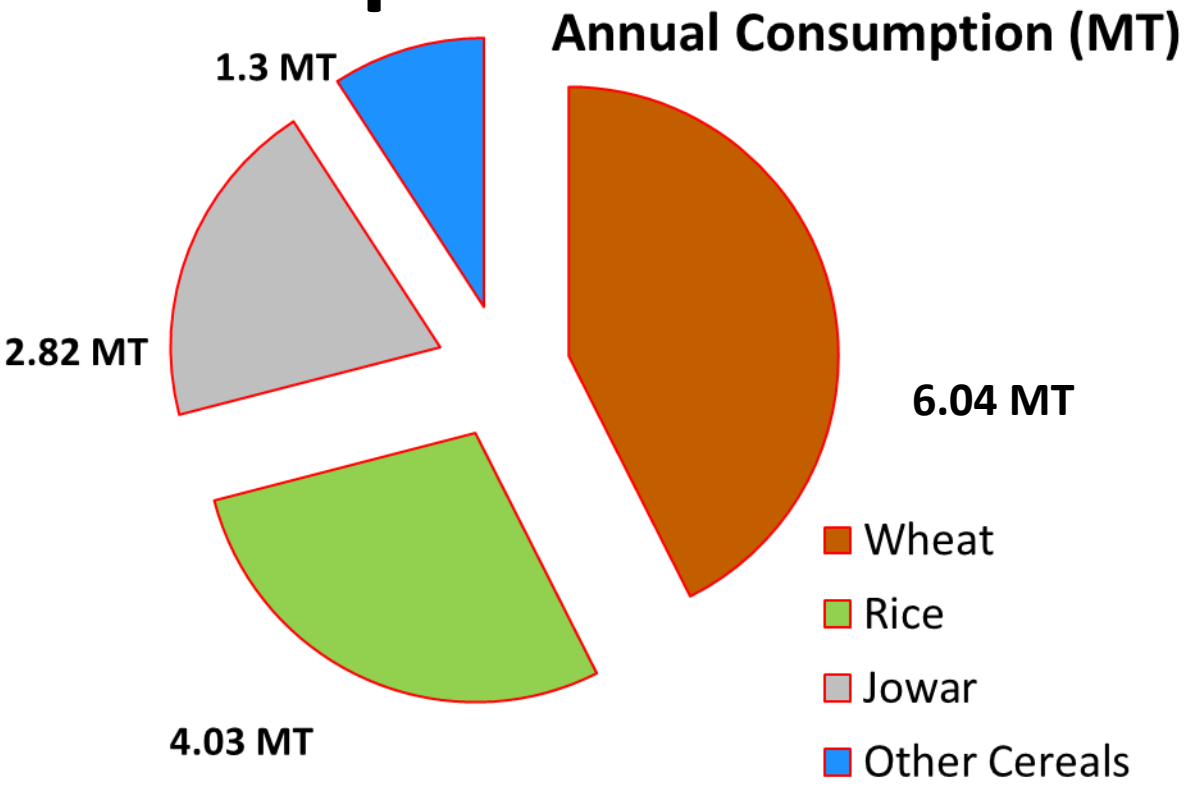
The pilot project to provide fortified wheat flour (atta) through public distribution system (PDS) is going well in two blocks of Ambala district.

Increased production capacity in Haryana

- Engaged continuously with ~32 chakki mill owners to increase production capacities.
- Some millers have already installed additional chakki lines; total production capacity in Haryana increased by 30-35%
- Scale-up to all of Haryana translates into 50,000 MT reaching around 12 million beneficiaries

On Going Supply Chain Assessment in Maharashtra

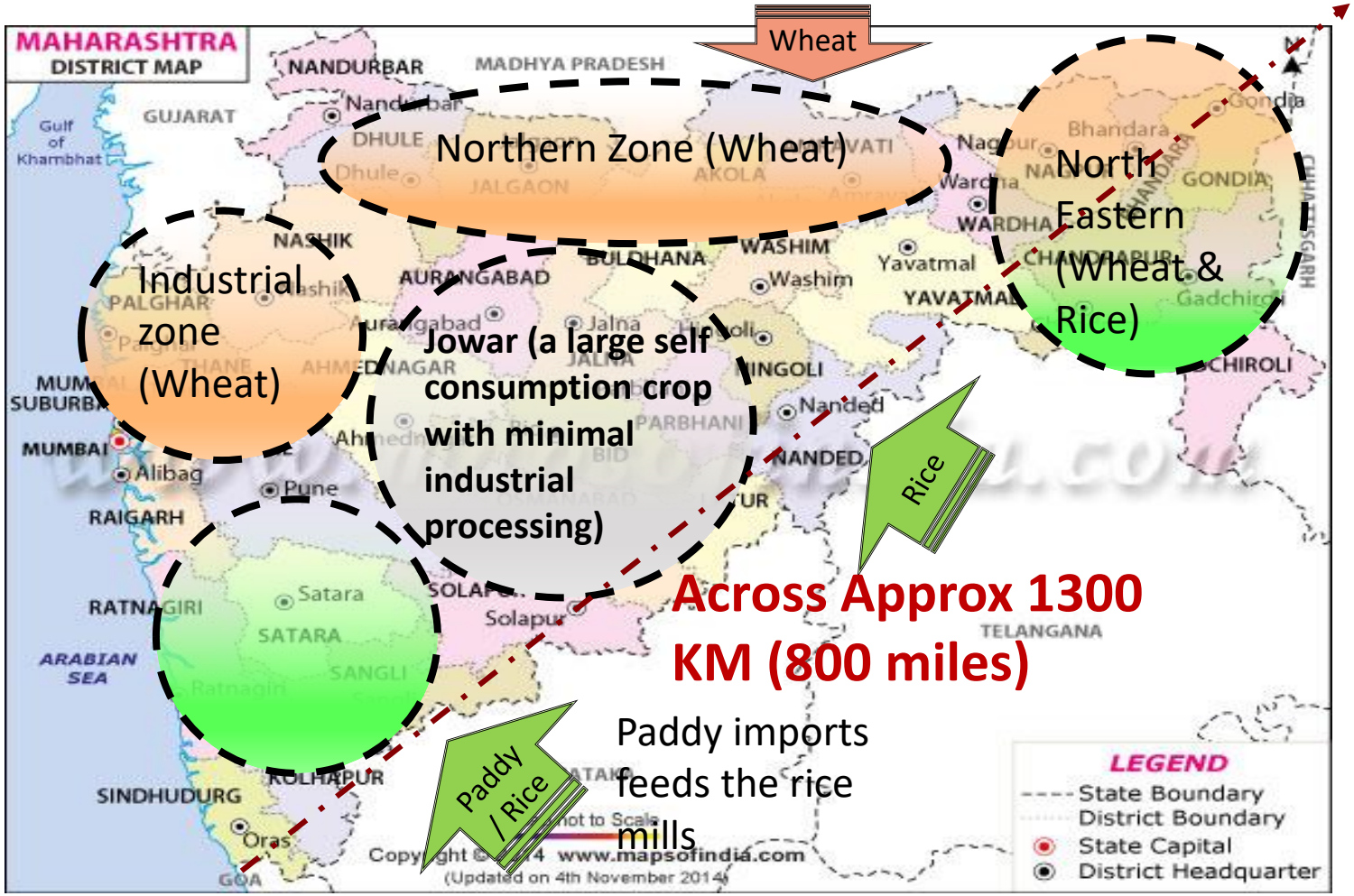
In Maharashtra, wheat dominates cereal consumption



Despite low production, wheat has the highest average per capita consumption at 160 g/day followed by rice at about 100 g/day, with a late increase.

(Source: Deshmukh et.al.2018).

Consumption and imports are region specific



Logistical complexity and consumption diversity leads to region specific supply chains

Source: Based on Inputs from FCI / Traders / per capital consumption, FFI analysis

Questions

Getting approval for using 2016 FSSAI standards for wheat flour fortification

- 2018 FSSAI fortification standards are significantly lower than World Health Organization recommendations.
- Non-recommended iron compounds have been mentioned in wheat fortification standards.
- Haryana sent an official request to FSSAI to continue with 2016 wheat flour fortification standards

FSSAI: Food Safety and Standards Authority of India

2018 published standards are far below global recommendations

Nutrient	Minimum in 2018 standard (mg/kg)	WHO recommendation (mg/kg)*	Compared with WHO recommendation
Folic acid	0.075	1.3	17 times lower
Vitamin B12	0.00075	0.01	13 times lower
Vitamin A	0.5	1.5	3 times lower
Zinc (in atta)	10	80	8 times lower
Zinc (in maida)	10	40	4 times lower

In addition, many iron compounds allowed are not recommended.

* Based on availability of combined intake of flour and rice of 150 to 300 grams per person per day