



Benefit Incidence Analysis

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Abbreviations

AME	Adult Male Equivalence
BIA	Benefit Incidence Analysis
DRI	Dietary Reference Intake
FACT	Fortification Assessment Coverage Tool
FFP	Food Fortification Programme
GAIN	Global Alliance for Improved Nutrition
IDD	Iron Deficiency Disorder
MPI	Multi-dimensional Poverty Index
MT	Metric Tonne
NI	Nutrition International
NTD	Neural Tube Defect
NNS	National Nutrition Survey
OPM	Oxford Policy Management
RDS	Rolling District Study
RFP	Request for Proposal
RTAG	Research and Technical Advisory Group
SEC	Socio-economic Classification
TORs	Terms of References
Unicef	UN Children's Fund
VAD	Vitamin A Deficiency
WFP	World Food Programme
WHO	World Health Organisation
WRA	Women of Reproductive Age

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Executive summary

This study uses data from the recent Fortification Assessment Coverage Toolkit (FACT) survey and phase 1 of the Rolling District Study (RDS), as well as from the global literature on fortification impact, to assess the expected distribution of benefits of the Food Fortification Programme (FFP). The analysis identifies the extent to which the poorest groups and demographic target groups (under 5s, women of reproductive age and adolescent girls) are likely to benefit from the programme if current consumption patterns are maintained. It also considers the possible impact of increased spending on commercial wheat flour on the household finances of poorer households.

This study focuses on consumption patterns for fortified, and potentially fortifiable wheat flour, oil and ghee at the household level. We are primarily interested in the share of wheat flour sourced from commercial roller mills and oil which are currently addressed through FFP.

The findings are divided into findings on coverage, including consumption by wealth group, and findings on projected nutrition protection and health impact.

On coverage, findings show that a lower percentage than previously thought (about 25% overall) consume commercially milled wheat flour addressable by FFP. Overall poorer households consume these products broadly proportionately. The Rolling District Study (RDS) found purchase of commercial fortifiable flour brands around 25% for the lower 4 quintiles, and only 15% for the richest quintile. There is, however, wide variation by province/district and there was some variation between the FACT and RDS. Fortifiable oil to be addressed by FFP is consumed almost universally by 98% of the population and is uniform across wealth groups.

Considering that micronutrient deficiencies affect a huge number of people across all wealth groups, the absolute numbers of people who will benefit from FFP remains very large. Coverage of fortified foods is estimated at **~50 million flour consumers** and nearly **200 million oil consumers**. Our analysis suggests fortification will prevent **~29 million cases of micronutrient deficiency annually**, affecting a minimum of **~24 million consumers**, predominantly women of reproductive age and children 6-59 months of age.

The impact of lower prevalence of micronutrient deficiencies on the attributable mortality is projected at a reduction in child mortality of about **~17.5 thousand deaths annually** – both directly and indirectly via maternal nutrition.

While benefits will be spread across income groups, it is the poorest groups who have the highest rates of malnutrition and based on the results of the RDS in Punjab, we can conclude that overall **the poorest groups will receive at least an equal benefit from FFP**.

The impact of increased spending on commercial wheat flour by the poorest groups is likely to be relatively modest as they currently spend only modest amounts on wheat flour and only a proportion of this is spent on wheat flour from fortifiable sources. Any major shifts in benefit incidence are likely to be positive, coming from poorer households shifting to sources which are potentially fortifiable than greater consumption of those already consuming fortifiable wheat flour (as overall consumption levels for the poor are comparable to those of better off groups).

In terms of **limitations**, sample sizes are small meaning that results should be treated with caution. The study looks only at type of product consumed at the household level and did not investigate intra-household consumption patterns. While we can reasonably assume all household members eat together from the same pot, we do not know much about *quantities*

consumed by individual household members. While the FACT study did estimate the quantities of fortifiable product consumed by women of reproductive age (WRA) and children under 5, these were pro-rata estimates of household consumption based on age and gender related energy needs and not actually measured. Consumption by adolescent girls was also not included.

We also do not know the amounts of other nutrient rich foods in the diet within our survey population. This would entail a more data intensive and expensive study but would give a more accurate picture of the difference contributed by addition of fortified foods.

Recommendations include some follow up studies / analyses:

- Run further analysis which combines the benefit distribution indices (which are currently based only on quantities consumed) with an index of micronutrient deficiency for each income quintile. This would yield a more complete picture of health benefits by income quintile;
- Commission a study on intra-household food consumption including of adolescent girls, possibly incorporated into the next round of RDS;
- Include food produced outside home (e.g. in nan stands, bakeries) in next round of RDS.
- Proceed with studies to investigate the feasibility of fortifying chakki flour
- Investigate the possibility of an end of project FACT which incorporates an additional module on consumption of other micronutrient-rich foods.

1 Introduction

Malnutrition, particularly micro-nutrient deficiency, is a major challenge in Pakistan. Various factors are involved but inadequate dietary intake of nutrient rich food is the biggest reason. According to the National Nutrition Survey, 2011¹, there are very high rates of micro-nutrient deficiencies: 51% of pregnant women are anaemic, 37% iron deficient, 46% deficient in vitamin A and 69% deficient in vitamin D. The problem also prevails in children, with 62% of those under five suffering from anaemia, and 54% from vitamin A deficiency. Such deficiencies cause a host of health complications, affect educational attainment, and ultimately economic productivity. Global evidence² indicates that food fortification is a cost-effective solution to the challenge of chronic micro-nutrient deficiencies. Indeed, wheat flour and edible oils/ghee are products consumed daily by most individuals in Pakistan and, if fortified, can enhance micro-nutrient status without requiring changes in eating habits.

Currently, none of the wheat flour millers in Pakistan are fortifying their products on a voluntary basis. Various reasons explain this and include: non-availability of local production of premix (fortificant) and equipment, specialised expertise for maintenance and management of equipment. Except for Punjab province, there is no current, mandatory legislation in Pakistan for wheat flour fortification (i.e. with iron and folic acid). Mandatory legislation aiming for universal coverage is important as, without it, voluntarily fortified products that pass along the cost of the fortificant to the consumer could have difficulty competing with cheaper non-fortified products. For edible oils /ghee, fortification is already mandatory (since 1965), but had been inadequately enforced. This is a matter that stretches beyond mandatory legislation, to one that also ensures regulation and enforcement.

For this reason, the Food Fortification Programme Pakistan (FFP) was launched. This five-year (2016-2021) programme, funded by the UK Government, originally strove to have over half of the population of Pakistan consuming fortified wheat flour, with over two-thirds using fortified edible oil and ghee, via the programme's work with over 1,000 wheat flour mills and 100 edible oil mills. More specifically, wheat flour at commercial roller mills will be fortified with iron, folic acid, B12 and zinc, and edible oil/ghee with vitamins A and D. Consequently, this programme seeks to reduce iron deficiency anaemia by a third, and vitamin A deficiency in women and children by a quarter. Population sub-groups of particular priority to the FFP are listed in the Box.

FFP Priority /Target Populations

- Women of reproductive age (15-49 years), with an emphasis on pregnant and lactating women;
- Children under 5 years (6-24 months; and 2-5 years);
- Adolescent girls (10-14 years)

Note: Women, adolescent, and young children in the poorest two wealth quintiles are a specific priority.

The FFP is implemented by Mott MacDonald (MM), in partnership with Nutrition International (NI; formerly known as the Micronutrient Initiative). The FFP will support government at federal, provincial and district levels in establishing the necessary legislative and regulatory frameworks,

¹ <https://pndajk.gov.pk/uploadfiles/downloads/NNS%20Survey.pdf>

² http://www.ffinetwork.org/why_fortify/documents/Cost-effectiveness_2017.pdf

and will support the wheat flour and edible oil/ghee industries through technical assistance and provision of equipment to the flour mills, with an incentive paid in the form of a subsidy on premix to catalyse and promote internal quality control measures. The FFP will also launch public communications campaigns in districts to explain reasons for fortification, and generate evidence-based data through research studies to improve the implementation of food fortification in Pakistan.

This study has been commissioned to assess the extent to which the benefits of the programme are likely to be enjoyed by the poor and other target groups and to consider what is needed to ensure such benefits can be demonstrated.

2 How to apply benefit incidence analysis to FFP

In broad terms benefit incidence analysis (BIA) attempts to assess the extent to which different wealth groups and other groups of interest benefit from interventions with a particular focus on how the poorest groups are faring. Typically, this involves looking at who benefits from any public subsidies spent supporting an intervention. Applying such approaches to FFP poses a number of challenges:

1. Firstly, the **support is aimed at the private sector** which raises an initial question of whether the subsidies are actually passed on to consumers (as is the intention of the programme in order to allow more gradual price rises) or whether they are captured by producers and reflected in more abrupt price rises for users. The ultimate intention is that the small marginal cost increase of fortification is passed to consumers (so the programme can be sustainable) but the subsidy allows a slower and smoother rise. This raises a number of further questions – notably how we would know if any price changes experienced reflect general changes in the market environment rather than ones directly related to the programme intervention. FFP will be tracking price changes closely to detect any evidence of price increases beyond what we would expect; however, given that prices tend to be relatively volatile it is likely to be difficult to address this issue definitively.

It is, however, worth noting that the incremental costs of fortification represent a very small incremental cost, usually a fraction of one percent of the product. In Pakistan, the cost of flour fortification with iron, folic acid, zinc and vitamin B12 is estimated at \$2.40 per metric ton (MT), with an increased annual consumer cost of ~\$0.20 annually for average adult consumers. The incremental cost of fortifying cooking oil and ghee with vitamin A and D is estimated at \$3.10 per MT, or an added cost of \$0.04 annually for average consumers.

2. Secondly, there is the question of **how we measure benefits**. Should these be measured simply in terms of consumption i.e. assuming that more consumption of fortified products means more benefits? However in this case, we are more interested specifically in health benefits. The rationale for focusing on health benefits is that FFP's objectives are primarily health related but also that the allocation of health benefits may be rather different than the allocation of consumption benefits. Basically, this is saying people don't consume fortified products for their own sake but as a means of improving their wellbeing. In the case of health benefits the assumption is that benefits from consumption accrue up to a point (where recommended daily intakes are achieved) and that any further consumption may have zero (or possibly even negative benefits) In general, using such an approach one would expect to find that benefits are concentrated more heavily amongst poorer groups as extra consumption is more likely to help them bridge the gap between current and recommended

daily intakes than for the better off who may already be meeting or exceeding daily intakes (although one of the reasons for these surveys is to actually test this hypothesis). For example, figures 16 to 19 of the FACT report suggest that some target populations already exceed daily vitamin A requirements from fortified oil and ghee alone. Based on average consumption, flour fortification can deliver a substantial dose for iron, folic acid and zinc to children 6-59 months and women of reproductive age, ranging from 32%-73% of Dietary Reference Intake (DRI) developed by Institute of Medicine (IOM) of the U.S. National Academies. The key challenge in assessing health benefits is to understand the extent to which increased consumption of the fortified products actually reduces the gaps between current and recommended intakes.

For the purpose of this analysis, however, we seek to quantify benefits of flour and oil fortification applying the following algorithm.

Cases X % Coverage X % Effectiveness = Reduced # Cases

3. Another issue is that the surveys focus primarily on direct purchase of wheat flour and do not pick up the considerable amount of indirect consumption where flour is processed e.g. into chapatis, bakery products. This can be addressed by incorporating additional questions into future rounds of the RDS.

3 Methodology

3.1 Current Data Sources and Approach

The design of the Benefit Incidence Analysis for FFP proposed using data from two key sources: the Fortification Assessment Coverage Toolkit (FACT) survey³ and the Rolling District Study⁴ (RDS) both published in 2018. The RDS was designed to collect complementary (and not duplicative) data to FACT and will be repeated on a rolling basis as set out below. The BIA design left open the possibility of commissioning an end line FACT if required (i.e. if the RDS shows evolving consumption patterns.) In this benefit projection, we have also incorporated evidence from international literature on prevalence of micronutrient deficiencies, population group numbers, effectiveness of fortification programmes and then applied our coverage data to project numbers of beneficiaries.

A National Nutrition Survey was carried out in 2011 and is being repeated in 2018 and should provide a broader picture of dietary habits and nutritional levels.

3.1.1 FACT survey 2018

The FACT study was commissioned by USAID and carried out by the Global Alliance for Improved Nutrition (GAIN)/Oxford Policy Management (OPM). It involved a cross sectional survey made up of a household assessment in 3 provinces and a market assessment in four provinces (Balochistan, Punjab, Sindh and Khyber Pakhtunkhwa). Its aim was “to provide data on household coverage and consumption of fortifiable and fortified foods among children (under five years of age) and women of reproductive age, and availability and quality of fortified foods from markets”. The household component surveyed 2104 households (704 households in

³ Global Alliance for Improved Nutrition and Oxford Policy Management (2018) *Fortification Assessment Coverage Toolkit (FACT) Survey in Pakistan, 2017*. Global Alliance for Improved Nutrition: Geneva, Switzerland.

⁴ Abacus Consulting Draft Baseline Report: Round-1 Survey FFP Rolling District Study (2018)

Balochistan, 690 in Punjab, and 710 in Sindh) and collected data on a range of household social characteristics, food security, dietary diversity, fortification logo awareness, and purchasing and consumption patterns of fortifiable salt, oil/ghee, and wheat flour. A final report was published in August 2018 and its authors helpfully provided access to the raw data.

In the FACT study, fortifiable wheat flour combines both roller mill flour and some chakki mills flour so results for “fortifiable wheat flour” do not translate directly to FFP’s potential impact based on current programme design.

3.1.2 Rolling District Study (RDS)

The RDS was carried out by Abacus Consulting Technology (Private) Limited and Gallup Pakistan on behalf of the Food Fortification Programme (FFP). Its main aim was to determine “if, and to what extent, poor households are benefiting from the initiatives undertaken by FFP by examining food purchase and consumption patterns, knowledge and perceptions, usage patterns and the food economics pertaining to food fortification of wheat flour and cooking oil/ghee”. It aims to identify a baseline and assess the impact of FFP activities in 8 districts and will involve three rounds of study to be conducted over a 3-year period. The initial Round 1 covers 4 districts: Lahore, Rawalpindi, Hafizabad and Gujranwala. The household module interviewed a total of 2,010 female respondents (502 from Lahore, 500 from Rawalpindi, 504 from Hafizabad and 504 from Gujranwala). A retailer module sampled some 603 operating in these districts. Round 2 is expected to commence shortly. It was intended to provide data for the project’s Benefit Incidence Analysis and raw data, provided by Abacus, was analysed for this purpose.

3.1.3 International Evidence

The effectiveness of flour and oil fortification in reducing the prevalence of micronutrient deficiencies has been established via efficacy studies and large-scale effectiveness trials as well as the evaluation of national programmes, with findings of reductions in prevalence of micronutrient deficiencies of 50% and higher. We explore whether these experiences can be applied to Pakistan and apply the findings on coverage to prevalence data to estimate health benefits. See Annex 5.

3.2 Approach to this Study

FFP wants to know:

- Whether the poorest groups in the different provinces (FACT) and different districts (RDS) are likely to benefit from FFP *if consumption patterns stay as they are*
- Whether target groups (women of reproductive age, children under 5 years and girls aged 10-14) in the different provinces are likely to benefit from the consumption of fortifiable products (roller mill flour and commercial oil)
- What are the projected impacts given consumption patterns and coverage data
- What the implications of any increase in expenditure on commercial roller mill flour are on household finances for poorer families

3.2.1 Methods

This study uses the data sources outlined above (FACT, RDS and peer-reviewed international evidence). It takes estimated consumption of potentially fortifiable products as a proxy for benefits. It is assumed that all oil and ghee and that commercial brand wheat flour from roller mills are addressable by FFP. In the RDS study consumption reported as “from the market commercial brand atta” is assumed to be addressable by FFP, while in the FACT study consumption reported as “from the market and it was OTHER than chakki flour” is assumed to

be addressable by FFP. Average household purchases per month (more straightforward to measure) were used as proxies for consumption. Per capita consumption was calculated by dividing household consumption by family size as measured in the survey.

Estimated consumption and household expenditures are assumed to be the midpoint of the ranges set out in the questionnaires⁵. The analysis disaggregates findings by reported household expenditure and by SEC (socio-economic classification). Results are reported both on a per household basis and on a per capita basis. The distribution of benefits by wealth category is summarised in an index which compares consumption of each wealth category with the overall average consumption of all households interviewed.

3.3 Limitations

- **How to identify wealth quintiles:** both FACT and RDS studies collect data on parameters which can allow the identification of wealth groupings. The FACT survey is much more comprehensive, in this respect, collecting information on a range of household socio-economic data and the authors were able to construct a multi-poverty index (along the lines of Alkire and Santos, 2014⁶). In their study, however, they only distinguish between the poor and the near poor on the grounds that sample sizes are too small to detect statistical significance in smaller wealth groupings. This study uses a slightly adapted Multi-dimensional poverty index (MPI) to identify wealth quintiles when using FACT data (for details see **annex 2**). For RDS analysis this study uses information on reported household expenditure, on socio-economic classification (SEC) and highest level of education attained by a household member as a proxy for wealth. However, whilst it is possible to categorise according to these indicators it is not possible to identify wealth quintiles. For example, the two poorer categories according to overall household expenditure account for 20.9% and 36.8% respectively. There are also many further questions as to how reliable each measure is as a means of proxying wealth (e.g. do people report household expenditure truthfully). Going forward it might make sense to use alternative approaches (e.g. different weightings for the MPI) to test the robustness of finding. **Summary: we can identify wealth groups if not actual quintiles; the approach is not perfect but is the best available under the circumstances.**
- **Intra-household distribution patterns:** In the FACT study, the daily apparent fortifiable food consumption per individual household member was determined using the adult male equivalent method (AME) (Weisell and Dop, 2012). At the household level, the daily quantity of the food vehicle consumed was estimated based on the reported quantity purchased and the duration it lasted in the household. Each member of the household was assigned an age- and sex-specific AME based on energy requirements. Each individual AME was divided by the household AME and then multiplied by the quantity of food vehicle consumed by the household to calculate the quantity of food consumed per day per individual household member. Thus actual quantities consumed by individual target groups, including adolescent girls, are not measured. **Small sample sizes reduce the strength of the findings:** as noted above both surveys are of modest size. Whilst the FACT survey does include tests of significance its authors have confirmed that breaking down results into quintiles at the

⁵ ie where a family reports expenditure between 20000-24000 Rs/month expenditure is assumed to be 22000 Rs. Similarly, if wheat consumption is reported between 30kg and 40kg consumption is assumed to be 35kg.

⁶ Alkire, Sabina, and Maria Emma Santos. 2014. "Measuring Acute Poverty in the Developing World: Robustness and Scope of the Multidimensional Poverty Index." *World Development* 59 (July): 251–74.

province level will reduce sample sizes to insufficient levels to demonstrate statistical significance. **Summary: we need to be cautious about the findings - many of the results could simply result from chance**

- **Knowing whether target groups benefit:** the studies focus on transactions at the household level. Thus, whilst we might be able to say a household with a girl aged 10-14 might benefit. We can assume that household members eat “from the same pot”, but without knowing quantities of foods consumed, we can’t necessarily say to what extent the girl, herself, actually benefits. **Summary - we can only assess whether target groups benefit indirectly - alternative and much more expensive and time-consuming methods would be needed to measure quantities actually consumed at individual level.**
- Getting reliable information on the consumption of fortifiable products (and other key variables such as expenditure and income): The questionnaires rely on recall which has well documented problems. Also, partly reflecting this, consumption volumes involved ranges rather than precise (i.e. 2 to 4 kgs rather than an exact amount). For the purposes of this study where data is provided in the form of ranges and a precise figure is needed (e.g. if you want to know the share of household expenditure going on flour) the mid-point of the range is used. In the studies purchase is used as a proxy for consumption, as this is easier to measure. The FACT study asked how long supplies lasted so we have a reasonable sense of usual spending patterns. Secondly, and more fundamentally perhaps, the studies only collect data on fortifiable products bought directly in the form of unprocessed wheat flour. Analysis carried out by Jack Bagriansky commissioned by FFP has shown this leaves a potentially huge gap in terms of product sold by producers for further refinement before subsequent purchase by consumers. Previous analysis of gross output from roller mills as a percentage of Pakistan’s Total Annual Wheat Supply (GAIN 2014) calculated a market share for roller mill flour of 53.39%. If, however, the market share for household purchase of wheat flour is only 25% (and these figures need to be further investigated) this would suggest as much as 28% of all flour produced in Pakistan could be roller mill flour which is used in foods produced outside the home (bakeries etc.) **Summary: we only look at a partial picture and make some crude (but reasonable) assumptions. In future rounds, we will collect more data on this missing piece of the puzzle.**
- **Lack of knowledge on what else families are consuming.** There is only limited information on wider dietary patterns – especially in relation to food containing key nutrients of interest to FFP. Though, the available data does give some indication whether households consume say eggs and how frequently it does not provide enough information to know the extent to which such consumption contributes to meeting daily requirements. However we know already that diets are insufficiently diverse. FACT found that overall, 59% of WRA in Balochistan, 64% in Punjab and 87% in Sindh did not meet the minimum dietary diversity score, and the situation is repeated with young children. Another approach might be to look at the bio-chemical assessments presented in the National Nutritional Surveys though the 2011 NNS did not disaggregate these by wealth group. However, we do have NNS 2011 data on stunting, underweight and wasting disaggregated by income quintile (see Annex 4); stunting could be a reasonable proxy for micronutrient deficiency. This, at least, would make clear that additional consumption is contributing to meeting a nutritional gap and help in setting out how large that gap might be. The very large percentages of people with deficiencies of iron folate, vitamins A, D and zinc imply a gap between recommended and actual micronutrient intakes among broad swathes of the population.
- **The focus is on looking at potential benefits not measuring actual benefits.** The study is intentionally designed to look at the consumption of *potentially* fortifiable products not

actually fortified products⁷. This was done due to the stage in FFP’s rollout when only a minority of mills have been covered as the study’s purpose was to project potential benefits FFP might achieve.

4 Findings on Coverage

4.1 Rolling District Study

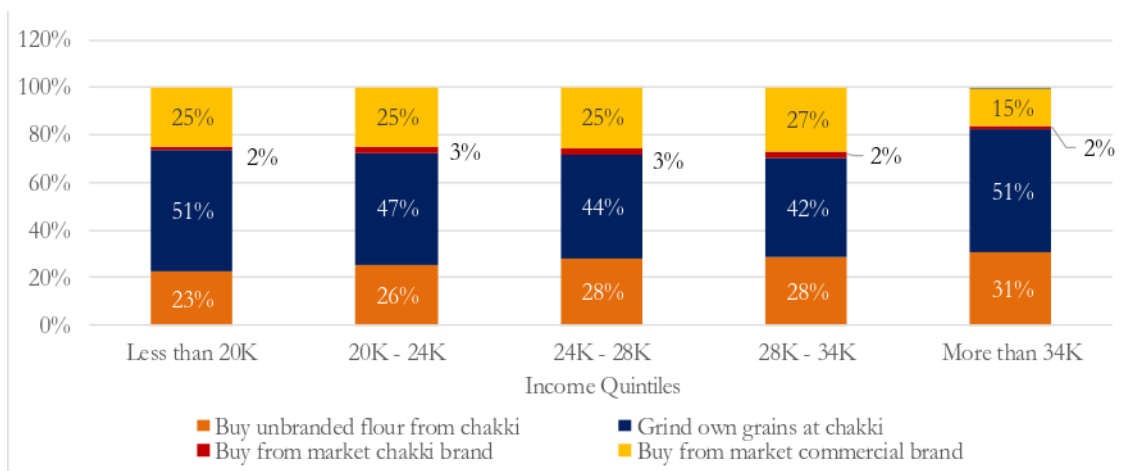
Our analysis suggests that: the market reach of Pakistan’s roughly 1030 roller mills producing fortifiable flour is ~25%; while the market reach of the roughly 100 commercial national oil producers is nearly universal, reaching 97%-99% of all consumers.

The Rolling District Study (RDS) conducted in 4 districts of Punjab found little variation by income group, with purchase of commercial brand flour (shaded yellow) around 25% for the lower 4 quintiles, and only 15% for the richest quintile (Figure 1).

Our analysis considered two methods of disaggregation by wealth: first, reported household expenditure and second, socio-economic classification. The distribution of RDS respondents using both methods is shown in Annex 3.

4.1.1 Wheat Flour Source

Figure 1: Source of Wheat Flour by Income Group



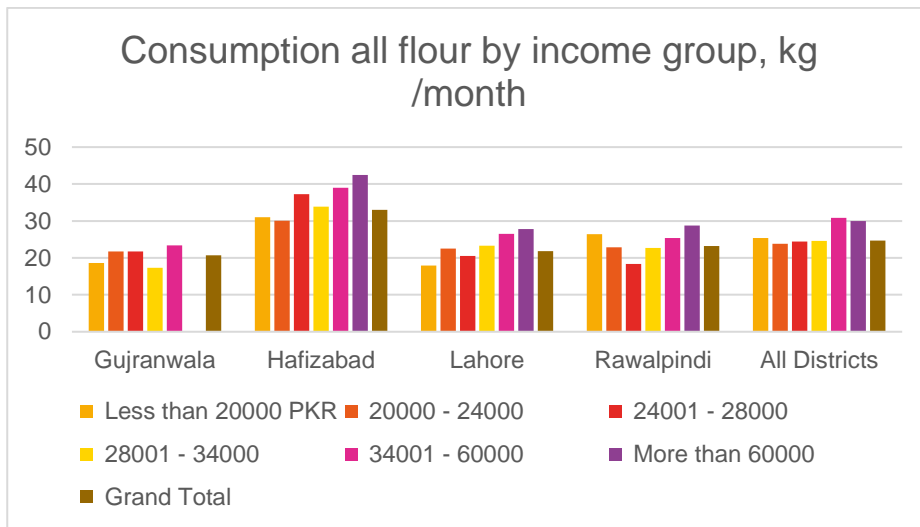
There is, however, wide variation by district and some variation with FACT findings. Analysis done by FFP on FACT data to disaggregate the non-chakki (i.e. roller mill) component of fortifiable flour shows a more skewed income distribution (see Section 4.2):

4.1.2 Wheat Flour Consumption

Average household consumption of **all wheat flour** is shown in Figure 2. The data suggest higher consumption levels in Hafizabad and for higher income groups, although the trend varies. It is possible that in the other districts people prefer to buy readymade chapati and naan from the market.

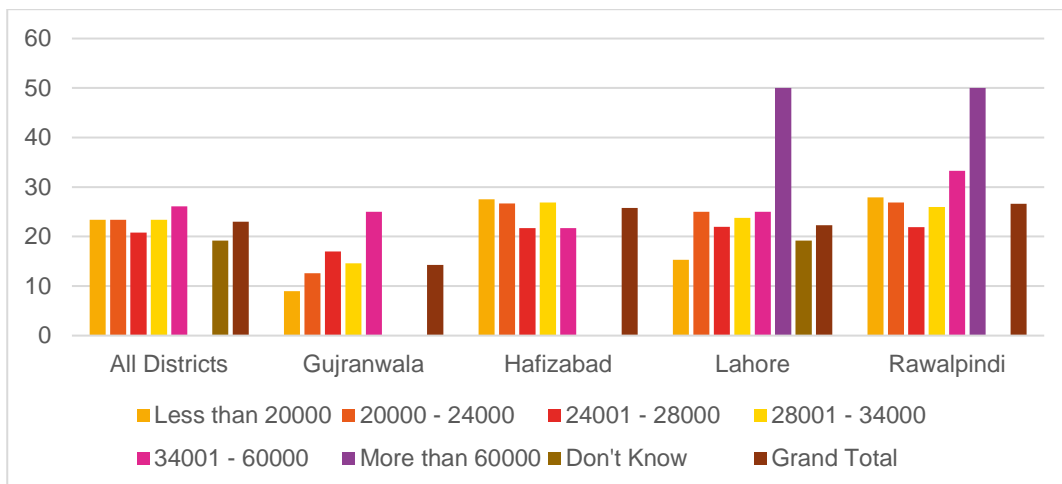
⁷ Other FFP work and the FACT surveys are looking in more depth at actual levels of fortification

Figure 2: Estimated Monthly Average Household Consumption of All Wheat Flour (Kg)



Looking only at consumption that is **addressable by FFP⁸**, Figure 3 shows average estimated household consumption of roller mill flour. It shows little difference in average household consumption with only the higher income groups appearing to consume more quantity. There are wide differences, however, between districts with higher levels of consumption in Lahore and Rawalpindi across wealth groups.

Figure 3: Monthly average household consumption of roller mill wheat flour by expenditure group



Tables showing average consumption in Kg for **households** and **per capita** by wealth group, using both **monthly expenditure** and **SEC** methods, can be found in Annex 3 (Tables C-F).

⁸ We assume that all of commercial brand wheat flour is addressable by FFP

4.1.3 Distribution of Benefits: Wheat Flour

Looking now at how benefits are shared Table 1 below shows a distribution index based on estimated average household consumption by income group compared to the average for all income groups. An index value greater than 1 suggests that group is consuming a larger share than its share of households. The results suggest that for the 4 study districts as a whole the **two poorest groups seem to consume in proportion to their size** though there is variation between districts and income groups. The following tables look at distribution of benefits at household level and then per capita, and analyses using both household expenditure group (Tables 1 and 2) and SEC methods (Tables 3 and 4).

Table 1: Distribution of Benefits – (Based on Estimated Household Consumption of FFP Addressable Wheat Flour by Household Expenditure Group (Source: RDS)

Index: Average H/H consumption =1	Reported Monthly Household Expenditure (Rs)							
	Less than 20000	20000 - 24000	24001 - 28000	28001 - 34000	34001 - 60000	More than 60000	Don't Know	Grand Total
All Districts	1.0	1.0	0.9	1.0	1.1	2.2	0.8	1.0
Gujranwala	0.6	0.9	1.2	1.0	1.7			1.0
Hafizabad	1.1	1.0	0.8	1.0	0.8			1.0
Lahore	0.7	1.1	1.0	1.1	1.1	2.2	0.9	1.0
Rawalpindi	1.1	1.0	0.8	1.0	1.3	1.9		1.0

A similar picture emerges when the analysis is done on a per capita basis in Table 2 (as family size differs by socio-economic category) and district and also when SEC classifications are used (Annex 3, Table F).

Table 2: Distribution of Benefits - Estimated Per Capita Consumption of FFP Addressable Wheat Flour by Household Expenditure Group (Source: RDS)

Index: Average H/H consumption =1	Reported Monthly Household Expenditure (Rs)							
	Less than 20000	20000 – 24000	24001 - 28000	28001 - 34000	34001 - 60000	More than 60000	Don't Know	Grand Total
All Districts	1.2	1.0	0.9	0.9	0.8	2.6	1.0	1.0
Gujranwala	0.7	0.9	1.1	0.9	2.1			1.0
Hafizabad	1.3	0.9	1.0	0.9	0.8			1.0
Lahore	0.8	1.1	1.0	0.9	0.9	2.5	1.1	1.0
Rawalpindi	1.2	1.0	0.8	1.0	0.7	2.3		1.0

Table 3: Distribution of Benefits - Estimated Household Consumption of FFP Addressable Wheat Flour by SEC (Socio-Economic Classification) (Source: RDS)

Index: Average H/H consumption =1	SEC					Grand Total
	A	B	C	D	E	
All Districts	0.99	1.18	0.94	1.01	0.95	1.00
Gujranwala	0.97	0.70	0.87	0.89	1.29	1.00
Hafizabad	0.84	0.97	0.84	1.11	1.06	1.00
Lahore	1.16	1.22	1.15	0.85	0.92	1.00
Rawalpindi	0.98	1.17	0.91	1.04	0.91	1.00

Table 4: Distribution of Benefits - Estimated Per Capita Consumption of FFP Addressable Wheat Flour by SEC (Socio-Economic Classification) (Source: RDS)

	SEC					Grand Total
	A	B	C	D	E	
All Districts	1.09	1.14	0.97	1.04	0.88	1.00
Gujranwala	0.98	0.79	0.92	0.83	1.21	1.00
Hafizabad	0.85	0.97	0.73	1.12	1.10	1.00
Lahore	1.48	1.11	1.29	0.87	0.85	1.00
Rawalpindi	1.03	1.12	0.93	1.03	0.89	1.00

4.1.4 Ghee and Cooking Oil Consumption

For ghee and cooking oil it is assumed that all of the consumption is potentially fortifiable. Tables 5 and 6 show estimated monthly average consumption of the two product groups by household income level and by district. There is very little variation in consumption of ghee according to household income level, but more so for cooking oil.

Table 5: Estimated Monthly Average Household Consumption of Ghee (kgs per month)

Kg	Less than 20000	20000 - 24000	24001 - 28000	28001 - 34000	34001 - 60000	More than 60000	Grand Total
Gujranwala	5.1	5.5	5.1	2.9	5.1	-	5.0
Hafizabad	6.4	6.1	6.4	7.5	6.1	19.5	6.5
Lahore	4.1	3.7	3.6	4.2	4.3	3.8	3.8
Rawalpindi	2.1	2.0	3.2	2.6	2.8	2.0	2.3
All Districts	4.4	4.3	4.6	4.3	4.9	5.8	4.4

Table 6: Estimated Monthly Average Household Consumption of Cooking Oil

Ltr	Less than 20000	20000 - 24000	24001 - 28000	28001 - 34000	34001 - 60000	More than 60000	Grand Total
Gujranwala	0.4	0.9	2.0	3.4	1.0	-	1.4
Hafizabad	0.2	0.5	0.6	0.5	1.6	-	0.5
Lahore	1.6	3.0	2.7	2.4	3.8	2.3	2.6
Rawalpindi	3.1	2.8	2.3	2.5	4.6	17.5	2.9
Grand Total	1.3	1.7	1.9	2.2	2.6	4.1	1.8

4.1.5 Distribution of Benefits: Ghee and Cooking Oil

Table 7 shows the benefit distribution for ghee on a household and per capita basis; Table 8 shows the corresponding figures for cooking oil. In the case of ghee benefits generally appear to be distributed fairly evenly across all expenditure groups - for cooking oil consumption appears somewhat higher for higher income groups.

Table 7: Distribution of Benefits - Estimated Consumption of Ghee by District

		Less than 20000	20000 - 24000	24001 - 28000	28001 - 34000	34001 - 60000	More than 60000	All
Gujranwala	Per Household	1.02	1.10	1.02	0.58	1.02	-	1.0
	Per Capita	1.2	1.1	1.0	0.5	1.0		1.0
Hafizabad	Per Household	0.98	0.94	0.98	1.15	0.94	3.0	1.0
	Per Capita	1.1	1.0	0.9	1.1	0.8	1.9	1.0
Lahore	Per Household	1.08	0.97	0.95	1.11	1.13	1.0	1.0
	Per Capita	1.3	1.0	1.0	0.9	1.0	0.8	1.0
Rawalpindi	Per Household	0.91	0.87	1.39	1.13	1.22	0.87	1.0
	Per Capita	0.9	0.9	1.4	1.1	1.0	0.3	1.0
Overall	Per Household	1.00	0.98	1.05	0.98	1.11	1.32	1.0
	Per Capita	1.1	1.0	1.0	0.9	0.9	0.9	1.0

Table 8: Distribution of Benefits – based on Household Estimated Consumption of Cooking Oil by District

	Less than 20000	20000 - 24000	24001 - 28000	28001 - 34000	34001 - 60000	More than 60000	Grand Total
Gujranwala	0.29	0.64	1.43	2.43	0.71	-	1.0
Hafizabad	0.40	1.00	1.20	1.00	3.20	-	1.0

	Less than 20000	20000 - 24000	24001 - 28000	28001 - 34000	34001 - 60000	More than 60000	Grand Total
Lahore	0.62	1.15	1.04	0.92	1.46	0.88	1.0
Rawalpindi	1.07	0.97	0.79	0.86	1.59	6.03	1.0
Grand Total	0.72	0.94	1.06	1.22	1.44	2.28	1.0

4.1.6 Impact of Increased Consumption of Fortified Food on Household Expenditure

To put spending on wheat into a broader context, Table 9 shows the share of household income reported spent on all wheat flour, oil and ghee. It shows that these products account for a modest share of overall expenditure but a share that rises for poorer households.

Table 9: Share of Household Expenditure on Wheat Flour, Ghee and Cooking Oil (%)

% of household expenditure	Less than 20000	20000 - 24000	24001 - 28000	28001 - 34000	34001 - 60000	More than 60000
Gujranwala	7.8	6.6	6.4	5.9	4.1	-
Hafizabad	13.5	9.1	8.4	7.6	5.8	6.0
Lahore	10.5	8.2	6.7	5.7	4.6	2.6
Rawalpindi	14.7	10.1	7.8	6.8	4.8	5.5
Districts	12.4	8.4	7.2	6.5	5.0	3.5

More specifically looking at wheat flour alone, Table 10 below sets out the estimated share of household expenditure spent on **all potentially fortifiable** wheat flour (this includes both commercial roller mill and fortifiable chakki flour). This shows that roller mill and fortifiable chakki flour account for a minor share of household expenditure, even in the lowest income group. So even if fortification efforts were extended to all potential fortifiable wheat flour, the marginal price increases on an already small share of household spending, would very likely be insignificant.

Table 10: Estimated Share of Household Expenditure (%) on Potentially Fortifiable Wheat Flour (RDS)

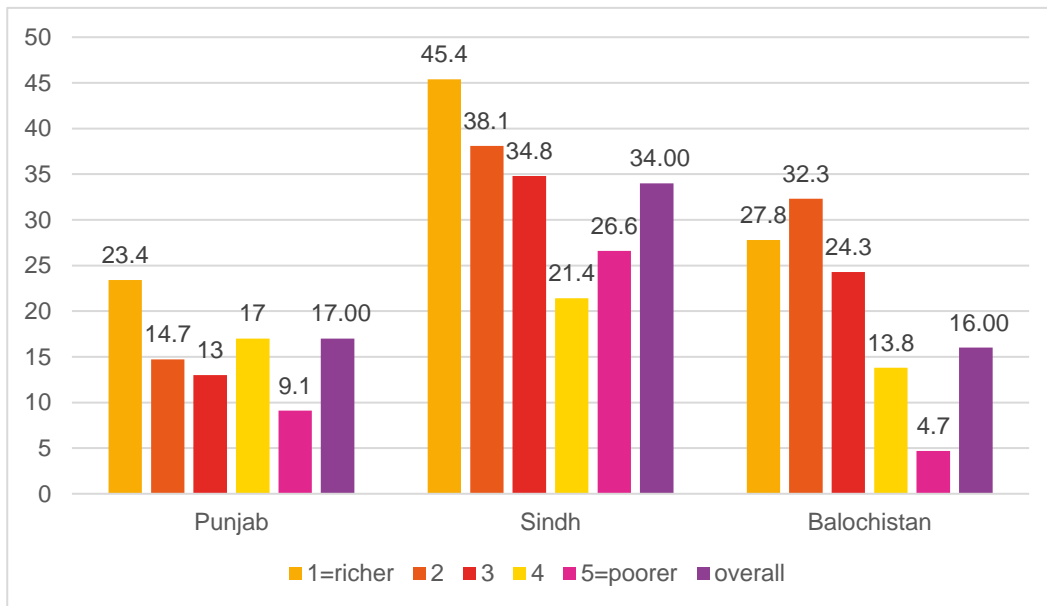
	Less than 20000	20000 - 24000	24001 - 28000	28001 - 34000	34001 - 60000	More than 60000	Overall
Gujranwala	0.4	0.8	1.0	0.7	0.6		0.8
Hafizabad	1.6	0.5	0.2	0.6	0.4	0.7	0.6
Lahore	2.4	2.0	1.7	1.5	0.6	0.4	1.6
Rawalpindi	4.9	3.2	2.2	2.1	1.3	1.5	3.0
All districts	2.6	1.6	1.3	1.3	0.6	0.6	1.5

4.2 Analysis of FACT Data

4.2.1 Wheat Flour Source

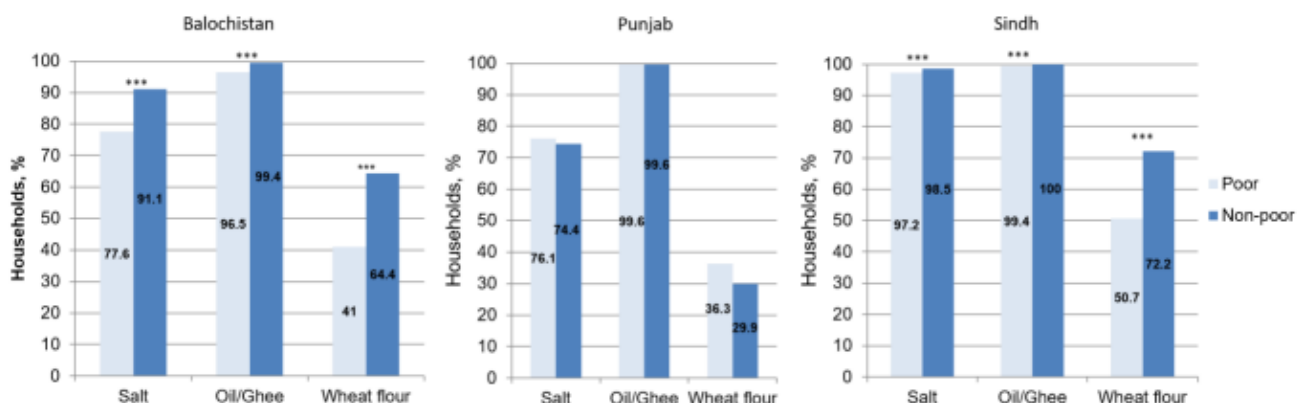
Analysis done by FFP on FACT data to separate out the non-chakki (i.e. commercial roller mill) component of fortifiable flour shows that wealthier income groups have a somewhat higher tendency to routinely purchase commercial branded flour (roller mills).

Figure 4: % Households buying roller mill wheat flour by income quintile (FACT)



However, when considering **all potentially fortifiable wheat flour** (including the share of chakki flour which is considered fortifiable), the income differentials narrowed and in Punjab the poor were **more likely** to use fortifiable wheat flour (36.3%) compared to the non-poor (29.9%). The poor were less likely to use potentially fortifiable wheat flour in Balochistan (41% vs 64.4%) and in Sindh (50.7% vs 72.2%).

Figure 5: Use of Fortifiable Foods by Poverty Status (from FACT report)



Poor = multi-dimensional poverty index ≥ 0.33 . Balochistan (Poor, N=406; Non-poor, N=298). Punjab (Poor, N=154; Non-poor, N=536). Sindh (Poor, N=290; Non-poor, N=420). *P<0.05, **P<0.01, ***P<0.001.

4.2.2 Wheat Flour Consumption

Table 11 shows average wheat flour consumption in kg per month from all sources by wealth quintile. The levels and pattern (a slight increase in average consumption for higher income

groups) are broadly consistent with the findings of the RDS although there is a lot of variation between provinces.

Interestingly, we see in Table 12 that average consumption for households buying non-chakki (i.e. roller mill) flour is higher than for households buying from other sources.

Table 11: Estimated Average Household Total Wheat Flour Consumption (Kg) per month by wealth group and province

Kg	1= RICHER	2	3	4	5=POORER	Grand Total
Balochistan	34.8	39.4	30.1	24.2	19.6	26.3
Punjab	23.6	15.1	9.5	12.8	9.8	15.3
Sindh	30.4	23.5	26.0	22.0	28.9	26.4
Grand Total	28.0	23.2	20.1	21.0	21.3	22.7

Table 12: Estimated Average Household Consumption of Potentially Fortifiable Wheat Flour per month (by wealth group and province)

	1 = RICHER	2	3	4	5 = POORER	Grand Total
Balochistan	22.7	32.5	19.6	14.5	10.9	17.0
From a chakki mill (unbranded / branded)	33.5	18.6	12.8	20.9	21.8	21.8
From the market and it was a chakki flour brand (branded)	19.6	23.4	34.1	28.8	30.0	28.6
From the market and it was OTHER than chakki flour*	38.2	79.5	37.2	34.9	46.6	49.3
Home produced	-	-	-	-	-	-
Punjab	19.1	13.5	7.9	10.2	6.4	12.6
From a chakki mill (unbranded / branded)	16.9	14.6	15.5	27.5	21.3	17.8
From the market and it was a chakki flour brand (branded)	28.0	18.9	22.4	25.0	33.8	25.2
From the market and it was OTHER than chakki flour*	61.9	81.5	49.0	45.1	31.9	60.7
Home produced	-	-	-	-	-	-
Sindh	23.1	17.7	19.6	15.5	21.6	19.7
From a chakki mill (unbranded / branded)	13.5	17.1	28.8	23.4	26.2	20.4
From the market and it was a chakki flour brand (branded)	17.0	12.8	17.4	27.0	21.3	17.5
From the market and it was OTHER than chakki flour*	34.6	31.2	37.2	40.8	53.5	37.7

	1 = RICHER	2	3	4	5 = POORER	Grand Total
Home produced	-	-	-	-	-	-
Grand Total	21.3	19.1	14.7	13.8	13.5	

*implies commercial roller mill flour

4.2.3 Oil/Ghee Consumption and Benefits

For oil and ghee there is little evidence of major differences between wealth quintiles although variation between products and provinces.

Table 13: Estimated Average Household Oil and Ghee Consumption (by wealth group and province)

Province		1=Richer	2	3	4	5=Poorer	Grand Total
Balochistan		8.2	6.6	6.2	7.4	6.9	7.0
	Ghee	7.3	6.3	6.1	7.2	6.7	6.7
	Oil	9.2	7.1	6.4	8.1	9.0	7.9
Punjab		6.9	7.2	5.5	5.8	4.8	6.3
	Ghee	6.7	7.4	5.4	5.9	4.9	6.2
	Oil	7.1	6.8	6.5	4.3	3.8	6.8
Sindh		6.6	6.1	7.2	6.3	4.8	6.3
	Ghee	7.2	6.0	6.2	6.2	5.0	5.9
	Oil	6.5	6.1	7.8	6.4	4.5	6.5
Grand Total		6.9	6.7	6.2	6.7	6.1	6.5

Table 14 shows some evidence of a small pro rich bias with wide variation between product and province. This table uses the consumption data from Table 13 and converts this into a ratio of consumption by income group with average across all income groups, to give a consumption benefit index.

Table 14: Distribution of Benefits: Oil and Ghee Consumption (by province)

Province (kg/ltr)		1 = RICHER	2	3	4	5 = POORE R	Grand Total
Balochistan		1.17	0.94	0.89	1.06	0.99	1.00
	Ghee	1.08	0.93	0.90	1.07	0.99	1.00
	Oil	1.04	0.90	0.91	1.06	1.01	1.00
Punjab		1.17	0.90	0.82	1.02	1.14	1.00
	Ghee	1.08	1.14	0.87	0.92	0.76	1.00
	Oil	1.09	1.20	0.86	0.95	0.79	1.00
Sindh		1.08	1.19	0.86	0.95	0.80	1.00
	Ghee	1.04	1.00	0.96	0.62	0.55	1.00
	Oil	1.04	1.00	0.96	0.62	0.55	1.00
Grand Total		1.06	0.98	1.15	1.00	0.76	1.00
	Ghee	1.22	1.02	1.05	1.04	0.84	1.00
	Oil	1.21	1.01	1.05	1.04	0.85	1.00
		1.01	0.95	1.21	0.99	0.69	1.00
		1.01	0.95	1.21	0.99	0.69	1.00
Grand Total		1.06	1.03	0.96	1.02	0.93	1.00

5 Findings – Projections of Health Impact

5.1 Numbers of Beneficiaries

Our coverage analysis suggests that the market reach of roller mill fortifiable flour is about 25%; while the market reach of oil/ghee is nearly universal, reaching 97%-99% of all consumers. FFP programme objectives target successful fortification of 95% of flour milling and oil production.

As shown in the table below, these two parameters, market reach and FFP program objectives, suggest FFP will reach about **50 million consumers** with fortified wheat flour and **198 million with fortified oil** – an estimated **~45% are women of reproductive age and children 6-59 months of age**. Older children, adolescents, males as well as older adults will also benefit from added nutrition protection provided by fortification.

Table 15: Estimated Coverage of Flour and Oil Fortification Based on Current Market Reach and FFP Objectives

	National Population ⁹	Flour Fortification			Oil Fortification		
		Market	FFP	Covered	Market	FFP	Covered
National Population	212,742,631	24.75%	95%	50,029,387	98%	95%	198,063,389
Women Reproductive Age	62,129,942			14,610,720			57,842,976
Children 6-59 months	32,124,137			7,554,437			29,907,572

While distribution of the benefits of fortified foods covers all income groups, available evidence suggests that the 25% market share for commercial fortifiable flour products is well targeted. Anaemia and other micronutrient deficiencies are widespread throughout the population regardless of income and domicile and addressing deficiencies will produce health and ultimately economic benefit to the whole country. For more information on nutrition status by wealth group, see **Annex 4**.

5.2 Parameters for Effectiveness of Fortification

The effectiveness of flour and oil fortification in reducing the prevalence of micronutrient deficiencies has been established via efficacy studies and large-scale effectiveness trials as well as the evaluation of national programs, with findings of reductions in prevalence of micronutrient deficiencies of 50% and higher.

Effectiveness in preventing and controlling micronutrient deficiencies is based on the dose of vitamin or mineral delivered to the consumer on a daily basis – determined by fortification level and volume of daily intake of the fortified food. Pakistani fortification standards are based on global best practice, including WHO *Recommendation for Flour Fortification*.¹⁰ While consumption varies widely reflecting a range of individual factors, based on consumption data from FACT and RDS, it is possible to develop a profile of nutrition protection delivered to an average or an “index” consumer.

The analysis in **Annex 5** suggests that at average consumption, flour fortification can deliver a substantial dose for iron, folic acid and zinc to children 6-59 months and women of reproductive age, ranging from **32%-73%** of The Dietary Reference Intake (**DRI**) developed by Institute of

⁹ https://en.wikipedia.org/wiki/Demographics_of_Pakistan

¹⁰ WHO Recommendations

Medicine (IOM) of the U.S. National Academies.¹¹ Oil fortification can deliver more than half of daily needs for children 6-59 months and pregnant women and about one third the DRI for lactating women.

While a fuller literature review is provided in **Annex 5**, the parameters for effectiveness in lowering the prevalence of micronutrient deficiencies among consumers of fortified foods are as follows:¹²

- 67% prevalence reduction in VAD in children 6-59 months based on Indonesia national oil fortification program.
- An average of 3 data points from fortification programs in Chile and Costa Rica suggests an 83% reduction in low serum folate among adult female fortified flour consumers.
- Reduction in prevalence of anaemia among children 6-59 months consuming fortified flour is projected at 60% based on the average of a global meta-analysis and an evaluation of flour fortification in Costa Rica.
- 39% reduction in prevalence of anaemia among women is taken from two national program evaluations and a global meta-analysis of iron fortified foods.
- Since there is no available evidence for flour fortification with Zinc, for the purposes of this paper, the same effectiveness parameter found for iron will be applied.

5.3 Projections for Reduced Prevalence and Case Load

Based on the prevalence of micronutrient deficiency along with estimated coverage and effectiveness, the basic benefit of flour and oil fortification defined as improvement or reduction in prevalence or number cases using the algorithm below:

$$\# \text{ Cases} \times \% \text{ Coverage} \times \% \text{ Effectiveness} = \text{Reduced} \# \text{ Cases}$$

$$\% \text{ Prevalence} \times \% \text{ Coverage} \times \% \text{ Effectiveness} = \text{Reduced} \% \text{ Prevalence}$$

The logic model and results shown in the table below indicate reduction in prevalence and prevented cases of anaemia and iron deficiency; folic acid deficiency; zinc deficiency; vitamin A deficiency.¹³ The analysis suggests fortification will prevent ~29 million cases of micronutrient deficiency annually in Pakistan. While the overlap of multiple micronutrient deficiencies of single individuals is unknown, we venture that this benefit affects a minimum of **~24 million consumers**, predominantly women of reproductive age and children 6-59 months of age.¹⁴ including:

- Prevalence reduction of 62.4% indicating **19 million cases of vitamin A deficiency** among children 6-59 months of age as well as pregnant and lactating women.
- **8.2 million cases of anaemia** annually via prevalence reduction of 14.1% among children 6-59 months, 9.2% in women of reproductive age and adult men, 11.6% among adolescent girls. These cases are associated with child and maternal mortality as well as retarded cognitive development, school performance and adult productivity.
- Prevalence reduction of 14.1% indicating **1.7 million cases of zinc deficiency** associated with higher rates of both morbidity and mortality in children 6-59 months.

¹¹ DRIs are used because WHO has not developed an Estimated Average Requirement (EAR) for iron. Therefore, in order to make the analysis comparable DRI was applied.

¹² Given lack of data on impacts and prevalence reduction, this paper will not address impact of Vitamin B12 and Vitamin D fortification.

¹³ With no baseline data available, benefits of Vitamin D and B12 fortification of flour will not be projected.

¹⁴ Assumes all children 6-59 months suffer from vitamin A, iron and zinc deficiencies.

- Reduction of 19.5% in the incidence of Neural Tube Defects, indicating **24.5 thousand cases** with an estimated fatality rate of 90%.¹⁵

Table 16: Summary Projections for Reduced Prevalence and Cases-Burden Attributed to Flour and Oil Fortification

	Prevalence		Market Coverage	Program Coverage	Effectiveness	Benefit:	
	%	Cases				%	%
Flour Fortification							
Anaemia							
Women Reproductive Age	50.50%	31,375,621	24.75%	95%	39.0%	9.2%	2,877,581
Males	21.24%	14,096,267			39.0%	9.2%	1,292,824
Child 6-59m	62.10%	19,949,089			60.0%	14.1%	2,814,783
Adolescent Girls	50.50%	10,367,480			49.5%	11.6% ¹⁶	1,206,838
Cases Prevented	8,192,027						
Folic Acid Deficiency							
Neural Tube Defect	38.6/10k Birth	24,471	24.75%	95%	83.0%	19.5%	4,776
Zinc Deficiency							
Children 6-59 months	36.50%	11,725,310	24.75%	95%	60.0% ¹⁷	14.1%	1,654,422
Cases Prevented	9,851,225						
Oil Fortification							
Vitamin A Deficiency							
Children 6-59 months	56%	17,989,517	98%	95%	67%	62.4%	11,221,321
Pregnant & Lactating Women	49%	12,679,461					7,909,067
Cases VAD Prevented	19,130,388						
Total Prevented Cases	28,981,613						

Source: <Insert Notes or Source>

5.4 Projected Reductions in Child Mortality via Flour and Oil Fortification

A consensus of global evidence indicates that reduction in prevalence of vitamin and mineral deficiency is associated with improvements in survival and health as well as cognition, schooling and productivity. These have recently been reviewed in a World Food Program analysis, *The Economic Consequences of Undernutrition in Pakistan*, which projected annual mortality,

¹⁵ Bagriansky, J. Economic Consequences of Undernutrition in Pakistan, WFP 2017

¹⁶ Since no data is available for adolescents applies average of women and children

¹⁷ Assume effectiveness is parallel to that of iron fortification children 6-59 months.

morbidity and economic losses attributable to 11 nutrition indicators in Pakistan.^{18 19} Findings of this WFP analysis have been updated with more recent demographic and nutrition data and presented in the following series of tables. The full paper is provided in Annex 2.

Global evidence indicates specific child and maternal nutrition indicators are associated with increased mortality rates in children <5 years of age. The updated table below based on *The Economic Consequences of Undernutrition in Pakistan*, suggests that ~36% of an estimated 565 thousand annual child deaths are attributable to the 11 indicators of malnutrition.²⁰ In this analysis maternal anaemia and folic acid associated birth defects as well as childhood vitamin A and zinc deficiencies account for about 37% of this mortality, 68.5 thousand annually.

The predominant share of child mortality occurs in the first 6 months of life, considered beyond the reach of fortified foods.²¹ However, food fortification can prevent mortality in this age group via improved maternal iron and folic acid nutrition. Fortification can directly prevent mortality by providing added nutrition protection to children 6-59 months a period when about ¼ of child mortality occurs. Applying reductions in prevalence derived in the previous sections to estimated child mortality attributed to 4 indicators projected in *Economic Consequences of Undernutrition in Pakistan*, indicates that fortification may prevent ~15.5 thousand deaths of children less than 5 years of age annually, lowering child mortality attributed to micronutrient deficiencies by 23% and reducing the mortality burden of malnutrition by 9% and the national child mortality rate by ~3%.

6 Discussion and Way Forward

The results from both the RDS and FACT have confirmed almost universal coverage of fortifiable oil/ghee meaning that the benefits will be felt across the entire population. While quantity consumed (of cooking oil) does rise slightly with income, the dose received by the poorest groups will be sufficient, based on evidence from other programmes, to reduce vitamin A and D deficiencies across the board.

While coverage of roller mill flour (addressable by FFP as currently designed) is less than previously thought, estimated at 25%, it should be recognised that FACT and RDS surveys are by no means definitive and may well underestimate the reach of the commercial flour market. Earlier anecdotal and expert opinion suggested market reach of >50%. A recent 2018 United States Department of Agriculture Grain and Feed Annual reports that Pakistan's flour mills "meet the consumption needs of 40% of the population."²² It is likely that much of this gap is accounted for by commercially produced wheat flour that is sold to bakeries, nan shops and used in food produced outside the home. Consumers eating these foods will also benefit in some way, though are omitted from this analysis because of the difficulty quantifying the

¹⁸ Bagriansky, J. *The Economic Consequences of Undernutrition in Pakistan*, WFP 2016 (unpublished).

¹⁹ <https://www.wfp.org/news/news-release/malnutrition-costs-pakistan-us76-billion-annually-new-study-reveals>

²⁰ @29.8/1000 births

²¹ Both because children do not consume sufficient quantities for general fortification levels to be effective, and because exclusive breastfeeding is recommended during this period.

²² Grain and Feed Annual 2018, USDA Global Agricultural Information Network Report

amounts consumed with current data. **Future rounds of the RDS can be designed to better capture consumption through these sources.**

Where consumption levels are broadly proportionate across income groups, poorer groups will fare slightly better in terms of health benefits given that their nutrition indicators tend to be the worst (see Annex 4). However given the prevalence of poor nutritional indicators across **all** wealth groups in Pakistan, and the impact this has on economic development which impact everyone, even with an income skewed distribution of consumption, the absolute number of people who stand to benefit is at least **24 million**, the majority of which will be from our target groups (women of reproductive age, adolescent girls and children 6-59 months). The impact of lower prevalence of micronutrient deficiencies on the attributable mortality is projected at a reduction in child mortality of about **~17.5 thousand deaths annually** – both directly and indirectly via maternal nutrition.

We note that a limitation of the study is that we did not explore intra-household distribution patterns. We can make reasonable assumptions about an index consumer and the average difference fortification will make to correcting micronutrient deficiencies based on global evidence. However, given patriarchal patterns and power imbalances it would be worth commissioning a further study, perhaps qualitative, to investigate intrahousehold distribution patterns and quantities of fortified foods consumed by individual household members. The foods that are fortified are staples, and not the especially valued foods such as meat that might typically exhibit more unequal household distribution. But the prevalence of underweight, especially among adolescent girls, suggests an investigation of the adequacy of daily quantities of the fortified food vehicle consumed would be a useful supplement to confirm our projections.

Although broadly comparable, there are some inconsistencies between the RDS and FACT – which is not surprising given that RDS covered four marker districts only in its first round and the surveys were designed with different purposes. Future rounds can be refined to collect more comparable data on wealth classification.

When all potentially fortifiable wheat flour is included (including fortifiable flour from chakkis), population coverage rises to 52% in Balochistan, 31% in Punjab, and 63% in Sindh according to FACT. This finding validates the exploratory work that FFP has started on the feasibility of fortification via chakkis.

Finally, the current distribution of benefits considers only average quantities consumed at household level by each wealth group, and does not account for prevalence of micronutrient deficiency as measuring this was beyond the scope of both surveys. We suggest some further analysis to create an index of nutrition status by income quintile (perhaps drawing on the data on Annex 4) and combining this with the consumption-based benefit index to provide more a more targeted benefit distribution.

GAIN has previously indicated that it might develop a further module of the FACT methodology which covers intake of other micro-nutrient rich foods. In this event, we could certainly consider the possibility of an end of project repeat of the FACT study with this module as an even better way of measuring the contribution of the fortified food to dietary reference intakes (DRIs) of those who actually consume it.

Annex 1- Terms of Reference

Purpose of assignment

To use data from the FACT study undertaken by GAIN and the FFP Rolling District study (baseline) to project who would be likely to benefit from FFP on the basis of today's consumption patterns.

Scope

Review datasets from the FACT study and the District Rolling Study baseline to:

- assess the extent to which each of the five wealth quintiles will benefit from the Food Fortification Programme, separately by province, assuming today's consumption patterns (FACT data);
- assess the extent to which target demographic groups (women of reproductive age, children under 5 years and girls aged 10-14) will benefit from the Food Fortification Programme in terms of their intake of roller mill flour and commercial oil, separately by province, assuming today's consumption patterns; (FACT data)
- For our four marker districts (Rawalpindi, Lahore, Gujranwala and Hafizabad), estimate the extent to which each of the five wealth quintiles will benefit from FFP (Rolling District Study baseline data);
- For our four marker districts, assess the extent to which any increase in consumption of commercial roller mill flour could affect total household spending on flour by the bottom two wealth quintiles (Rolling District Study baseline data);
- Provide a summary of any key issues which could affect uptake of fortified product by poorer groups.

Provide comments on the draft FACT survey and rolling district survey.

Deliverables

- Brief report with summary of findings
- Suggested methodology for further economic and costing analysis through lifetime of Rolling District Study
- Setting out possible approaches to the benefit incidence analysis
- Mapping out our current knowledge based on the available studies - identified likely drivers of benefit incidence
- Suggesting ways forward re changes to the methodology in future district surveys

Annex 2 - MPI Index

Parameter	Traditional Method (Weight)	Adaptation Used (weight)
At least on HH member has completed 5 yrs schooling	16.7%	Completed 5 years: 10% Number of school years completed in HH: 10%
School age child (years 1 to 8) not attending school	16.7%	19%
Any child has died	16.7%	19%
Evidence of malnutrition in any family member	16.7%	Not available
No electricity	5.6%	7%
Unimproved sanitation/shared	5.6%	7%
No access to safe water/long distance	5.6%	7%
Dirt, sand or dung floor	5.6%	7%
Dung, wood or carbon used for cooking	5.6%	7%
Owens few major assets e.g. TV	5.6%	7%

Annex 3 - Additional Tables

WEALTH GROUPS

Table A: Wealth Group Distribution by Household Expenditure Method (RDS)

	Less than 20000	20000 - 24000	24001 - 28000	28001 - 34000	34001 - 60000	More than 60000	Grand Total
Gujranwala	14.3	49.0	21.4	12.5	2.6	-	100.0
Hafizabad	29.6	28.4	19.0	15.3	7.1	0.4	100.0
Lahore	13.3	29.3	26.5	20.3	6.8	2.0	100.0
Rawalpindi	26.6	40.4	15.2	15.0	2.0	0.4	100.0
Grand Total	20.9	36.8	20.5	15.8	4.6	0.7	100.0

Table B: Wealth Group Distribution by Socio-economic Classification (RDS)

Row Labels	A	B	C	D	E	Grand Total
Gujranwala	13.1	9.3	23.8	19.0	34.7	100.0
Hafizabad	7.7	8.3	16.9	20.4	46.6	100.0
Lahore	10.0	17.1	20.9	22.7	29.3	100.0
Rawalpindi	19.2	10.0	16.6	29.0	25.2	100.0
Grand Total	12.5	11.2	19.6	22.8	34.0	100.0

AVERAGE CONSUMPTION OF COMMERCIAL ROLLER MILL FLOUR

Table C: Estimated Monthly Average Household Consumption (Kg) per month of FFP Addressable Wheat Flour by Household Expenditure Group (Source: RDS)

kg	Reported Monthly Household Expenditure (Rs)						Don't Know	Grand Total
	Less than 20000	20000 - 24000	24001 - 28000	28001 - 34000	34001 - 60000	More than 60000		
All Districts	23.4	23.4	20.8	23.4	26.1	50.0*	19.2	23.0
Gujranwala	9.0	12.6	17.0	14.6	25.0			14.3
Hafizabad	27.5	26.7	21.7	26.9	21.7			25.8
Lahore	15.3	25.0	22.0	23.8	25.0	50.0	19.2	22.3
Rawalpindi	27.9	26.9	21.9	26.0	33.3	50.0		26.6

* note – this figure is based on data from only two households

Table D: Estimated Monthly Average Per Capita Consumption (Kg) per month of FFP Addressable Wheat Flour by Household Expenditure Group (Source: RDS)

Kg	Reported Monthly Household Expenditure (Rs)							Grand Total
	Less than 20000	20000 - 24000	24001 - 28000	28001 - 34000	34001 - 60000	More than 60000	Don't Know	
All Districts	6.4	5.6	4.8	5.0	4.5	14.3	5.2	5.4
Gujranwala	2.3	2.9	3.2	2.8	6.3			3.0
Hafizabad	5.8	4.2	4.3	4.1	3.4			4.5
Lahore	4.0	5.5	5.1	4.6	4.3	12.5	5.2	5.0
Rawalpindi	8.4	6.9	6.0	7.3	5.3	16.7		7.2

Table E: Estimated Monthly Average Household Consumption of FFP Addressable Wheat Flour by SEC (Socio-Economic Classification) (RDS)

Kg	SEC					Grand Total
	A	B	C	D	E	
All Districts	22.8	27.2	21.6	23.3	21.9	23.0
Gujranwala	13.9	10.0	12.5	12.7	18.5	14.3
Hafizabad	21.7	25.0	21.7	28.8	27.3	25.8
Lahore	25.8	27.1	25.5	19.0	20.4	22.3
Rawalpindi	25.9	31.0	24.3	27.7	24.2	26.6

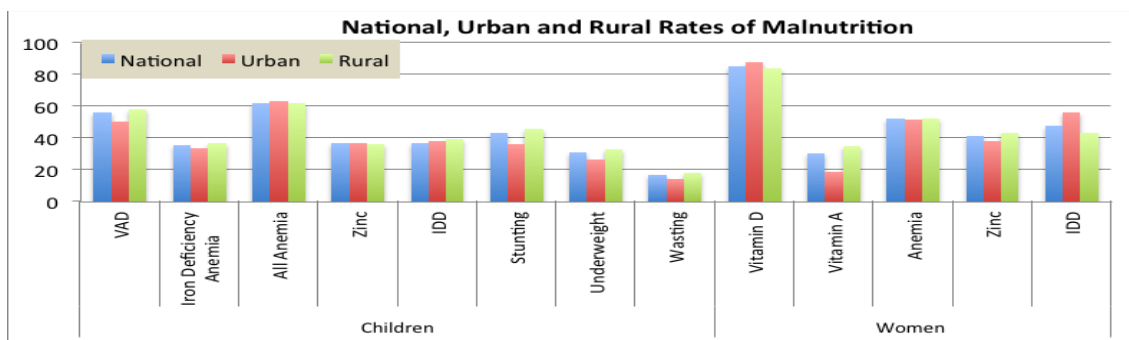
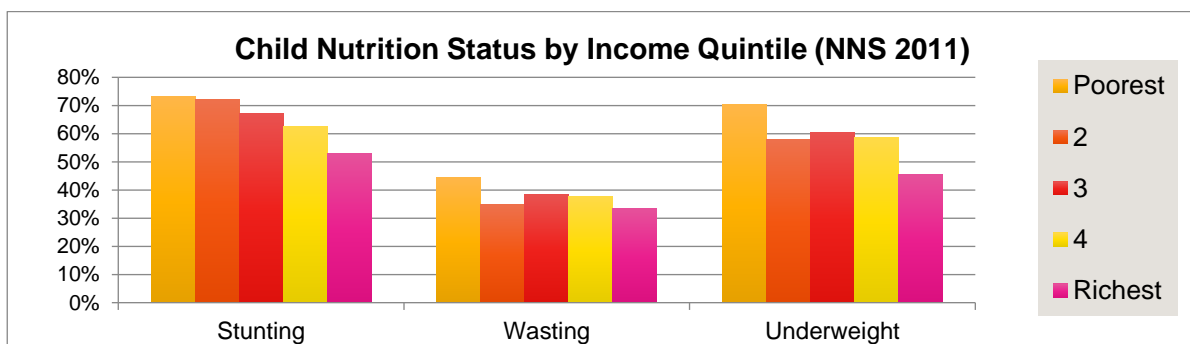
Table F: Estimated Monthly Average Per Capita Consumption (in Kg) of FFP Addressable Wheat Flour by SEC (Socio-Economic Classification) (RDS)

kg	SEC					Grand Total
	A	B	C	D	E	
All Districts	5.9	6.2	5.3	5.6	4.8	5.4
Gujranwala	3.0	2.4	2.8	2.5	3.7	3.0
Hafizabad	3.8	4.3	3.3	5.0	4.9	4.5
Lahore	7.4	5.5	6.4	4.3	4.2	5.0
Rawalpindi	7.4	8.1	6.7	7.4	6.4	7.2

QUICK CALC						
kg/yr	g/d	Average MG added at 15ppm Minimum	Added Mg/ day	EDTA Adjustment (RBV of 2)	RNI WRA 18 mg/d	RNI Male 8 mg/d
36	98.6	16.5	1.6	3.3	18%	41%

Annex 4 - Nutrition Status by Income Quintile

Available evidence suggests that the ~25% market share for commercial fortifiable flour products is well targeted. First, as indicated in the charts below, anaemia and other micronutrient deficiencies are likely widespread throughout the population regardless of income and domicile. No national prevalence data segmented by income quintile was identified, however, distribution of other nutrition deficiencies documented by NNS 2011 such as stunting, underweight and wasting indicate that, although the poor suffer most, even among upper income quintiles in Pakistan, prevalence is high, 33%-53%, representing a significant public health problem based on WHO definitions. Recent reviews by Muhammad Atif Habib et al²³ and Soofi et al²⁴ also found relatively minor associations (OR) between income quintile and risk of anaemia and other micronutrient deficiencies. A composite look from several sources for a range of nutrition indicators including anaemia, zinc, iodine and vitamin A deficiencies show little skew between urban and rural populations.²⁵ We conclude that wherever the market for fortifiable oil and flour may reach, a significant proportion of consumers will be micronutrient deficient.



²³ Habib MA, Black K, Soofi SB, Hussain I, Bhatti Z, Bhutta ZA, et al. (2016) Prevalence and Predictors of Iron Deficiency Anaemia in Children under Five Years of Age in Pakistan, PLoS ONE 11(5): e0155051. doi:10.1371/journal.pone.0155051

²⁴ Soofi S, Khan GN, Sadiq K, et al. Prevalence and possible factors associated with anaemia, and vitamin B12 and folate deficiencies in women of reproductive age in Pakistan: analysis of national-level secondary survey data. BMJ Open 2017;

²⁵ Compiled in Bagriansky, J. Economic Consequences of Undernutrition in Pakistan, WFP 2017,

Annex 5 - International Evidence on Fortification Effectiveness

Nutrition Protection per Index Customer

Nutrition Protection for Average or Index Consumer: % DRI Delivered							
	Consume g/dy	Nutrient Added		Nutrient Delivered		Nutrition Protection	
		Minimum	Average ²⁶	Retain	Unit/dy	FNB DRI	% DRI
Flour Fortification							
Iron							
Child 6-59m ²⁷	74.7	15	16.5	99%	1.23/2.47 ²⁸	7.629	32%
Women Rep Age	230	15	16.5	99%	3.80/7.59	18	42%
Adult Men	230	15	16.5	99%	3.80/7.59	8	95%
Folic Acid							
Women Rep Age	230	1	1.1	90%	253.15	400	63%
Zinc							
Children 6-59	74.7	30	33	99%	2.47	3.4	73%
Oil Fortification							
Vitamin A							
Children 6-59m	15.5	10.5	11.55	53% ³⁰	179	320	56%
Pregnant	34.4	10.5	11.55	53%	397	770	52%
Lactating	34.4	10.5	11.55	53%	397	1300	31%

The projected proportion of DRI delivered, as shown in the table above, indicates significant added micronutrient protection delivered to the average consumer – and suggests that in making projections for effectiveness it will be appropriate to apply results from favorable trials and evaluations of national fortification programs in other countries.

Effectiveness from Other Programmes

²⁶ Average addition includes recommended 10% overage to achieve minimum fortification standard

²⁷ Since consumption of children in surveys is for multiple segments of children 6-59 months and DRIs are given for multiple age child groups and adjusted combined figure has been developed for the purposes of this analysis.

²⁸ Since Relative Bioavailability (RBV) for NaFeEDTA is generally considered to be 2 relative to Ferrous Sulfate, the amount of iron is doubled to reflect the use of this superior product in fortification.

²⁹ Since consumption of children in surveys is for multiple segments of children 6-59 months and DRIs are given for multiple age child groups and adjusted combined figure has been developed for the purposes of this analysis.

³⁰ Hifza Akhtar, Lubna Tahir, Shahid Mahmud and Shahnaz Hamid, Loss of vitamin A in fortified edible oils and ghee during cooking in asian traditional style, *Bangladesh J. Sci. Ind. Res.* 47(2), 243-248, 201; Dewi Kristina Natalia Silalahi, Dewi Yuliyanti, Monica da Silva, Isti Christianti, Karyanto Mulyono & Paul Wassell The stability of vitamin A in fortified palm olein during extended storage and thermal treatment, *International Journal of Food Science and Technology* Accepted in revised form 16 March 2017

Anaemia emerges from multifactorial causation including malaria, helminthes, infections, genetic disorders, life cycle segments and other origins as well as low dietary iron intake. Flour fortification can only address low iron intake. The FFP target for reduction of anaemia among regular fortified flour consumers is based on several analysis and studies:

- A meta-analysis of 60 trials published in the *American Journal of Clinical Nutrition* showed that iron fortification of foods resulted in 41% population wide reduction in the risks of anaemia and a 52% reduction in iron deficiency.³¹
- A compilation of 12 evaluations from 10 countries based on a comprehensive literature review supplied by the Food Fortification Initiative of Emory University Rollins School of Public Health with an average anaemia reduction of 35-37% as shown in the table below.³²

Selected Studies and Program Evaluations from Compilation from Food Fortification Initiative			
Country	Study	Study Population	
Venezuela	Layrisse 2002	Children 7-15 yrs	-6%
Costa Rica	Martorell 2015	Children 1-7 yrs	-79%
Azerbaijan	Tazhibayev 2008	Children 2-15 yrs	-70%
Kazakhstan	Tazhibayev 2008	Children 2-15 yrs	-35%
Mongolia	Tazhibayev 2008	Children 2-15 yrs	62%
Tajikistan	Tazhibayev 2008	Children 2-15 yrs	-71%
Uzbekistan	Tazhibayev 2008	Children 2-15 yrs	-47%
South Africa	Modjadji 2007	Non-pregnant WRA	-33%
Australia	Kamien 1975	Adults < 55yrs	-62%
Brazil	Fujimori 2011	Pregnant women	-21%
Costa Rica	Martorell 2015	WRA	-45%
China	Huo 2011	WRA	-28%
Fiji	Fiji MOH/UNICEF/WHO 2012	WRA	-32%
Average Impact Children			-35%
Average Impact Women ³³			-37%
13 Study Average			-36%

Most of the studies above measure impact of fortification on the target population and not specifically flour consumers that were actually covered by the intervention. Since coverage, even in the most optimal cases is less than 100%, the reported impact underestimates actual effectiveness of flour fortification. Moreover, many of these studies above may not apply in the context of the Pakistan FFP. Confounding factors such as malaria, helminths, other infections and genetic diseases as well as intake of iron absorption inhibitors such black tea varies greatly among evaluated program. In some cases, the measurements were based on regional efforts rather than national programs, and in the case of national programs the evaluations are rarely nationally representative. In other cases, these programs were restricted by their application only to higher quality and more expensive flours, limiting coverage and scope of their impact. In almost all cases, technical fortification specifications were less than optimal, namely significantly lower addition levels and/or less bioavailable iron compounds than those recommended by

³¹ Gera T, Sachdev HS, Boy E. Effect of iron-fortified foods on hematologic and biological outcomes: systematic review of randomized controlled trials. *Am J Clin Nutr* 2012; **96**: 309–24.

³² Helena Pachon, Science Director, Food Fortification Initiative, Emory University Personal Communication. Note: Two studies in the original list were omitted in this analysis because of known issues regarding the methodologies or confounding by temporal trends.

³³ Includes Fujimori study on pregnant women and Kamien study on all adults

World Health Organization (WHO) – while the Pakistan program specifications are based on WHO recommendations.

Only 2 evaluations, Costa Rica and Fiji, represent full national evaluations of comprehensive national programs and are based on fortification standards reflecting WHO recommended levels and iron compounds. The published evaluations from Costa Rica, representing perhaps the most credible methodology and authorship, found 45% decrease in prevalence of anaemia among adult woman of reproductive age and 79% decrease among children.³⁴ The evaluation of the Fiji national flour fortification program by the Fiji MOH Food & Nutrition Institute (supported by WHO and UNICEF) found 32% decrease in prevalence of anaemia among women of childbearing age.³⁵ In the case of iron deficiency, the Fiji evaluation found 48% reduced prevalence in adult woman and the Costa Rica study found 57% decline in iron deficiency (counter intuitively less than improvement in anaemia).

Proposed Effectiveness Parameter and Anaemia and Iron Deficiency Impact Target. The original FFP log frame set a target of 1/3rd reduction for anaemia and at least 1/3rd reduction in iron deficiency among women, children and teenage girls who are regular consumers of fortified flour. Based on the review above these may be overly modest or cautious. The proposed revised effectiveness parameters are based on an average of reduction in prevalence reported by the Costa Rica and Fiji evaluations along with the meta-analysis published in the *American Journal of Clinical Nutrition*. The outline of this proposed analysis is shown in the table below.

Selected Effectiveness Parameters for Impact of Fortification on Anaemia and Iron Deficiency		
	Anaemia	Iron Deficiency
Children		
Costa Rica (Martorell et al, 2015)	79%	57%
Meta-analysis (Gera et al, 2012)	41%	52%
Average: Selected Effectiveness Parameter	60%	55%
Women		
Costa Rica (Martorell et al, 2015)	45%	
Fiji (NFNC, 2010)	32%	48%
Meta-analysis (Gera et al, 2012)	41%	52%
Average: Selected Effectiveness Parameter	39%	50%

Folic Acid Deficiency (FAD) Prevalence in Women & Reduced Neural Tube Defects (NTD)

A significant reduction in NTDs including spina bifida, anencephaly and other birth defects has been consistently demonstrated via flour fortification with folic acid. The original FFP impact targeting 30% reduction in these cases was conservatively based on 20 longitudinal studies from 12 different countries showing average of 41% reduction in the incidence of NTDs, with individual studies finding improvements ranging from 19%-60%. This is shown in the table below.

³⁴ Martorell R et al. Effectiveness evaluation of the food fortification program of Costa Rica: impact on anaemia prevalence and hemoglobin concentrations in women and children. *American Journal of Clinical Nutrition* 101:210-7, 2015

³⁵ Impact of Iron Fortier Flour in Child Bearing Age (CBA) Women in Fiji 2010 Report, UNICEF, WHO, National Food & Nutrition Institute

Table 1: <Insert Table Caption>

NTD Reduction Pre and Post Fortification: 20 Studies in 12 Countries					
Country	Study	Prefortification NTD/10,000	Postfortification NTD/10,000	Difference from pre to postfort	% Reduction in NTD Prevalence
Argentina	Calvo 2008	321	176	145	45%
Brazil	Silva 2009	7.2	5.1	2.1	29%
Chile	Castilla 2003	24.2	14	10.2	42%
Chile	Cortes 2012	17.1	8.6	8.5	50%
Costa Rica	Tacsan 2004	9.7	6.3	3.4	35%
Costa Rica	Arguello 2011	11.97	7.32	4.65	39%
Peru	Sanabria 2013	13.6	8.7	4.9	36%
Canada	De Wals 2007	15.8	8.6	7.2	46%
Canada (Alberta)	Botto 2006	9.65	6.81	2.84	29%
Canada (Newfoundland)	Liu 2004	43.6	9.6	34	78%
Canada (Nova Scotia)	Persad 2002	25.8	11.7	14.1	55%
Canada (Ontario)	Ray 2002	11.3	5.8	5.5	49%
Canada (Ontario)	Gucciardi 2002	10.3	5.3	5	49%
Canada (Quebec)	De Wals 2003	18.9	12.8	6.1	32%
Iran	Abdollahi 2011	31.6	21.9	9.7	31%
Jordan	Amarin 2010	18.5	10.7	7.8	42%
Saudi Arabia	Safdar 2007	19	7.6	11.4	60%
South Africa	Sayed 2008	14.1	9.8	4.3	30%
USA	Honein 2001	3.78	3.05	0.73	19%
USA (Atlanta)	Botto 2006	11.53	7.5	4.03	35%
USA (Texas)	Botto 2006	9.13	7.07	2.06	23%
Average Reduction					41%

However, due to challenges in gathering NTD incidence data in Pakistan, the project RTAG recommended changing this target from NTD incidence to prevalence of folic acid deficiency (as measured by serum folate). RTAG experts set a similar target of 30% reduction in serum folic acid deficiency (<3.0 ng/ml) among women of reproductive age. The global literature review supplied by the Food Fortification Initiative included 3 results for changes in serum folate prevalence for women of reproductive age, including separate reports for urban and rural populations in Costa Rica. As shown in the table below, an average of these 3 data points suggests an 83% reduction in prevalence of low serum folate among adult female consumers of fortified flour. This suggests that the 30% target improvement selected by RTAG may be overly cautious and the target selected the 83% target is proposed.

Prevalence of Low Serum Folate found in 3 Studies					
Country	Study	Prefortification %	Postfortification %	Difference %	% Reduction in Prevalence
Chile	Hertrampf 2003	1.30%	-	(0.01)	100%
Costa Rica	Tacsan Chen 2004 (urban)	19%	2.50%	(0.17)	87%
Costa Rica	Tacsan Chen 2004 (rural)	31.40%	11.60%	(0.20)	63%
Average Decrease in Prevalence					83%

Reduction in Vitamin A Deficiency in Children

There are several efficacy trials showing potential effectiveness of vitamin A fortified oil or margarine.³⁶ However, there are no known national evaluations of cooking oil fortification programs with vitamin A.³⁷ The best and very recent evidence emerges from the Indonesian national oil fortification program, which undertook two effectiveness studies measuring impact of commercially fortified cooking oil on young children. A citywide study in Makassar found VAD reductions of 32%. A later and more extensive survey in 24 villages in West Java reported improvements among children in these villages ranging from 91% to 67% – no single impact figure was provided. Consequently the 3 data points, from these two trials, suggest improvements of 91%, 67% and 32% among children consuming fortified oil. In light of these findings, the original FFP target of 35% reduction in VAD may be overly conservative. FFP proposes the middle value of 67% as the effectiveness parameter for FFP oil fortification with vitamin A.

Impact of Vitamin A Fortified Palm Oil: 2 Effectiveness Trials in Indonesia			
	Range of Results in 24 Villages in West Java ³⁸		Makassar City Pilot Trial ³⁹
	Hi Range %	Low End %	%
Pre Fortification	6.50%	18%	26.9
Post Fortification	0.60%	6%	18.3
Point Reduction	5.90%	12.00%	8.6
Percent Reduction	91%	67%	32%

³⁶ Summarized in Bagriansky, J. & Ranum, P. Vitamin A fortification of PL480 vegetable oil. SUSTAIN, Washington, DC.

³⁷ Impact of margarine fortification in was carefully measured and Newfoundland, Canada was dramatic, but results are confounded as post fortification is within a few years of the end of World War II.

³⁸ Sanjdaya et al Vitamin A-fortified cooking oil reduces Vitamin A deficiency in infants, young children and women: Results from a programme evaluation in Indonesia , Public Health Nutrition - January 2015

³⁹ Soekirman et al Fortification of Indonesian unbranded vegetable oil, Food and Nutrition Bulletin, Vol 33 No 4 2012 United Nations University

