FOOD FORTIFICATION IN TAJIKISTAN

A COST-EFFECTIVE STRATEGY FOR SUSTAINABLE ECONOMIC GROWTH

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REPORT ON ANALYSIS OF ECONOMIC LOSSES DUE TO IRON & FOLIC ACID DEFICIENCIES IN TAJIKISTAN

FOOD FORTIFICATION AS A COST-EFFECTIVE STRATEGY FOR ECONOMIC GROWTH

Cost Benefit Analysis and Report by Kalimuddin Ghauri

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ABBREVIATIONS

ADB	Asian Development Bank
Capex	Capital Expenditure
CBA	Cost Benefit Analysis
DHS	Demographic and Health Survey
FAO	Food and Agriculture Organization
g/dL	Grams per deciliter
GAIN	Global Alliance for Improved Nutrition
GDP	Gross Domestic Product
Hb	Hemoglobin
Kg	Kilogram
IDA	Iron Deficiency Anemia
m	Million
MT	Metric ton
NPV	Net Present Value
NTD	Neural Tube Defects
PAR	Population Attributable Risk
RR	Relative Risk
SD	Standard Deviation
UN	United Nations
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USD	United States Dollars
WHO	World Health Organization

EXECUTIVE SUMMARY

Micronutrient malnutrition is a major public health problem in Tajikistan, with devastating, often lifelong consequences for the health, mental development, and productivity of its people, as well as the economic progress of the nation. Women and children are especially vulnerable. In addition to the serious implications of micronutrient malnutrition for the development and wellbeing of individuals, it is estimated that undernutrition in Tajikistan costs the economy millions of US dollars annually[1].

Children with micronutrient malnutrition are more susceptible to illnesses that prevent them from regularly attending school. They find it more difficult to learn, with deficits equivalent to a 2 to 3 year loss in education[2]. As adults, they are more likely to be overweight and in danger of contracting diseases such heart problems and diabetes[3]. They will earn as much as 22 per cent less as adults[4], causing challenges in raising and feeding their own families, perpetuating a cycle of poverty.

Micronutrient malnutrition costs lives, deepens poverty, and slows economic growth. Poor maternal and infant nutrition affects the well-being of communities and the economic performance of entire nations across generations[5]. Losses due to lower productivity, poor cognitive development, reduced schooling and the heavy burden on already stretched health care systems, hamper a nation's economic advancement through reductions of as much as 3 per cent in GDP[6].

There is growing international agreement that micronutrient malnutrition can be addressed through low-cost, high-impact interventions aimed at the first 'Thousand Days' of children's development: the period from pregnancy to age two. Making sure that children and women of reproductive age have the essential vitamins and minerals they need for life, learning and health can break the cycle of poverty in which they have been trapped, enriching their lives, their communities, and ultimately their nations.

Tackling the problem of micronutrient malnutrition is also one of the best investments a nation can make in its future. The Copenhagen Consensus, a group of economists who calculate the most cost-efficient ways of improving the lives of populations, has said that even in very poor countries and using very conservative assumptions, every dollar spent reducing chronic malnutrition has at least a USD30 payoff. The economists have also found that delivering micronutrients through fortification of food staples is a top public health priority. The cost benefit ratios are up to 30:1 for salt iodization, and 28:1 for flour fortification.

In Tajikistan, a cost-benefit analysis (CBA) on wheat flour fortification, the result of a workshop with the government and other stakeholders in March 2016, has established just how much micronutrient

[1] World Bank/UNICEF Situational Analysis: Improving economic outcomes by expanding nutrition programs in Tajikistan. Dushanbe, Tajikistan 2012.

[2] Hoddinott J, Maluccio JA, Behrman JR, Flores R, Martorell R. Effect of a nutrition intervention during early childhood on economic productivity in Guatemalan adults. Lancet. 2008;371:411–16. doi:10.1016/S0140- 6736(08)60205-6.

[3] Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, et al.; the Maternal and Child Nutrition Study Group. Maternal and child undernutrition and overweight in low-income and middle-income countries. Lancet 2013;371:243–60. doi:10.1016/S0140-6736(13)60937-X

[4] Victora C., et al. 2008. Maternal and Child Undernutrition: Consequences for Adult Health and Human Capital. The Lancet 2008 (Maternal and Child Undernutrition Series).

[5] Walker, S. P., T. D. Wachs, S. Grantham-McGregor, et al., 2011, "Inequality in early childhood: risk and protective factors for early child development," *The Lancet* - 8 October, 378(9799): 1325-1338.

[6] . Repositioning nutrition as central to development: a strategy for largescale action. Washington DC: The World Bank; 2006 (http://siteresources. worldbank.org/NUTRITION/Resources/281846-1131636806329/ NutritionStrategy.pdf, accessed 21 October 2014).

malnutrition is costing the nation's economy. Data from CBA show that **failing to tackle the problem will lead to economic losses of USD878 million over the next decade.**

Consequences of Vitamin and Mineral Deficiency	USD million
Neural tube defects	3.125
Neonatal deaths	61.935
Maternal Mortality	1.226
Iron Deficiency Anemia in children	394.507
Iron Deficiency Anemia in adults	417.154
Accumulated economic loss over 10 years	**877.947**

But the CBA also yielded good news. The CBA looked at the cost-effectiveness of **a single intervention**, wheat flour fortification, in addressing micronutrient malnutrition. Analysis revealed that over a ten-year period, a successful fortification program would reduce these losses by USD302 million.

Lastly, the CBA estimated the cost of such a ten-year wheat flour fortification program in Tajikistan at USD32 million, with the potential to generate nine times more benefit than cost. The minimal direct cost to the consumer would be just 0.79 per cent of the current average retail price of wheat flour in Tajikistan – an increase of 1.21 Somoni on a 50kg bag. Now, there is a clear economic case for moving forward to fortify flour in Tajikistan with essential micronutrients.

IRON AND FOLIC ACID DEFICIENCY IN TAJIKISTAN

Iron deficiency anemia is a major cause of maternal deaths and of cognitive deficits in young children. It can permanently affect school performance and has a negative impact on the economic well-being of individuals, families and national economies. In adults, anemia also affects productivity. In Tajikistan, anemia affects an estimated 24% of women of reproductive age and 28% of children under the age of five.[7] In 2014, according to the Agency of Statistics of Tajikistan anemia prevalence in pregnant women was 44.8% and in non-pregnant women was 24.2%, as per the Ministry of Health of Tajikistan, emphasizing the high rates of anemia across Tajikistan.

Folate is a vitamin that is essential for development of the brain, spinal cord and skull. Ensuring sufficient levels of folate in women prior to conception can reduce neural tube defects. An estimated 225 children in Tajikistan are born each year with neural tube defects like spina bifida[8].

Large-scale food fortification, the addition of small amounts of vitamins and minerals to staple foods and condiments, is one strategy for improving diet quality.

In Tajikistan, wheat flour is an ideal vehicle for fortification with iron and folic acid. Bread is consumed by most in Tajikistan, usually at every meal, with an estimated per capita consumption of 410 grams per

[7] *Micronutrient* status *survey* in *Tajikistan*, *2009*. Dushanbe, Republic of *Tajikistan*: Ministry of Health and *UNICEF*, 2010

[8] *Registry form 32*, Ministry of Health and Social Protection of Tajikistan, 2015.

day[9]. Earlier efforts to implement and sustain wheat flour fortification failed in 2007, but since 2014, GAIN, with financial support from USAID, has been working with the Government of Tajikistan to build an enabling environment for fortification. Prior to further adopting wheat flour fortification as an intervention to tackle micronutrient deficiencies, the Government of Tajikistan and other stakeholders requested that a robust analysis of flour fortification be conducted to determine its cost effectiveness in addressing iron and folic acid deficiencies.

To this end, on 10-11 March 2016, sixty-five representatives from the national government, international development partners and the flour milling industry, under the leadership of Mrs. Khayriniso Yusufi, Deputy Chairman of the Lower Chamber of the Parliament (Majlisi Namoyandagon of Majlisi Oliy) and Mrs. Saida Umarzoda, First Deputy Minister of Health and Social Protection of Population of the Republic of Tajikistan, attended a workshop titled *Cost Benefit Analysis of Flour Fortification in Tajikistan* in Dushanbe. The workshop was co-hosted by the United States Agency for International Development (USAID) and the Global Alliance for Improved Nutrition (GAIN).

Participants at the workshop applied scientific and economic methods to national health, demographic, labor and economic data, allowing them to quantify the health and economic losses of iron and folic acid deficiencies in Tajikistan.

METHODOLOGY

The Cost Benefit Analysis (CBA) has three major components: assumption data sets; a spreadsheet based model; and an analysis of results. Data sets were discussed in detail and agreed upon at the workshop and are attached as Appendix A. Participants at the workshop discussed and agreed upon the findings set out in this report.

Economic consequences are measured via four distinct pathways:

1. Mortality and disability in children and consequent forgone income from future employment;
2. Economic deficits due to poorer child cognition, inferior school performance and depressed future productivity;
3. Depressed productivity in working but anemic adults; and
4. Additional health care costs due to micronutrient malnutrition.

Monetizing health risks and deficits is based on a range of national demographic, labor and health statistics, as well as some key assumptions in cases where data is not available. The general algorithm (coefficients of loss) for projecting the magnitude of economic losses is set out in the diagram below.

[9] Consumption statistic agreed at workshop

GENERAL ALGORITHM FOR PROJECTION OF ECONOMIC LOSSES

Risk Group Population		Prevalence of Condition		Population with Deficit		Economically Active Population[10]		Average Annual Wage[11]		Coefficient Of Deficit or Loss		Lost Productive Activity
National statistics	X	% from Survey 2013	=	By Indicator and Risk Group	X	68% 77% Male 50% Female	X	USD 923 Per Year	X	% or RR (Relative Risk) From global literature	=	USD/year

Since deficits are applied only to individuals projected to be economically active, with Tajikistan's low employment rate, participation rate impacts of iron and folic acid deficiencies are not applied to about half of working age men and about three-quarters of females.

Childhood productivity deficits are not felt until children enter the workforce, as much as 15 years in the future, and earnings stretch out for another 40-50 years. Therefore, a Net Present Value (NPV) of future economic losses is calculated based on a 2.5% discount rate to account for the time the child is not in the workforce.

Converting indicators of malnutrition to economic activity and attaching a monetary value to that economic activity involves many factors beyond simply human potential and performance. Workplace incentives, technology and opportunity all affect how increased potential translates into actual improved productivity and earnings. Additionally, the effects of iron and folic acid deficiency extend beyond the workplace to a range of activities, including parenting, household work, education, entrepreneurial pursuits and community participation.

ECONOMIC IMPACTS OF ANEMIA AND FOLIC ACID DEFICIENCY

ANEMIA IN CHILDREN

Data confirmed by Tajikistan's Ministry of Health and Social Protection during the workshop show that some 60% of children under 5 years of age suffer from iron deficiency. A range of evidence links iron status in children to cognitive development and future productivity deficits as adults. A *Journal of Nutrition* review documents the positive impact of iron intervention on cognitive scores, ranging from 0.5 to 1 Standard Deviation (SD) and concludes that "available evidence satisfies all of the conditions needed to conclude that iron deficiency causes cognitive deficits and developmental delays."[12]

A recent review of child psychology, nutrition and economic knowledge concluded that developmental problems related to iron status in children under 5 years is associated with a 4% reduction in lifetime earnings.[13] This led us to correct the 4% deficit by a factor of 0.62 to arrive at a 2.5% decrease in

[10] Labor Force
[11] IBID
[12] Haas, J. and Brownlie T., Iron Deficiency and Reduced Work Capacity: A Critical Review of the Research *Journal of Nutrition.* 2001;131
[13] Horton & Ross The Economics of Iron Deficiency Food Policy 28 (2003) 51–75

lifetime earnings for children under five who are iron deficient.[14] Our estimates are based on a 39-year work life, with a 2.5% discount rate to account for the time the child is not in the workforce.

ANNUAL NPV OF FUTURE EARNINGS LOSS FROM IDA IN CHILDREN

Children w/ IDA		Average Annual Wage		Labor Force Participation Rate		Coefficient of Loss		NPV for 39 years earnings after 12.5 year delay[15]		NPV economic loss (12.5 years to workforce entry)
0.730 million	X	USD1000	X	68%	X	2.5%	X	2.5%	=	NPV USD38.571m

At this current anemia prevalence, more than 0.730 million children in Tajikistan under 5 years of age will not live up to their full cognitive potential, will perform less well in school and will suffer associated earnings deficits as adults. Even with modest 2.5% productivity deficits estimated at USD923 per child per year, this accumulated loss will have a significant impact on national GDP. The NPV of Tajikistan's lost earnings totals USD38.57 million per year. Adding an annual birth growth rate of 0.5%, increases that figure to about USD 395 million over a 10-year period.

ANEMIA IN ADULT WORKERS

Weakness, fatigue and lethargy brought on by anemia in adults result in measurable productivity losses across the manual labor sector, including agriculture, manufacturing, construction, mining and defense. There is substantial documented evidence demonstrating the negative impact of anemia on indicators of work performance.

The table below summarizes the projection for an annual productivity deficit of almost USD38.271 million. Separate calculations for male and female workers have been made in order to account for significant variances in anemia prevalence, wage levels and labor participation. Productivity deficits are applied only to those engaged in manual labor where aerobic capacity, endurance and strength play a role in work performance. While doubtless anemia has consequences in non-manual "white collar jobs", the 10% work deficit is not applied to education and social sectors where women represent a significant share of the workforce.

ANNUAL ECONOMIC LOSSES IN ADULT MANUAL LABOR AS A CONSEQUENCE OF IDA

IDA prevalence Adults 15-65		**Manual labor wage**		**10% Manual Labor Deficit**		**12% Loss Heavy Labor[16]**		**Annual Loss**
Women: 19.9%x1.333m	X	USD562/yr	X	USD14.916	+		=	USD30.816m/yr
Men: 10.7%x1.986m		USD750/yr		USD15.900		2.680		
Women: 19.9%x0.199m		USD562/yr				4.770		USD7.455m/yr

[14] Horton & Ross The Economics of Iron Deficiency Food Policy 28 (2003) 51–75

[15] Average number of years before entering workforce

[16] Estimated at 12% (From Horton et al 2003)

PERINATAL AND MATERNAL MORTALITY DUE TO MOTHER'S ANEMIA

During pregnancy, iron requirements increase significantly and the risk of anemia rises in parallel, threatening the health and survival of mother and child. Tajikistan's Ministry of Health and Social Protection rates the prevalence of maternal iron deficiency anemia at 25.9%. A recent meta-analysis with WHO Global Burden of Disease estimates suggest that perinatal mortality decreases by 16% for each 1 gram per deciliter (1g/dL) increase in hemoglobin, with a relative risk of 0.84.[17] Based on IDA prevalence of 25.9% and over-all anemia rate of 51.2%, mean hemoglobin is calculated at 12.08 grams per deciliter and mean hemoglobin in the absence of iron deficiency, is projected at 12.92 grams per deciliter.[18]

ANNUAL MATERNAL DEATHS DUE TO ANEMIA

Calculated Deficit in Mean Hb	X	Relative Risk Mortality	=	Population Attributable Risk	X	Annual Maternal Deaths (live births x MMR)	=	Annual Maternal Deaths
0.85 g/dL		0.75		22%		64		14

While the loss is immeasurable, in economic terms these 14 annual deaths simply represent the NPV of a lost future workforce, valued at about USD0.119 million/yr.

ESTIMATE FOR NPV OF LOST WAGES DUE TO MATERNAL DEATH

Attributed Deaths	X	Average Annual Wage(All Sectors)	X	Labor Participation Rate	X	Average Years in Workforce	X	Discount Rate for NPV[19]	=	Lost Productive Activity
14		USD750/yr		50%		43		2.5%		USD0.119 million

Due to a 25.9% prevalence of IDA in pregnant women (as per Ministry of Health, Tajikistan) and a relative mortality risk of mortality 1.45, the population attributable to risk is 10.4%. As per national statistics the annual deaths of infants of less than 1 month of age is 4,030 (as per Ministry of Health, Tajikistan). Accordingly, the estimate of number of child deaths attributed to IDA in mothers is 420.

[17] Stoltzfus R, Mullany, L, Black R. Iron Deficiency Anaemia, in Global Burden of Disease, WHO 2004
[18] Presuming normal Hb distribution from Stoltzfus above.
[19] After 15 years delay

PROJECTION OF PERINATAL DEATHS DUE TO MOTHERS' IDA

Prevalence of IDA in pregnant women	X	Decreased Relative Risk Mortality	=	Population Attributable Risk	X	Annual Deaths of infants<1month	=	Number of Child Deaths Attributed to IDA in Mother
26%		1.45		**10.4%**		4030		420

Presuming 30 years of age is the average age of maternal death,[20] suggesting 22 years of additional work lost, we estimate an NPV of average USD6.055 million.

ESTIMATE OF LOST WAGES DUE TO PERINATAL DEATH

Attributed Deaths	X	Average Annual Wage	X	Labor Participation Rate	X	Average Years in Workforce	X	Discount Rate For NPV	=	NPV Lost Productive Activity[21]
420		USD1,538/ year		68%		43		2.5%		USD6.055 million /year

FOLIC ACID-RELATED NEURAL BIRTH DEFECTS

Neural Tube Defects (NTDs), spina bifida and anencephaly, are a significant cause of death and disability throughout the world. With no nationally representative figures available for the incidence of spina bifida and anencephaly in Tajikistan, we used The March of Dimes Global Report which estimates almost eleven thousand cases annually – a rate of 2/1,000 births, about the global average.[22] For the sake of analysis we make the conservative assumptions: that the annual NTD rate per 1000 births is 0.20 out of which around 85% are Folic Acid Associated/Preventable NTDs. Accordingly, if we apply this assumption to total births of 212,000 annual births, the approximate annual folic acid associated NTDs are in the range of 32.

PROJECTED NTD-ASSOCIATED MORTALITY

Annual Births	X	Average Annual NTD Rate/1000 Births x Folic Acid Associated/Preventable NTDs	=	Projected Annual Folic Acid Associated NTDs	X	Assumed Mortality Rate	=	Total Projected Folic Acid Associated Deaths from NTDs
0.21 million		0.20x85%=0.17		36		90%		32

Application of our insufficient methodology, significantly undervaluing human life, projects NPV of lost wages at USD0.525 million annually.

[20] Based on scan of DHS 2007
[21] Assuming 15 years to workforce entry
[22] March of Dimes Global Report on Birth Defects, Appendix B, 2011

PROJECTION OF ECONOMIC LOSSES FROM NDT MORTALITY

Attributed Deaths		Average Annual Wage		Labor Participation Rate		Average Years in Workforce		Discount Rate For NPV after 15 years delay	=	NPV of Annual Economic Loss[23]
32	x	USD1000/ yr	x	68%	x	43	x	2.5%	=	USD260 million/yr

PROJECTION OF NPV OF LOST PRODUCTIVITY DUE TO NTD CASES

Number of Survivors		Average Annual Wage		Labor Participation Rate		Average Years in Workforce		Discount Rate For NPV after 15 years delay	=	NPV of Annual Lost Productivity[24]
Severe Disability 1	x	USD1000/yr	x	68%	x	43	x	2.5%	=	100% Productivity Loss USD0.004m/yr
Moderate Disability 2	x	USD1000/yr	x	68%	x	43	x	2.5%	=	50% Productivity Loss USD0.009m/yr

The Projected Annual 32 folic acid associated NTDs face a lifetime of moderate or severe disability. Infants born with NTDs require surgery at birth and will require specialist care throughout life. The associated lost productivity and health care costs are estimated very roughly as follows:

- Presuming appropriate level of facilities are available in 1/5 of birth cases and the cost of surgery is USD6,500 this suggests about USD23,436 costs to the health system – both public and private.
- USD2,500 per year for rehabilitation and medicines along with USD2,100 estimated Annual Cost per Case of Ongoing Rehabilitation and Care for individuals with Moderately Disabled NTDs.

SUMMARY OF ANNUAL NATIONAL ECONOMIC LOSSES

Based on the analysis above, the best available global evidence applied to national health, labor and demographic data suggests depressed national economic activity of nearly 878 million dollars over a ten year period which could be attributed to current rates of IDA and folic acid related NTDs.

[23] Assuming 15 years to workforce entry
[24] Assuming 15 years to workforce entry

SUMMARY ECONOMIC CONSEQUENCES FOR ALL INDICATORS

Year	Baseline Loss	Country GDP	Loss as % of GDP
	USD Millions		
2017	83	9,242	0.90%
2018	84	9,519	0.89%
2019	85	9,805	0.87%
2020	86	10,099	0.85%
2021	87	10,402	0.84%
2022	88	10,714	0.82%
2023	89	11,035	0.81%
2024	90	11,366	0.79%
2025	91	11,707	0.78%
2026	92	12,059	0.77%
Total	**878**		

COST OF LARGE SCALE WHEAT FLOUR FORTIFICATION

This calculation only covers the costs associated with fortification of wheat flour produced by flour mills in Tajikistan. The recent supply chain study by GAIN in Tajikistan has been used as a basis. Three types costs are covered: Premix, Industry and Government. Although, as part of the current Wheat Flour Fortification Program the cost of fortification will be passed on to the consumers but for this analysis this cost has been used for cost benefit analysis as opportunity cost to do fortification. For a national level program other cost recovery or subsidy strategies could be used but the costs attributable to fortification will remain the same. The tables below present costs of fortification clustered by premix cost, industry cost and government costs along with related assumptions:

COST OF LARGE SCALE WHEAT FLOUR FORTIFICATION OVER A 10-YEAR PERIOD

Year	Premix Cost	Industrial Cost	Government Cost	Total	Total USD millions
	USD millions				
2017	886,017	1,891,913	1,860,000	4,637,929	4.638
2018	1,127,111	337,146	60,000	1,524,256	1.524
2019	1,393,981	358,913	260,000	2,012,894	2.013
2020	1,688,855	382,333	1,660,000	3,731,188	3.731
2021	2,014,134	407,534	260,000	2,681,668	2.682
2022	2,253,788	428,721	210,000	2,892,509	2.893
2023	2,389,223	444,974	1,860,000	4,694,196	4.694
2024	2,532,796	461,918	60,000	3,054,714	3.055
2025	2,684,996	479,586	260,000	3,424,583	3.425
2026	2,846,343	498,014	60,000	3,404,357	3.404
	19,817,244	**5,691,051**	**6,550,000**	**32,058,294**	**32.058**

PREMIX COST

Total Population (1)	Consumption kg/yr (2)	% Population Consuming Flour (3)	% Flour Fortified (4)	Target/Scale Fortified Production MT/yr (5)	Cost of Premix USD million

	A	B	C	D	E	
2017	5,744,158	150	94.0	50	404,963	0.886
2018	5,853,297	151	94.5	60	500,153	1.127
2019	5,964,510	152	94.9	70	600,560	1.394
2020	6,077,836	152	95.4	80	706,406	1.689
2021	6,193,314	153	95.9	90	817,925	2.014
2022	6,310,987	154	96.4	95	888,588	2.254
2023	6,430,896	155	96.9	95	914,549	2.389
2024	6,553,083	155	97.3	95	941,268	2.533
2025	6,677,592	156	97.8	95	968,768	2.685
2026	6,804,466	157	98.3	95	997,071	2.846
					7,740,250	**19.817**

1. Population projected as per latest current population figures using population growth rate and proportion of two type of Wheat flour Premium and 1st Grade since only these two are required to be fortified.

2. Per capita consumption of wheat flour and wheat flour products.

3. As per FAO data project by a standard increase per year. Annual Wheat Flour Consumption as compared to other food items is assumed at 0.5% per annum.

4. Assumed for progressional effectiveness of the program.

5. A*B*C*D = E

INDUSTRIAL COST

	Equipment - Capex (1)	Equipment Maintenance (2)	Operational Costs (3)	Total	Total USD million
2017	1,575,000	272,612	44,301	1,891,913	1.892
2018	-	280,790	56,356	337,146	0.337
2019	-	289,214	69,699	358,913	0.359
2020	-	297,890	84,443	382,333	0.382
2021	-	306,827	100,707	407,534	0.408
2022	-	316,032	112,689	428,721	0.429
2023	-	325,513	119,461	444,974	0.445
2024	-	335,278	126,640	461,918	0.462
2025	-	345,336	134,250	479,586	0.480
2026	-	355,697	142,317	498,014	0.498
	1,575,000	**3,125,188**	**990,862**	**5,691,051**	**5.691**

1. Includes costs associated to microfeeders for 50 flour mills and establishment of 5 new labs for quality assurance.

2. Includes costs associated to Process Labor, maintenance of equipment and quality assurance spot testing.

3. Other operational cost at 5% of the premix cost.

GOVERNMENT COST

	Ongoing Food Control (1)	Additional Monitoring (2)	One time start-up cost (3)	Total	Total USD billion
2017	60,000	200,000	1,600,000	1,860,000	1.860
2018	60,000	-	-	60,000	0.060
2019	60,000	200,000	-	260,000	0.260
2020	60,000	-	1,600,000	1,660,000	1.660
2021	60,000	200,000	-	260,000	0.260
2022	60,000	150,000	-	210,000	0.210
2023	60,000	200,000	1,600,000	1,860,000	1.860
2024	60,000	-	-	60,000	0.060
2025	60,000	200,000	-	260,000	0.260
2026	60,000	-	-	60,000	0.060
	600,000	**1,150,000**	**4,800,000**	**6,550,000**	**6.550**

1. This mainly represent the costs associated to in total 50 inspections by government officials to flour mills. 2 inspections per year at each flour mill. Further, this also includes cost of laboratory tests per inspection.

2. Project costs associated with external backstopping engagements.

3. This represents one time capacity building and social advocacy costs for related government officials.

PROJECTING THE BENEFITS OF FORTIFICATION

Large scale wheat flour fortification could generate material economic value through the reduction in economic loss due to malnutrition to the extent of $878 million over a period of ten years. For the purpose of calculating economic benefit, the coverage has been used as the fortification of flour produced by flour mills in Tajikistan and the effectiveness of this intervention in the context of five areas of economic loss from international studies. This benefit analysis is only for a wheat flour fortification-related intervention.

SUMMARY CALCULATIONS OF INTERVENTION BENEFITS

	Neo Natal	Maternal Mortality	NTD	IDA Kids	IDA Adults	Total	Coverage (1)
2017	6.055	0.120	0.306	38.571	38.272	83.324	47%
2018	6.086	0.120	0.307	38.764	38.999	84.276	57%
2019	6.116	0.121	0.309	38.958	39.740	85.244	66%
2020	6.147	0.122	0.310	39.153	40.495	86.226	76%
2021	6.177	0.122	0.312	39.348	41.264	87.224	86%
2022	6.208	0.123	0.313	39.545	42.048	88.238	92%
2023	6.239	0.123	0.315	39.743	42.847	89.268	92%
2024	6.271	0.124	0.316	39.942	43.661	90.314	92%
2025	6.302	0.125	0.318	40.141	44.491	91.377	93%
2026	6.333	0.125	0.320	40.342	45.336	92.457	93%
Total	61.935	1.226	3.125	394.507	417.154	877.947	

Effectiveness (2)	15%	15%	70%	40%	50%

2015	0.427	0.008	0.101	7.251	8.994	16.781
2016	0.517	0.010	0.122	8.789	11.053	20.491
2017	0.610	0.012	0.144	10.357	13.205	24.327
2018	0.704	0.014	0.166	11.955	15.456	28.294
2019	0.800	0.016	0.188	13.584	17.807	32.394
2020	0.853	0.017	0.201	14.482	19.249	34.801
2021	0.861	0.017	0.203	14.627	19.712	35.421
2022	0.870	0.017	0.205	14.774	20.187	36.053
2023	0.879	0.017	0.207	14.922	20.674	36.699
2024	0.887	0.018	0.209	15.072	21.172	37.358
Total	**7.407**	**0.147**	**1.744**	**125.813**	**167.509**	**302.619**

1. As per level of fortification stipulated as part of Wheat Flour fortification intervention.
2. As per international studies.

COST AND BENEFIT RATIO FOR FLOUR FORTIFICATION

A CBA for a large-scale food fortification program which is presented below. By spending $32 million over a ten year period, economic benefits equal to $302 million could be generated, 9.44 times the costs expected to be incurred in the *implementation of a large scale wheat flour fortification program in Tajikistan.*

Years	Cost	Benefit	Cost Benefit Ratio
	in USD millions		
2017	$4.64	$16.78	3.62
2018	$1.52	$20.49	13.44
2019	$2.01	$24.33	12.09
2020	$3.73	$28.29	7.58
2021	$2.68	$32.39	12.08
2022	$2.89	$34.80	12.03
2023	$4.69	$35.42	7.55
2024	$3.05	$36.05	11.80
2025	$3.42	$36.70	10.72
2026	$3.40	$37.36	10.97
	$32.06	**$302.62**	**9.44**

RETAIL PRICE IMPACT OF WHEAT FLOUR FORTIFICATION

The CBA shows that the overall percentage of marginal fortification cost of current average retail price of wheat flour is 0.79%. Accordingly, we are looking at a potential increase of 1.21 Somoni on 50kg bag or 24.32 Somoni in 1MT of wheat flour based on current average current retail price of wheat flour. It is apparent from the analysis that the impact of cost of fortification on the end user retail price is minimal.

Current average per kg price of Wheat Flour in USD	**0.4000**
Current average per kg price of Wheat Flour in Tajik Somoni	**3.0800**
Projected average per kg price of Fortified Wheat Flour in USD	**0.4032**
Projected average per kg price of Fortified Wheat Flour in Tajik Somoni	**3.104**

	Premix Cost	Industrial Cost - Recurring	Industrial Cost - Capital Cost Allocated	Industrial Cost - Total	Total	Expected Production of Fortified Wheat Flour (MT)
			$			
2015	886,017	272,612	157,500	430,112	1,316,128	404,963
2016	1,127,111	280,790	157,500	438,290	1,565,401	500,153
2017	1,393,981	289,214	157,500	446,714	1,840,695	600,560
2018	1,688,855	297,890	157,500	455,390	2,144,245	706,406
2019	2,014,134	306,827	157,500	464,327	2,478,461	817,925
2020	2,253,788	316,032	157,500	473,532	2,727,320	888,588
2021	2,389,223	325,513	157,500	483,013	2,872,235	914,549
2022	2,532,796	335,278	157,500	492,778	3,025,574	941,268
2023	2,684,996	345,336	157,500	502,836	3,187,833	968,768
2024	2,846,343	355,697	157,500	513,197	3,359,539	997,071
	19,817,244	3,125,188	1,575,000	4,700,188	24,517,432	7,740,250

	Fortification Cost Per MT	Fortification Cost Per KG	% of Current Retail Price
	$	$	$
2015	3.25	0.0032	0.81%
2016	3.13	0.0031	0.78%
2017	3.06	0.0031	0.77%
2018	3.04	0.0030	0.76%
2019	3.03	0.0030	0.76%
2020	3.07	0.0031	0.77%
2021	3.14	0.0031	0.79%
2022	3.21	0.0032	0.80%
2023	3.29	0.0033	0.82%
2024	3.37	0.0034	0.84%
	Overall Average		0.79%

	USD
Current average per kg price of Wheat Flour in USD	**0.4000**
Projected average per kg price of Fortified Wheat Flour in USD	**0.4032**
Fortification Cost Per 50 kg bag in Tajik Somoni	**1.216**
Fortification Cost per MT in Tajik Somoni	**24.328**

CONCLUSION

Among all stakeholders there is consensus on the fact that micronutrient malnutrition costs lives, deepens poverty, and slows economic growth. Accordingly, it is a potential hindrance to the sustainable economic growth of any country.

Following the workshop and the CBA, we know that failing to tackle the problem of micronutrient malnutrition will lead to economic losses of USD 878 million over the next decade. We know that over a ten-year period, one single intervention, a successful wheat flour fortification program, would reduce these losses by USD 302 million. We also know that the cost of this fortification program is USD 32 million, with the potential to generate nine times more benefit than cost.

Now, there is a clear economic case for moving forward to fortify flour in Tajikistan with essential micronutrients. It is a common myth that cost of fortification is the key hurdle in sustainability of food fortification. Through this analysis it is proven that cost of fortification as compared to current retail price of wheat flour in Tajikistan is insignificant and it could easily be absorbed in the retail price of final fortified product under good price control process.

Beyond that, this wheat flour fortification program can be the cornerstone upon which other nutrition interventions can be built, with positive consequences for the health and wealth of the people of Tajikistan and the future of its children.

ANNEX A: LIST OF DATA SETS

Data Class 1	Data Title	Value Set	Values[25]
Demographic / Health	Total Population	No.	8,837,167
Demographic / Health	Proportion of Male	%	52%
Demographic / Health	Proportion of Female	%	48%
Demographic / Health	Population Working Age Adults 15-65	No.	5,777,065
Demographic / Health	Population Working Age Male Adults 15-65	No.	2,866,878
Demographic / Health	Population Working Age Female Adults 15-65	No.	2,962,254
Demographic / Health	Population Children < 15 years	No.	2,838,713
Demographic / Health	Population Children < 5 years	No.	1,216,803
Demographic / Health	Birth Rate	No. per 1000	24
Demographic / Health	Annual Population Growth	%	1.90%
Demographic / Health	Annual Birth Rate Growth	%	0.50%
Demographic / Health	Under 5 Mortality/1000	No. per 1000	39
Demographic / Health	Infant Mortality/1000	No. per 1000	29
Demographic / Health	Neonatal < 1 month/1000	No. per 1000	19
Demographic / Health	Maternal Mortality/100000	No. per 100,000	30
Demographic / Health	Estimated ID in Children 6-59 months	%	60.0%
Demographic / Health	Anemia in Pregnant Women	%	48.0%
Demographic / Health	IDA in Pregnant Women	%	25.9%
Demographic / Health	Anemia Adult Women	%	24.2%
Demographic / Health	IDA Adult Women	%	19.9%
Demographic / Health	Anemia Adult Men	%	28%
Economics	Start year of Model	Year	2017
Demographic / Health	Adult Labor Participation Rate (Male and Female Combined)	%	68.0%
Demographic / Health	Adult Male Labor Participation Rate	%	77.0%
Demographic / Health	Adult Female Labor Participation rate	%	50.0%
Demographic / Health	Healthy Life Expectancy	Age in years	61
Demographic / Health	Healthy Life Expectancy, Male	Age in years	63
Demographic / Health	Healthy Life Expectancy, Female	Age in years	58
Demographic / Health	Average Maternal Age at Birth of First Child	Age in years	23
Demographic / Health	Age at Work Force Entry		18
Economics	GDP (current US$)	USD	$9,242,000,000
Economics	Individual Wage/Labor Share GDP	%	60%
Economics	Per Capita Manual Wage as % Average Wages	%	75%
Economics	Female Manual Wage as % Male Manual Wage	%	75%
Economics	Discount Rate	%	2.50%
Demographic / Health	Relative Risk of Neonatal Death Due IDA in Mother		1.45
Demographic / Health	Average Annual NTD Rate/1000 Births	No. / 1000	0.20
Demographic / Health	Folic Acid Associated/Preventable NTDs	%	85%
Demographic / Health	Proportion of Survivors with Severe Disability	%	33%
Demographic / Health	Proportion of Survivors with Moderate Disability	%	67%
Demographic / Health	% Births with Access to Special Care or Pediatric Surgery for NTD Cases	%	10%
Demographic / Health	Estimate of Cost per Case for Pediatric Surgery for NTD Cases	$	$6,500
Demographic / Health	Estimated Annual Cost per Case of Ongoing Rehabilitation and Care for Severely Disabled	$	$3,500
Demographic / Health	Estimated Annual Cost per Case of Ongoing Rehabilitation and Care for Moderately Disabled	$	$2,100
Demographic / Health	Annual Social Security, Welfare or Other Special Programs	$	$500
Demographic / Health	RR of Maternal Mortality Associated with a 1 g/dL Increase in		0.75

[25] Agreed during the workshop

	Hemoglobin:		
Demographic / Health	Reduction in Future Productivity in All Sectors due to Anemia	%	**2.50%**
Cost of Fortification	Feeders and Start-Up	Total units	**50**
Cost of Fortification	Cost per unit of Microfeeder	$	**$10,000**
Cost of Fortification	Feeders for Expansion into Private Sector	$	**$3,500**
Cost of Fortification	Installation and Training	Per Unit $	**$1,500**
Cost of Fortification	Lab and Other Capital Improvement Costs	No. Units	**5**
Cost of Fortification	Lab and Other Capital Improvement Costs per unit cost	$	**$300,000**
Cost of Fortification	Per Capita Consumption in kg/yr Among Consumers	Kgs	**150.0**
Cost of Fortification	Current Percent Population Consuming Flour	%	**94%**
Cost of Fortification	Growth Population Rate	%	**1.9%**
Cost of Fortification	Growth in Population of Consumers	%	**0.5%**
Cost of Fortification	Growth in Average per Person Flour Consumption	%	**0.5%**
Cost of Fortification	Proportion of Consumption of Wheat Flour - Premium	%	**10%**
Cost of Fortification	Proportion of Consumption of Wheat Flour - 1st Grade	%	**55%**
Cost of Fortification	Proportion of Consumption of Wheat Flour - 2nd Grade	%	**35%**
Cost of Fortification	Training Food Control Agency	$ for 3 years	**$300,000**
Cost of Fortification	Training Program Monitors	$ for 3 years	**$300,000**
Cost of Fortification	Advocacy/Social Marketing	$ for 3 years	**$500,000**
Cost of Fortification	Boarder Control Monitoring	$ for 3 years	**$250,000**
Cost of Fortification	Capital Improvement	$ for 3 years	**$250,000**
Cost of Fortification	Inspections/Yr	No. of inspections per year	**2**
Cost of Fortification	Estimated Total Cost/Inspection	$	**$500**
Cost of Fortification	Lab Costs/Inspection-per Sample	$	**$50**
Cost of Fortification	Lump Sum Bi Annual	$	**$200,000**

ANNEX B: PARTICIPANT LIST

Name	Title and Organization
Khayriniso Yusufi	Deputy Chairman of Majlisi Namoyandagon of Majlisi Oliy of the Republic of Tajikistan
Hilobi Jumakhon Qurbonzoda	Chairman of the Committee on Social Affairs, Family and Health Care, Majlisi Namoyandagon of Majlisi Oliy of the Republic of Tajikistan
Gulbakhor Sangilloevna Ashurova	Member of the Committee on Social Affairs, Family and Health Care, Majlisi Namoyandagon of Majlisi Oliy of the Republic of Tajikistan
Jamshed Saidalievich Murtazoqulov	Member of the Committee on Science, Education, Culture and Youth Policy, Majlisi Namoyandagon of Majlisi Oliy of the Republic of Tajikistan
Saida Ghayrat Umarzoda	First Deputy Minister of Health and Social Protection of the Population of the Republic of Tajikistan
Emin Numon Sanginzoda	First Deputy Minister of Labor, Migration and Employment of the Republic of Tajikistan
Jamshed Nurmuhammadzod	Deputy Minister of Finance of the Republic of Tajikistan
Saidova Jamilya	Deputy Minister of Agriculture of the Republic of Tajikistan
Ruzizoda Akram Hamroqul	Deputy Minister of Industry and New Technologies of the Republic of Tajikistan
Ismonov Fathiddin Badriddinovich	Deputy Minister of Education and Science of the Republic of Tajikistan
Gulnora Hasanzoda	Director of the State Statistical Agency under the President of the Republic of Tajikistan
Marhabo Olimiy	First Deputy Head of Committee on Women Affairs and Family under the Government of Tajikistan
Mavsuma Muini	First Deputy Head of Committee on Youth Affairs, Sports and Tourism under the Government of Tajikistan
Karomat Nazarovna Saidova	Deputy Director, The Agency on Standardization, Metrology, Accreditation, Certification and Trade Inspection under the Government of Tajikistan
Nurmahmad Ato Ahmadzoda	Director of the State Agency on Material Reserves under the Government of Tajikistan
Malikov Tavakkal Saidovich	Head of Office for Development of Social Sector, Ministry Economic Development and Trade of the Republic of Tajikistan
Sherali Rahmatulloevich Rahmatulloev	Head of Maternity and Children Healthcare Services, Ministry of Health and Social Protection of Population
Munira Ganieva	Director of the National Reproductive Health Center, Ministry of Health and Social Protection of Population
Parvina Shavkatovna Mukhtorova	Director of the National Healthy Life Style Center, Ministry of Health and Social Protection of Population
Hotambek Khayrov	Director of the National Center for Nutrition, Ministry of Health and Social Protection of Population
Hikmat Hisorievich Hisoriev	Director of the Biological Institute on Food Fortification, National Academy of Science of the Republic of Tajikistan
Ibrohim Sharipovich Gulov	Deputy Head of Tojikmatlubot (Consumer's Cooperation)
Fayzigul Rahimova	Director of the National Center for Nutrition «Ghizo», Ministry of Industry of New Technologies
Zulfiya Kholovna Barotova	Senior Specialist of the Management Office of the Lower House of Parliament of the Republic of Tajikistan
Abdusalom Vokhidov	Deputy Director of the National Center for Pediatrics and Pediatric Surgery
Tagoymurod Sharipov	Director, State Unitary Enterprise «Ghalla»

Kathleen McDonald	Mission Director, USAID Central Asia Region (CAR)/ Tajikistan
Malika Makhkambaeva	Project Management Specialist/Health, USAID CAR/ Tajikistan
Aziza Nabijonovna Homidova	The United Nations Populations Fund (UNFPA) Assistant Representative for Tajikistan
Yuki Suehiro	Chief, Health and Nutrition, The United Nations Children Fund (UNICEF) Tajikistan
Safina Abdulloeva	Nutrition Officer, The United Nations Children Fund (UNICEF) Tajikistan
Igor Pokanevych	The World Health Organization (WHO) Representative and Head of Country Office in Tajikistan
Khadija Boymatova	National Professional Officer Nutrition and Food Safety, World Health Organization (WHO) in Tajikistan
Andrea Berardo	Head of Programme, World Food Programme (WFP) in Tajikistan
Azam Bahorov	Resource Manager, World Food Programme (WFP) in Tajikistan
Manzura Mirsaidova	Team Leader, Health in Central Asia/ Tajikistan, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Halima Boboeva	Project Officer, Health in Central Asia/ Tajikistan, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Manuchehr Baqoev	Sector Coordinator, Health & Social Sector, Climate Change, KfW Development Bank
Laylo Qurbonmamadova	Health Programme Manager, Agha Khan Foundation Tajikistan
Akoyat Nazrishoeva	Aga Khan Health Services (AKHS)
Mizrob Amirbekov	Mountain Societies Development Support Programme (MSDSP)
Elizabeth Fisher	Chief of Party, USAID Health and Nutrition Activity Project
Alfiya Rofieva	Representative of Tajikistan Chamber of Commerce and Industry
Rustam Shoev	Milling company «Zernovaya Kompaniya»
Alisher Umarov	Milling company «MK Barakat»
Mansurjon Umarov	Milling company «MK Barakat»
Shamil Tazhibayev	Vice-President, Kazakh Academy of Nutrition
Evegeniy Gan	President of the Association of Grain Processors, Kazakhstan
Aleksandra Zhestovskaya	Assistant to the President of Association of Grain Processors, Kazakhstan
Binusrat Sharipova	Local Consultant, Global Alliance for Improved Nutrition (GAIN)
Shuhrat Kalandarov	Local Consultant, Global Alliance for Improved Nutrition (GAIN)
Kalim Ghauri	International Consultant, Global Alliance for Improved Nutrition (GAIN)
Quentin Johnson	International Consultant, Global Alliance for Improved Nutrition (GAIN)
Frantisek Horn	Board Member, International Federation of Spina Bifida and Hydrocephaly (GAIN)
Dora Panagides	Senior Manager, Large-Scale Food Fortification, Global Alliance for Improved Nutrition (GAIN)
Caroline Manus	Junior Associate, Global Alliance for Improved Nutrition (GAIN)
Yulia Beloslyudtseva	Country Coordinator in Kazakhstan, Global Alliance for Improved Nutrition (GAIN)
Mutriba Latypova	Country Coordinator, Global Alliance for Improved Nutrition (GAIN)
Zarina Ergasheva	Editor of the Magazine "Salomati"
Zarrina Abdunazarova	TV Channel "Mir"
Kristina Erlikh	Representative of the National Information Agency of Tajikistan "Khovar"
Azam Ahrulloev	Representative of the Information Agency "Asia-Plus"
Muhiddin Tojiev	Interpreter
Nigina Khadzhieva	Interpreter