



# **Phase 1- Pilot testing of locally purchased and manufactured microfeeders in 6 Chakki Mills**

## **Final Report**

November 2020



Mott MacDonald  
10 Fleet Place  
London EC4M 7RB  
United Kingdom

T +44 (0)20 7651 0300  
F +44 (0)20 7248 2698  
mottmac.com

# **Phase 1- Pilot testing of locally purchased and manufactured microfeeders in 6 Chakki Mills Draft Report**

November 2020



# Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
0	3 July 2020	Akhlaque Ahmed	Mariam Ahsan	Diane Northway	Draft for submission to FCDO
1	20 July 2020	Mariam Ahsan	Stuart King	Ruth Pratt	Revised version submission to FCDO
2	20 Nov 2020	Mariam Ahsan	Stuart king	Ruth Pratt	Revised and approved from FCDO

## Document reference:

### Information class: Standard

This document is issued for the party which commissioned it and for specific purposes connected with the above-captioned project only. It should not be relied upon by any other party or used for any other purpose.

We accept no responsibility for the consequences of this document being relied upon by any other party, or being used for any other purpose, or containing any error or omission which is due to an error or omission in data supplied to us by other parties.

This document contains confidential information and proprietary intellectual property. It should not be shown to other parties without consent from us and from the party which commissioned it.

# Contents

1	Background and Introduction	9
2	Pilot testing of microfeeders at Chakki Mills	10
3	Implementation	10
3.1	Technical working group (TWG)	10
3.2	Selection of chakkis and MoU signing	10
3.3	Installation of Microfeeders	10
3.4	Premix/micronutrients	11
3.5	Capacity building of chakki staff	11
4	Results	12
4.1	Microfeeders functioning	12
a.	Microfeeders installed by Technomight	12
b.	Microfeeders installed by Rehan brothers	12
4.2	Fortified wheat flour production	13
4.3	Quality assurance and Quality control mechanisms	15
4.4	Experience of Chakki owners with Fortification	16
4.5	Cost of fortification	16
5	Issues and challenges	18
6	Lessons Learned	18
7	Recommendations	18
8	Limitations of this study	20
	Annex 1 Summary of the Overall Research Study	21
	Annex 2 Terms of Reference - TWG	22
	Annex 3: Project Expenditure (3 months implementation Feb 15-May15)	24
	Annex 4: Technical specifications of Microfeeders	26
	Annex 5: QAQC Protocols and Roles and responsibilities of Chakki mills	27
	Annex 6: Start-up and ongoing estimated cost at chakki level	28

## List of Figures

Figure 1: Microfeeder manufactured by Technomight	12
Figure 2: Microfeeder manufactured by Rehan Brothers.	12

## List of Tables

Table 1: Fortified Production in the 6 chakkis during Phase 1	14
Table 2: Third Party Lab Sample Results	15
Table 3: Cost of Fortification for 3 Months in PKR (15 Feb- 15 May)	17

# List of abbreviations

FCDO	Foreign Commonwealth and Development Office
FACT	Fortification Assessment Coverage Tool
FFF	Food Fortification Facilitator
FFP	Food Fortification Programme
MOU	Memorandum of Understanding
MT	Metric Tonne
NFA	National Fortification Alliance
NI	Nutrition International
PFMA	Pakistan Flour Mills Association
QAQC	Quality Assurance
RFP	Request for Proposal
TORs	Terms of References
WFP	World Food Programme



# 1 Background and Introduction

Pakistan has high rates of stunting and wasting among children, and high rates of iron deficiency among adult women and children alike. Cereals contribute around half the energy intake in Pakistan and wheat dominates all other cereals. The standard meal includes flat wheat flour bread or roti cooked either on a hot plate as chapati (flatbread) or baked in a clay oven as naan (leavened bread<sup>1</sup>). Global evidence indicates that food fortification is a cost-effective solution to the challenge of chronic micronutrient deficiencies. Wheat flour is part of the staple diets of individuals in Pakistan and, if fortified, can improve micro-nutrient uptake without needing any additional changes in eating habits of the general population. Currently, Food Fortification Programme (FFP) supports industry to adequately fortify wheat flour produced at commercial roller mills with iron, folic acid, vitamin B12, and zinc. Although long experience and numerous studies and reports, attest to fortification's effectiveness and feasibility<sup>1,2</sup> yet less evidence is available on fortification effectiveness at chakkis.

One important study is the recent work done by the World Food Programme (WFP), under the umbrella of the National Fortification Alliance (NFA) and with support from the Australian Department for Foreign Affairs and Trade (DFAT), through their feasibility study for small-scale wheat flour mills<sup>1</sup>. The report shares that chakkis can play a pivotal role in narrowing the nutrient gap in Pakistan. An overwhelming majority (63.6%) of the Pakistani population lives in rural areas<sup>3</sup>. The National Nutrition survey 2011 identifies rural populations as particularly vulnerable to micronutrient deficiencies. With 73% of the rural populations consuming whole wheat flour, the report authors suggest that chakkis are by far the most effective mechanism for reaching out to the nutritionally vulnerable populations with food-based approaches.

A recent Benefits incidence analysis study based on the latest evidence from the GAIN Fortification Assessment Coverage Toolkit (FACT) survey and the first Rolling District Survey commissioned by FFP indicates that micronutrient deficiencies affect a large number of people across all wealth groups in Pakistan and the absolute numbers of people who will benefit from wheat flour fortification remain very large<sup>4</sup>. There are about 50,000 to 70,000 Chakki mills operating throughout the country with individual milling capacities ranging between 500kg and 1,500 kg/day. . Fortification of chakki output is possible but it will entail a strong political will backed up by a conducive policy, regulatory and operational environment and sustained consumer demand<sup>1</sup>.

Based on an agreement with WFP and NFA that WFP pilot study would involve small chakkis based in Rawalpindi and Islamabad, FFP would target large chakkis mills (based on production size of chakki flour of more than 15 MT per month of production) based in Faisalabad and Hafizabad. The criteria were defined by FFP to differentiate small and large chakkis and were also shared in the proposal shared with National Fortification Alliance (NFA). Together these intervention studies overall aim to achieve a better understanding of the overall feasibility of fortifying wheat flour in chakkis across a broader geographical area covering both large and small chakki units in rural and urban areas. Both the studies were under the mantle of the NFA in agreeing with the proposal and also looking to take advantage of potential synergies to try and ensure consistency in approach, systems and sustainability. Furthermore, through the NFA, Food Fortification Partners Coordination meetings and the Research and Technical Advisory Group (RTAG) established under FFP, experiences and lessons learnt during the research study would eventually be shared to ensure wider dissemination and greater understanding for future scale-up.

<sup>1</sup> Khattak.A. Feasibility Study on the Fortification of Wheat Flour Milled by Small-Scale Grinders (Chakkis) -World Food Programme

<sup>2</sup> Ansari N, Mehmood R, Gazdar H. Volume 2018 No 27 A Value-Chain Perspective on Wheat Flour Fortification in Pakistan. 2018;2018(27).

<sup>3</sup> Population census 2017 accessed on 12<sup>th</sup> February 2019

<sup>4</sup> Benefit Incidence Analysis 1- Food Fortification Programme

## 2 Pilot testing of microfeeders at Chakki Mills

A summary of the original proposal approved by FCDO is shared as Annex 1. This report shares the findings of phase 1 of the study

Phase 1 was implemented for a period of three months (February 15- May 15, 2020). The main purpose of the pilot phase was to assess and finalise the microfeeders specification and standardisation for fortification. The microfeeders were procured from two local manufacturers. The local capacity of manufacturing microfeeders for both commercial millers and chakki units was assessed as part of a separate earlier study<sup>5</sup> under FFP. Based on the findings and recommendations of that study, a detailed request for proposal was advertised and two organisations were shortlisted and after thorough evaluation using both local and international expertise both were contracted to manufacture and install microfeeders in accordance with the specifications for the chakkis mills selected.

## 3 Implementation

A detailed cost of this stage and for testing the microfeeders for three months is shared in Annex 3

### 3.1 Technical working group (TWG)

A TWG working under the oversight of the NFA was formed. The main purpose of the TWG was to provide a forum for planning, coordination of activities and sharing of experiences between the chakki projects of FFP and WFP. The forum was to ensure support among the partners and to prevent any duplication of efforts. ToRs of the TWG are shared as Annex 2.

### 3.2 Selection of chakkis and MoU signing

Three larger chakki mills were selected for the study in both Hafizabad and Faisalabad. Faisalabad because it is an urban district with a population of 3.2 million and having larger urban chakkis, and Hafizabad because it is a rural district with a population of 0.83 million where the majority of the population was consuming wheat flour produced by chakkis. The chakkis were selected based on the following criteria

- Chakki units producing wheat flour 10-15 MT per month
- Production-based chakkis which are also providing additional grinding services
- Chakki owners who give consent to be the part of the research

An experienced project coordinator in wheat flour fortification was hired for this study to conduct all the field level activities. A Memorandum of Understanding (MoUs) was signed with each chakki owner after seeking their consent to be part of the research study. Before MoUs signing separate meetings were conducted in each district with the chakki owners to discuss the purpose, duration, objectives, and the implementation of the research study and provide any clarification needed by them.

### 3.3 Installation of Microfeeders

Microfeeders were manufactured according to the given specifications by two manufacturers for each district as follows

1. Technomight Engineering installed three microfeeders in chakkis of Faisalabad
2. Rehan brothers installed three microfeeders in chakkis of Hafizabad District.

---

<sup>5</sup> FFP Feasibility Study of Local Manufacturers of Microfeeders both for commercial roller mills and chakkis April 2019

The microfeeders were developed in consultation with an international expert on food fortification Quentin Johnson. A number of meetings and discussions took place with the manufacturers before finalising the design and agreeing to issue contracts. During the initial assessment of the microfeeders, the operating performance was assessed by Quentin Johnson.

### 3.4 Premix/micronutrients

Premix used was in accordance with WHO guidelines and in accordance with international standards contained the prerequisite quantities of iron, zinc, folic acid and vitamin B 12. The premix supplied to chakkis is as per the standards as recognised by Food Chemical Codex (FCC). The details are shared as follows Ingredient specifications meet the following standards:

- **Sodium Iron EDTA:** Should meet Joint Expert Committee on Food Additives (JECFA) standards\*
- **Folic Acid:** meets USP, BP, FCC standards,
- **Vitamin B12:** meets USP, BP, FCC standards
- **Zinc Oxide:** meets USP, BP, FCC standards
- **Inert Carrier:** Food grade Wheat or Corn Starch, Calcium Sulphate

\* The premix quality complies with:

1. British Pharmacopoeia (BP),
2. Food Chemical Codex (FCC),
3. Merck Index (MI),
4. United States National Formulary (NF),
5. European Pharmacopoeia (Ph. Eur),
6. United States Pharmacopoeia (USP);
7. FAO / WHO CODEX Alimentarius Commission (CAC)

Premix was provided free of charge to the chakkis for this pilot. Existing prequalified premix suppliers were used which were already established under FFP for large scale mills. Each shipment is tested on arrival in Pakistan. The sample is analysed by the internationally recognized third party independent lab. Premix suppliers are required to release COA (*Certificate of Analysis*) on shipment complying with international standards and provision is made for samples to be randomly checked and validated for each shipment within the country.

### 3.5 Capacity building of chakki staff

Following the installation of the microfeeders, the Project Coordinator ensured that the capacity of the chakki workers was built for the smooth running of the fortification process. The training was provided on calibration, care and maintenance of microfeeders. Furthermore, the fortification process was also explained in detail. After installation, Quentin Johnson also visited the chakkis again to ensure the smooth running of the microfeeders and check on the fortification process.

## 4 Results

### 4.1 Microfeeders functioning

#### a. Microfeeders installed by Technomight

Technomight has been manufacturing microfeeders for small scale mills for several years. They have supplied microfeeders for pilot projects in Pakistan (Peshawar) and in Tajikistan for World Food Programme (WFP) projects.

Fig 1 shows the microfeeder developed by Technomight. The feeder is made up of stainless steel and is small in size measuring 1 feet in length, 8 inches in width with a nozzle size of 10 inches (varies from 3-10 inches) and with a capacity of hopper of three kilogram for adding premix. Due to small size it was easily fitted in in the chakkis. In this microfeeder configuration, the feeder discharges the premix into the wheat as the wheat exits the hopper into the hammermill. In an initial trial, using one of the first units manufactured by them problems were faced in the trial run with the premix clogging and the resulting fortification was unsatisfactory. As a result, they were asked to run a trial using a slightly larger diameter discharge tube (2 cm) and screw, as suggested by Quentin Johnson. The trial was then completed successfully and subsequently, all three microfeeders were manufactured with this modification and were successfully installed. No further issues were faced with the working of these microfeeders. An Urdu language-based user manual was also provided by Technomight to the chakki owners for their future use.

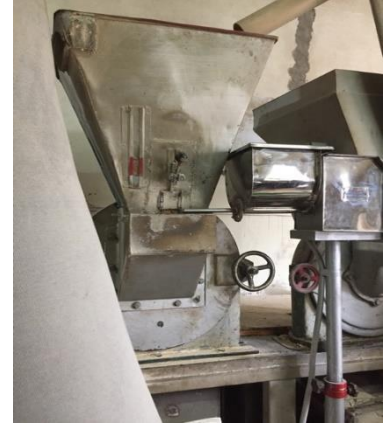


Figure 1: Microfeeder manufactured by Technomight

#### b. Microfeeders installed by Rehan brothers

Rehan brothers initially designed two types of microfeeders. Of the three microfeeders to be supplied two were of a similar design to those supplied by Technomight, while the third microfeeder type offered was for a post milling blending system. As phase 1 was to assess the capability of different locally manufactured microfeeders, based on the consultant's advice and proposal shared by Rehan brothers the post milling blending system was also manufactured and tested but with an understanding that if it failed it would be replaced by the original selected design without additional cost. Unfortunately, the design did fail under operating conditions and the result was the unit was replaced with their other design and 3 similar models were also deployed by this manufacturer. The microfeeders were designed and constructed based on the typical feeders used in larger flour mills. The construction material was stainless steel of the feeders and each feeder had a wire helical screw discharge. The diameter of the discharge pipe was about 2 cm. This allowed for the premix to flow easily. The feeder control panel was placed on the wall and relatively easy to reach the controls that set the adjustments.



Figure 2: Microfeeder manufactured by Rehan Brothers.

Figure 2 shares the Microfeeder developed by Rehan brothers

#### Further feedback on the post milling fortification blending system developed by Rehan brothers

The programme was able to gain valuable insight into the post milling blending system, which has a mixing device with the feeder installed on top. Whilst it was tested twice but ultimately failed the following observations based on the trial run were made:

- The post milling fortification blending system adds to the capital cost of the chakki mill fortification.

- The system increases the number of operational steps that need to be taken for fortification and therefore increased the waiting time for millers and customers
- The flour hopper needs to include an agitation device to ensure a consistent flow of flour during the blending process so that there is uniform blending. This would have required additional redesign, modification and additional expense.
- The discharge end of the premix feeder needed to have been lowered down the walls of the mixing conveyor just above the screw blade of the mixing device. This proved impractical due to lack of space.
- The clearance between the mixing screw blade and the walls of the blending conveyor needed to have been reduced. The reason for this was that the current spacing allowed for too much flour to stay in the mixing conveyor. This resulted in the customer not getting all their flour back from the original quantity provided to the chakki mill.

As a result of the above issues, the design was rejected, and they were asked to replace the microfeeder with one of their other models which were later installed.

The installed microfeeders are made up of stainless steel with a length and height of 24 inches, the width of 20 inches, nozzle size of 8 inches and capacity of hopper for adding premix is 25 kg. Problems persisted with their three installed units and despite dropping the post blending system unit the premix flow/discharge was often found to be inaccurate requiring regular adjustment. Regular coordination by the project coordinator helped in resolving those issues and in the third week of June the nozzles of all the microfeeders were replaced and following this change adequate working was ensured. Furthermore, the size of microfeeders manufactured by Rehan brother's were bigger and they were fixed at a height in the chakkis causing problems to the owners and they had to climb up to turn the microfeeder on and off. As electricity shortage is common in Hafizabad, every time the electric supply is back, the chakki owner has to climb up to turn on the power button of the feeder to make it work. Similarly, if any client refuses to fortify he has to climb up to turn off the feeder, which becomes a cumbersome exercise for the chakki owner. This problem is not faced in the feeders manufactured by Technomight.

The Technical specifications of both the feeders are shared as Annex 4

## 4.2 Fortified wheat flour production

The fortification was a voluntary process and no targets were shared with the chakki owners. During the microfeeders testing phase 1, total production of wheat flour in two districts was 337.09/MT (128.38/MT in district Hafizabad and 208.71/MT in Faisalabad) while fortified production was 289.88 MT (117.78/MT (92%) in Hafizabad and 172.10/MT (83%) in Faisalabad). Month wise data reveals that the percentage of fortified wheat flour production gradually increased from 83% in the first month to 95% in last third month. These figures indicate that the acceptance of fortified flour increased gradually in the community and chakki owners are eager to fortify chakki atta. Before joining the programme mill owners and their staff were given an orientation on the fortification process and the benefits of fortification by technical members of the team and an international expert Quentin Johnson who is also an experienced miller at the time of planning the installation of the microfeeders and conducting assessments at the mills on the microfeeders performance following installation. Apart from these interactions with mill owners IEC material already developed for commercial roller mills was provided to them which was useful to make them further understand and pass on the importance of fortification to their customers. One of the millers also used a liquid crystal display (LCD) for customers awareness and shared videos on flour fortification. This helped in sensitising the consumers and their own team. The refusal rate for fortification was low and those who were bringing their grains were also fortifying (95%) as reported by the chakki owners.

A breakdown of month-wise production of fortified chakki atta is shared in Table 1.

The data indicates that the fortification improved gradually over 3 months in all the 6 chakkis

**Table 1: Fortified Production in the 6 chakkis during Phase 1**

Sr. No	District	15-29 Feb 2020			March 2020			Apr-20			1-15 May-20		
		Total Production	FF Production	% of Atta fortified	Total Production	FF Production	% of Atta fortified	Total Production	FF Production	% of Atta fortified	Total Production	Fortified Production	% of Atta fortified
1	HFZ	9.54	9.54	100%	19.48	19.48	100%	6.4	6.4	100%	9.80	9.80	100%
2	HFZ	11.56	1.28	89%	16.32	12.88	79%	13.4	11.00	82%	6.20	5.60	90%
3	HFZ*	-	-	-	17.56	16.96	97%	12.00	10.20	85%	6.12	5.64	92%
4	FSD	17.48	17.4	100%	45.84	45.84	100%	30.84	30.53	99%	13.44	13.44	100%
5	FSD	11.32	9.4	83%	21.56	15.04	70%	14.00	12.32	88%	6.00	5.52	92%
6	FSD	8.20	1.54	19%	21.52	8.00	37%	12.76	8.28	65%	5.75	4.83	84%
<b>Grand Total</b>		<b>58.1</b>	<b>48.16</b>	<b>83%</b>	<b>142.28</b>	<b>118.2</b>	<b>83%</b>	<b>89.40</b>	<b>78.73</b>	<b>88%</b>	<b>47.31</b>	<b>44.83</b>	<b>95%</b>

HFZ- Hafizabad, FSD-Faisalabad. FF-Fortified

\*Due to issues in the Microfeeder manufactured by Rehan brother's fortification did not start in the chakki during the month of Feb

### 4.3 Quality assurance and Quality control mechanisms

In the initial phase, the chakki owners were facing issues on microfeeders calibration and in the calculations of the premix to be added but these were resolved by regular guidance and support from the coordinator.

The QAQC procedures already established in commercial roller mills were adapted for chakki fortification as well and daily tests were conducted using rapid test kits and externally samples were assessed through Qarshi labs.

The following QAQC protocols were used as part of the assessment of the microfeeders performance and quality of fortification:

1. Internal Quality Assurance relied on the use of RTKs. Two tests were performed by the miller daily while the Project coordinator also used RTKs for testing on a weekly basis during his visits.
2. The external Quality Control plan was interrupted by COVID 19 but is continuing with two out of the four samples extracted being randomly selected and sent to the third-party testing laboratory.
3. Two fortnightly samples of fortified wheat flour are also sent to the iCheck lab in Faisalabad for testing purpose.

The third-party lab tests results are shared in Table 2. In March 12 samples were sent to third party Lab (Qarshi Research International) for testing. The results indicated 7 samples to be adequately fortified and were passed (passing value: 12/PPM to 40/PPM). No tests were done during April and May due to the COVID-19 lockdown. QA/QC process resumed in June 2020 and 12 samples were tested out of which 9 passed. The microfeeders' nozzles from the Rehan Brothers units were changed during June, and subsequently 6 samples were tested in the last week of June and all the samples were passed indicating adequate fortification. This demonstrated that the changes to the microfeeders had worked and that following additional guidance from the coordinator on the fortification process the results from the chakki mill QAQC process also showed improvement. Equally as important was the fact that the chakki mill owners none of whom had had previous training or exposure to the fortification process were also becoming more knowledgeable and skilled over the period and this added to the results achieved in a relatively short period of time. The QAQC protocols used as part of the testing of the microfeeder models are shared in Annex 5.

**Table 2: Third Party Lab Sample Results**

Month	Flour Mills Name	District Name	MF Vendor	1st sample Code	Added Iron in PPM	2nd Sample Code	Added Iron in PPM
Mar-20	Awami Atta Chakki	HFZ	Rehan Brothers	CHM/02/20/03/0002	60	CHM/02/20/03/0008	40
Mar-20	Ameer Atta Chakki	HFZ	Rehan Brothers	CHM/02/20/03/0003	16	CHM/02/20/03/0009	45
Mar-20	Ghousia Atta Chakki	HFZ	Rehan Brothers	CHM/02/20/03/0004	20	CHM/02/20/03/0010	20
Mar-20	Malik Mini Flour Mill	FSD	Technomight	CHM/01/20/03/0005	61	CHM/01/20/03/0011	16
Mar-20	Al-Sehat Atta Chakki	FSD	Technomight	CHM/01/20/03/0006	13	CHM/01/20/03/0012	6
Mar-20	Shaheen Flour House	FSD	Technomight	CHM/01/20/03/0007	13	CHM/01/20/03/0013	11
Jun-20	Ghousia Atta Chakki	HFZ	Rehan Brothers	CHM/02/20/06/0020	15	CHM/02/20/06/0032	31
Jun-20	Ameer Atta Chakki	HFZ	Rehan Brothers	CHM/02/20/06/0021	19	CHM/02/20/06/0033	14
Jun-20	Awami Atta Chakki	HFZ	Rehan Brothers	CHM/02/20/06/0022	53	CHM/02/20/06/0034	13
Jun-20	Malik Mini Flour Mill	FSD	Technomight	CHM/01/20/06/0014	8	CHM/01/20/06/0035	28
Jun-20	Al-Sehat Atta Chakki	FSD	Technomight	CHM/01/20/06/0015	17	CHM/01/20/06/0036	17
Jun-20	Shaheen Flour House	FSD	Technomight	CHM/01/20/06/0016	8	CHM/01/20/06/0037	28

**Note: The passing value: 12/PPM to 40/PPM**

#### 4.4 Experience of Chakki owners with Fortification

Whilst undergoing the initial phase 1 to test the microfeeders performance the following experience was shared by chakki owners

- The chakki owners shared that they were facing difficulties at the start but with the ongoing support, they became familiar with the practices and procedures and fortification process. Regular visits were required initially to guide the chakki owners on microfeeders calibration and premix calculations.
- In reply to a question asked about issues in fortification, they shared that going forward proper calibration, care and maintenance of microfeeders and availability of premix after project completion would be the key challenges they would face.
- Chakki operators indicated they would like to continue fortification provided the cost of premix and testing is covered (during this initial phase to test the microfeeders there was no price adjustment to cover the cost of fortification and millers were selling the atta at the same previous cost).
- Millers were sensitised about the malnutrition status of the population and the impact and continued to express their willingness to help address this problem.
- Regarding the community's willingness to purchase fortified wheat flour, they are expecting an increase in sales as the community is slowly coming to know the health benefits of fortified chakki atta. The consumers did not report any sensory changes of colour and taste and they were given a choice to fortify. Among those who were bringing their own grains the response rate to fortify was around 90% with very low refusal rate reported by the chakki owners.

#### 4.5 Cost of fortification

Whilst the initial phase of the study was to only assess the use and capability of locally manufactured microfeeders some simple preliminary calculations were done to identify the added cost of fortification for the individual chakkis on a monthly basis to help assess the cost of continuing for future reference.

An estimated cost for ongoing and sustaining chakki mill fortification is also calculated at Annex 6. Based on it an estimated human resources (HR) support cost per kg of wheat flour production was found to be 0.54 PKR. This is an estimated amount based on this short study and would vary according the scope and scale of future programmes including the number, location and type of chakkis covered.

Table 3 indicates cost of fortification including with and without HR cost. It should be noted that HR cost is not a fixed cost and will vary depending on the number of visits/month, the number of chakkis covered and the fee rate of HR. Based on the calculations for a larger chakki mill having more fortified production average cost per month is around 10,000PKR (without HR) to 20,000 PKR (with added HR cost).

Cost of fortification based on the production for the three months is shared in Table 3.



**Table 3: Cost of Fortification for 3 Months in PKR (15 Feb- 15 May)**

									Cost excluding HR			Cost Including HR				
Sr No	District	Chakki Mills Name	Total Production (MT)	Total production in Kgs	Total Premix used (Kg)	Total Premix Cost @1,240PKR	Total RTKs used	Total Cost of RTKs @350 PKR	Total Cost of Fortification excluding HR (PKR)	Per kg Cost of fortification excluding HR	40/Kg bag cost of fortification (PKR)	3 months HR cost @ 10,800/month	HR Cost/kg of fortified flour	Total Cost of Fortification (PKR)	Total per kg Cost of fortification	40/Kg bag cost of fortification (PKR)
1	Faisalabad	Malik Mini Flour Mills	107.21	107,210	21.44	26,586	10	3,500	30,086	0.28	11.22	32,400	0.30	62,486	0.58	23.31
2	Faisalabad	Al-Sehat Atta Chakki	42.28	42,280	8.45	10,478	10	3,500	13,978	0.33	13.22	32,400	0.77	46,378	1.10	43.88
3	Faisalabad	Shaheen Flour House	22.65	22,650	4.53	5,617	9	3,150	8,767	0.39	15.48	32,400	1.43	41,167	1.82	72.70
4	Hafizabad	Ghousia Atta Chakki	45.22	45,220	9.05	11,222	9	3,150	14,372	0.32	12.71	32,400	0.72	46,772	1.03	41.37
5	Hafizabad	Awami Atta Chakki	39.76	39,760	7.96	9,870	10	3,500	13,370	0.34	13.45	32,400	0.81	45,770	1.15	46.05
6	Hafizabad	Ameer Atta Chakki	32.8	32,800	6.56	8,134	8	2,800	10,934	0.33	13.33	32,400	0.99	43,334	1.32	52.85
Average			<b>48.32</b>	<b>48320</b>	<b>9.665</b>	<b>11984.6</b>	9.33	3,267	15,251.27	0.33	13.24	32,400	0.84	47,651	1.17	46.69

## 5 Issues and challenges

Key issues and challenges faced during Phase 1 are shared as follows:

- i. The test run of microfeeder manufactured by Rehan brothers failed twice in one of the chakkis of Hafizabad which delayed the start of chakki atta fortification in that mill. However even after changing the microfeeder the accuracy of all three microfeeders was not standardised and these issues required further modification to ensure adequate fortification.
- ii. The chakki millers were initially facing difficulties in microfeeders' calibration. However, regular interaction with the Project Coordinator minimised this issue.
- iii. Some customers refused to add the premix during the wheat flour grinding process. However adequate targeted IEC material for the local population and counselling can help reduce this challenge.

## 6 Lessons Learned

- The locally manufactured microfeeders installed in the chakkis proved to be capable of fortifying the wheat flour to prescribed standard levels of fortification. Due to the short length of this initial stage, and its primary focus on the functionality of the microfeeders, and the interruption to testing from COVID-19, the numbers of samples were limited and it would be prudent to consider future trials with longer duration covering all project related other activities specifically advocacy and communication and engagement with stakeholders.
- Chakki owners were easily motivated to start fortification and were also eager to fortify chakki atta once they were informed about the importance of fortification
- Possibility of continuation of fortification after project completion is higher in case of chakki mills as an individual mill owner decides to fortify and is less influenced by other mills However the cost of fortification needs to be catered for as they will not be able to absorb the cost and passing it on in the price would impact sales especially to poorer households. An additional budget for initiating and sustaining the activities at chakki level is also shared as Annex 6
- Chakki owners responded positively to fortifying but to sustain the process regular monitoring and mentoring would be beneficial.

## 7 Recommendations

- Based on the technical assessment and working of the microfeeders, it was found that fewer technical issues were faced using the microfeeders supplied by Technomight compared to Rehan brothers in the early stages of the testing. These technical issues have been addressed and are now properly working although more time to properly assess the microfeeders operating performance would be beneficial.
- Based on this experience we can suggest that locally manufacturing of microfeeders is feasible for larger china chakki mills and offers a more sustainable option than imported models for future

fortification projects. The microfeeders were developed as per given specifications and were working efficiently in the given time period.

- Pakistan is moving towards having legislation for mandatory fortification of wheat flour in all the provinces. As chakkis are widespread all across Pakistan and the majority of households are using chakki Atta, mandatory fortification at chakkis should also be considered. Legislating for such large numbers of mills across Pakistan may be unrealistic but consideration could be given for including larger capacity mills.
- Initially targeting larger chakki mills may be the most feasible and sustainable option and the legislation or the policies in relation to mills allocated wheat flour quotas should include provision for millers to recover their costs of fortifying whilst maintaining agreed sale prices to target key groups and the poor
- In this phase the 6 chakki owners were found to be motivated to fortify wheat flour but it should be noted that all the costs were covered by the programme and the price of fortified flour sold was not increased to cover fortification costs related to premix expense and quality testing. Based on the programme's experience with the larger commercial mills it would be more challenging if they had to cover some or all the costs. As shared by WFP<sup>6</sup>, one way of encouraging chakki operators to participate in the fortification programme would be to assign them a quota whereby, every participating chakki operator would receive an agreed amount of wheat grains at subsidised support prices.
- The Pakistan informal milling sector is largely made up of chakki mills. There are about 50,000 to 70,000 chakki mills operating throughout the country with individual milling capacities ranging between 500kg and 1,500 kg/day. A rigorous QAQC mechanism may not work as in commercial roller mills and also due to different sizes and production capacities of chakkis. A minimal criteria as proposed in the following table should be looked into and decided if appropriate by the authorities:

Process controls for fortification at Chakkis <sup>7</sup>		
Process/ Component	QC/QA Point	Frequency
Premix Manufacture	Certificate of Analysis	Each Production lot
	Quantitative Testing	
Premix Production (Premix Dilution)	Production records	Each production lot
	Certificate of Analysis	Each production lot
	Quantitative Testing	Each production lot
Milling/blending	Milling Records	Each customer
	Iron Spot Test	Daily
	Premix stock records	Weekly
	Quantitative Analysis	Monthly
	Equipment/Facility Inspection	Monthly

<sup>6</sup> Khattak.A. Feasibility Study on the Fortification of Wheat Flour Milled by Small-Scale Grinders (Chakkis) -World Food Programme

<sup>7</sup> FFP Feasibility Study of Local Manufacturers of Microfeeders both for commercial roller mills and chakkis

## 8 Limitations of this study

The current study has some limitations as follows

1. The primary focus of this pilot was to procure, install and assess the capability of locally manufactured microfeeders to fortify flour in 6 pilot chakki mills and to determine their suitability for future ongoing use and possible scale up to other mills.
2. No additional communication activities were done to sensitise the local community
3. As only three chakkis were selected from each district to test microfeeders , therefore, local, and provincial government stakeholders were not involved at this stage but for larger scale comprehensive projects local administrators and food departments should be engaged and involved in establishing application of standards and quality testing along with exploring ways to incentivise millers to provide fortified flour beyond the life of project interventions with a clear focus on sustainability
4. This was a small pilot and sustainability of these activities was not incorporated at this stage. The cost of fortification was borne by FFP and all the equipment, premix and testing were provided free of cost to the millers.

## Annex 1 Summary of the Overall Research Study

Aim	To establish technical, supply chain and financial feasibility and business models for wheat flour fortification at chakkis
Objectives	<ol style="list-style-type: none"> <li>1. Introduce fortification of wheat flour in selected chakkis in two districts of Punjab</li> <li>2. Compare feasibility of fortification of wheat flour at chakkis in urban vs rural settings</li> <li>3. Ensure and maintain standards of fortification through testing and monitoring</li> <li>4. Under the umbrella of the National Fortification Alliance (NFA)/ Provincial Fortification Alliance (PFA) develop strong stakeholder engagement including: government partners, chakki mill owners, traders, local businesses and consumers for the effective implementation of the study</li> <li>5. Establish roles and responsibilities, identify opportunities and challenges among these groups</li> <li>6. Assess the scaleup and provide recommendations</li> <li>7. Report regularly on progress to the NFA and on completion commission an independent evaluation to assess the study and provide recommendations for scale up</li> </ol>
Study site	This study is an initial research and is proposed to be implemented in two districts namely Faisalabad and Hafizabad
Technical Working Group (TWG) with WFP	TWG working under guidance of NFA has been developed and the research will be carried out in consultation with TWG
Selection criteria	<ul style="list-style-type: none"> <li>• Chakki units producing more than 15 MT per month</li> <li>• Production based chakkis providing grinding services will also be included in the study</li> <li>• Chakki owners who give consent to be the part of the research</li> </ul>
Sample size	<p>A total of 20 chakki (10 from Faisalabad and 10 from Hafizabad, including all the crushing units of selected chakkis) will be included in this research study. These chakkis will be selected in following 2 phases</p> <p>Phase I: Initial testing of locally manufactured microfeeders in 6 chakkis</p> <p>Phase II: based on the results of Phase 1 running the research in rest of the selected 14 chakkis</p>
Implementation	<ul style="list-style-type: none"> <li>• Initial assessment, mapping and selection of chakkis</li> <li>• Pilot testing of microfeeders at 3 chakkis (6 in total) in Phase 1</li> <li>• Implementing the inception process in the two districts selecting 14 chakkis as Phase 2 (after phase 1)</li> <li>• Procurement of relevant equipment and supplies</li> <li>• Development of Monitoring and Evaluation Framework</li> <li>• Evaluation/ assessment phase</li> <li>• Scalability findings</li> </ul>
Proposed Team	<ul style="list-style-type: none"> <li>• Team leader</li> <li>• Project Coordinator</li> <li>• Technical Director</li> <li>• National Manager Wheat Flour Fortification</li> <li>• NFA Consultant</li> <li>• National Manager M&amp;E</li> <li>• Research Manager</li> <li>• Advocacy Manager</li> <li>• X Food Fortification Facilitators</li> </ul>
Timelines	<p>Phase 1- 3 months, for testing the local manufactured microfeeders in 6 chakkis</p> <p>Phase 2 – 13 months implementing the study in other 14 chakkis</p>

# Annex 2 Terms of Reference - TWG



No.1-2 (Adolescent-N)/2018-Dir(Nut)-NHSRC  
**GOVERNMENT OF PAKISTAN**  
 Ministry of National Health Services, Regulations and Coordination  
 Telephone: +92 51 9255096; Fax: +92 51 9255214  
 \*\*\*\*\*

Islamabad the 14<sup>th</sup> June, 2019

## **OFFICE ORDER**

**Subject: Constitution of Technical/ Advisory Working Group for Piloting of WFF produced by Chakkis.**

With the prior approval of the competent authority, National Fortification Alliance, Ministry of National Health Services, Regulations & Coordination, Government of Pakistan has constituted the Technical/ Advisory Working Group to oversee the activities, processes and progress regarding Piloting of Wheat Flour Fortification through small scale mills (Chakkis) in Punjab/ Islamabad, Pakistan. Following are the members of the Platform and their terms of references.

### **Lead:**

National Coordinator –Nutrition & NFA M/o NHR&C

### **Members:**

- ✓ Mr. Tahir Nawaz, Program Policy Officer, WFP, Islamabad
- ✓ Ms. Rabia Zeeshan, Food Technologist, WFP, Islamabad
- ✓ Ms. Faaria Ahsan, Project Consultant Chakki WFF, WFP Islamabad
- ✓ Mr. Munawar Hussain, National Program Manager, WFF, FFP Islamabad
- ✓ Ms. Maryam Ashraf, Research Manager, FFP, Islamabad
- ✓ Mr. Javaid Iqbal, National Manager Monitoring & Evaluation, FFP Islamabad.
- ✓ Any member co-opted by the Director Nutrition M/o NHR&C/ Working Group.

### **Aim**

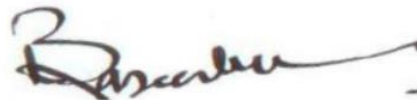
The aim is to provide a forum for planning, harmonization, coordination, advocacy and exchange of information/ experiences to guide in strategic direction for Piloting of WFF through Chakkis in Punjab/ Islamabad as well as to monitor the progress and make appropriate recommendations.

### **Objectives:**

1. To establish a small working group to guide in strategic direction for Piloting of WFF through Chakkis in Punjab/ Islamabad based on evidence generated in the feasibility study for WFF through Chakkis.
2. To act as coordination platform for regular data and program updates, harmonization of implementation modalities and information sharing
3. To oversee and monitor the progress of the piloting of the projects implemented by WFP and FFP under the umbrella of NFA with goal, outputs and milestones, with regular progress review and course correction

**Working Modality & Structure:**

- The Working group will meet not less than every two months (six times a year). Meeting minutes will be recorded and circulated.
- Urgent meetings (core group) can be convened as and when needed. The decisions will be based on general consensus after inputs from all the group members. Final decision will be shared by email with all members.
- NFA would act as secretariat of the group and the National Coordinator would send the invitation to convene the meeting.
- NFA will send out meeting minutes; final decisions and follow-up on agreed actions etc.



**Dr. Baseer Khan Achakzai**  
**Director Nutrition/ NPM**  
Secretary National Fortification Alliance

**Copy to:-**

- I. SPS to the Secretary M/o NHR&C
- II. PS to the Director General, M/o NHR&C
- III. The Distribution List is attached.

## Annex 3: Project Expenditure (3 months implementation Feb 15-May15)

### A. Project cost summary

Expenditure Summary in PKR		
Sr. No	Head/Activity	Amount
1	Microfeeders Cost	1,927,725
2	Premix Cost	71,907
3	Third Party Test Cost	12,707
4	RTKs Cost	19,600
5	Miscellaneous Cost	37,274
<b>Grand Total</b>		<b>2,069,213</b>

### B. Cost details

1. Microfeeders Cost (including transportation and installation) in PKR					
Sr No	MFs Vendor Name	District	No. of MFs	MF Cost (1)	Total Cost (3)
1	Technomight Engineering	Faisalabad	3	337,500	1,0125,00
2	Rehan brother's	Hafizabad	3	305,075	915,225
<b>Grand Total</b>			<b>6</b>		<b>1,927,725</b>

2. Premix Cost					
Sr No	Chakki Mills Name	District	Total Premix/Kg	Premix cost Per Kg (PKR)	Total Premix Cost (PKR)
1	Malik Mini Flour Mills	Faisalabad	21.44	1,240	26,586
2	Al-Sehat Atta Chakki	Faisalabad	8.45	1,240	10,478
3	Shaheen Flour House	Faisalabad	4.53	1,240	5,617
4	Ghousia Atta Chakki	Hafizabad	9.05	1,240	11,222
5	Awami Atta Chakki	Hafizabad	7.96	1,240	9,870
6	Ameer Atta Chakki	Hafizabad	6.56	1,240	8,134
<b>Grand Total</b>			<b>57.99</b>	<b>1,240</b>	<b>71,908</b>

3. QAQC Third Party Lab Payment*				
Sr. No	Month Name	No. of Total sample Tested	Cost of a Test (PKR)	Amount (PKR)
1	15-29 Feb-20	1	977.5	977.5
2	Mar-20	12	977.5	1,1730
<b>Grand Total</b>		<b>13</b>	<b>977.5</b>	<b>12,708</b>
*No tests were done during April and May due to COVID-19 lockdown				



4. Rapid Test Kits Cost					
Sr. No	Chakki Mill Name	District	Total RTKs used Feb 15-May 15	Cost of a RTKs (PKR)	Total Cost PKR
1	Malik Mini Flour Mills	Faisalabad	10	350	3,500
2	Al-Sehat Atta Chakki	Faisalabad	10	350	3,500
3	Shaheen Flour House	Faisalabad	9	350	3,150
4	Ghousia Atta Chakki	Hafizabad	9	350	3,150
5	Awami Atta Chakki	Hafizabad	10	350	3,500
6	Ameer Atta Chakki	Hafizabad	8	350	2,800
<b>Grand Total</b>			<b>56</b>	<b>350</b>	<b>19,600</b>

5. Miscellaneous Cost			
Sr. No	Activity Name	District	Amount PKR
1	MoU Signing Ceremony Lunch	Hafizabad	8,580
2	MoU Signing Ceremony Lunch	Faisalabad	6,444
3	Millers Training Lunch	Faisalabad	10,800
4	Millers Training Lunch	Hafizabad	10,800
5	Training Stationery	FSD/HFZ	650
<b>Grand Total</b>			<b>37,274</b>

# Annex 4: Technical specifications of Microfeeders

## 1. Specifications of Technomight microfeeder

Construction: Hopper and all other parts of the machine, coming in contact with premix or flour are made of Stainless Steel (SS) while the mounting pedestals, both for feeder and electrical panel are made of mild steel (MS).

Installation: The design of micro-feeder is so flexible that it can be installed on every type of chakki, e.g., stone grinder or China chakki (Disk mill). The length of discharging nozzle is determined at the site depending upon the installed position of the micro-feeder.

Hopper: U- shaped trough having 8 square inches opening (mouth) at top, incorporated with a shaker to avoid a possible BRIDGING and RAT HOLING of the premix during working of the machine.

Hopper Capacity: 7.5 Litres or 460 cubic inches or 0.266 cubic feet.

Accuracy: 1 to 2 % full scale with uniform free flowing materials.

Feeder's output: The machine is supplied with FOUR feed spring (conveyors) having the following performance characteristics:

- S spring has the discharge range from 0.08 to 1.01 gm/min
- M spring has the discharge range from 0.89 to 13.77 gm/min
- MM spring has the discharge range from 1.13 to 18.01 gm/min
- L spring has the discharge range from 3.46 to 55.69 gm/min

Overall Dimensions:

- Length= 17" without nozzle
- Width= 15"
- Height= 14"

Weight: Not exceeding 27 kgs

Power Requirement: 220-240 V (AC), single phase

Ambient Operating Temp: 0 to 55 °C (32 to 131 °F)

## 2. Specifications of Rehan Brothers microfeeder

Construction: Stainless steel.

Hopper Capacity: 12/kg-15/kg

Feed rate: The machine is supplied with Three feed spring (conveyors) having the following performances:

- S spring has the discharge range from 0.3 to 2.5/gm/min
- M spring has the discharge range from 1.0 to 9.5 gm/min
- L spring has the discharge range from 7.75 to 50.00 gm/min

Weight: 30/Kg

Power Requirement: 220-240 V

Load Carrying Ability: Not exceeding 15/kg

Provided the toolkit and weight scale along with microfeeders to all the Chakki mills.

# **Annex 5: QAQC Protocols and Roles and responsibilities of Chakki mills**

## **Quality Assurance and Quality Control (QAQC) Protocols**

The following QAQC protocols were used as part of the assessment of the microfeeders performance and quality of fortification:

1. Internal Quality Assurance was assessed using RTKs. Two tests were performed by the miller daily while the Project coordinator also used RTKs for testing weekly during his visits.
2. For external quality control, two samples on the fortnightly basis of fortified wheat flour were sent to the I-Check lab established by FFP at Faisalabad for testing purpose.
3. For third party lab testing two samples from each Chakki were collected on a weekly basis randomly and were sent to third party laboratory for testing

## **Roles and responsibilities of Chakki owners.**

1. To understand the fortification process and fortify wheat flour as per the standard procedure
2. Operating and maintain the microfeeder as per given instructions
3. Following QAQC process as shared with them
4. Utilise the given IEC material
5. Raise awareness among community about the benefits of fortified wheat flour.
6. Record keeping of total production and fortified flour daily

## Annex 6: Start-up and ongoing estimated cost at chakki level

The following cost as been estimated based on our experience with fortification at Chakkis.

Start-Up Cost for 1 Chakki in PKR				
Microfeeder cost	Training cost (3 days)	*HR support (5 days)@2700PKR	Advocacy	Total (PKR)
337,500	9000	13500	10,000	370,000

Ongoing Cost for 1 Chakki in PKR on monthly basis						
QAQC (third Party)	Premix (4kg)@1240PKR	RTKs (4kits)@350 PKR	*HR Support (4 visits) @2700 PKR	Total (PKR)	Fortified production (kg)	HR cost /kg of production (PKR)
2,000	4960	1,400	10,800	19,160	20,000	0.54
*HR cost is a variable cost and will vary upon the monthly fee offered to HR, distance of chakki, number of chakkis covered. Cost of fortification calculations normally do not add HR cost as these are one time costs and once sustained the chakki owners are able to manage the fortification process.						

**Note:** These costs are estimates and we have considered the chakki which produced the highest amount of fortified Atta during the three months. The cost may vary due to the changing cost of premix and the travel/lodging boarding cost of the human resource, the number of visits by the HR to the chakkis and the geographical location of the chakki where it is situated.

