FUNCTIONAL REQUIREMENTS FOR RICE FORTIFICATION QUALITY MANAGEMENT SYSTEM

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1. Project Description

Rice is fortified with iron, folic acid (Vitamin B6) and Vitamin B12 to address anaemia and micronutrient deficiency. The process of fortifying rice involves multiple stakeholders. To ensure that the quality of fortified rice is as per polices and guidelines of a geography (country, region or sub-unit), there is requirement to have a robust quality control and quality assurance infrastructure and processes. It is very important to establish a fool-proof process to ensure that desired quality fortified rice is produced and supplied to the consumer, so as to achieve goal to curtail chronic nutritional deficiencies can be achieved.

In context of India, Government has decided to scale up the distribution of fortified rice in distribution under the Integrated Child Development Scheme (ICDS), PM POSHAN Schemes and Public Distribution System (PDS) in a phased manner leveraging the existing domestic supply chain through Food Corporation of India (FCI) and/or the state agencies with blending of rice with fortified rice kernels (FRK) happening at the rice mills.

Rice fortification programme today suffers from a lack of quality due to weak oversight and enforcement mechanisms that are primarily a result of poor incentives and lack of trained personnel in the system. As a result, rice mills, FRK manufacturers and premix suppliers are not held accountable to fortify to government standards - and many may not be fortifying at all, reducing impact.

The Standard operating process (SOP) for quality assurance mainly covers the following three aspects:

1. **Quality Assurance of the processes in the supply chain**
2. **Quality Control of the inputs and the produce, primarily Premix, Fortified Rice Kernels and Fortified Rice**
3. **Traceability of material movement within the critical stakeholders in the supply chain, namely Premix Manufacturers, FRK Manufacturers and Rice Mills carrying out blending of FRK with milled Rice to produce Fortified Rice**.

The solution will have end to end digital solution for Quality Assurance (QA), Quality Control (QC) and Traceability (Trace) to be implemented across the manufacturing supply chain.

2. List of Modules of the Rice Fortification System

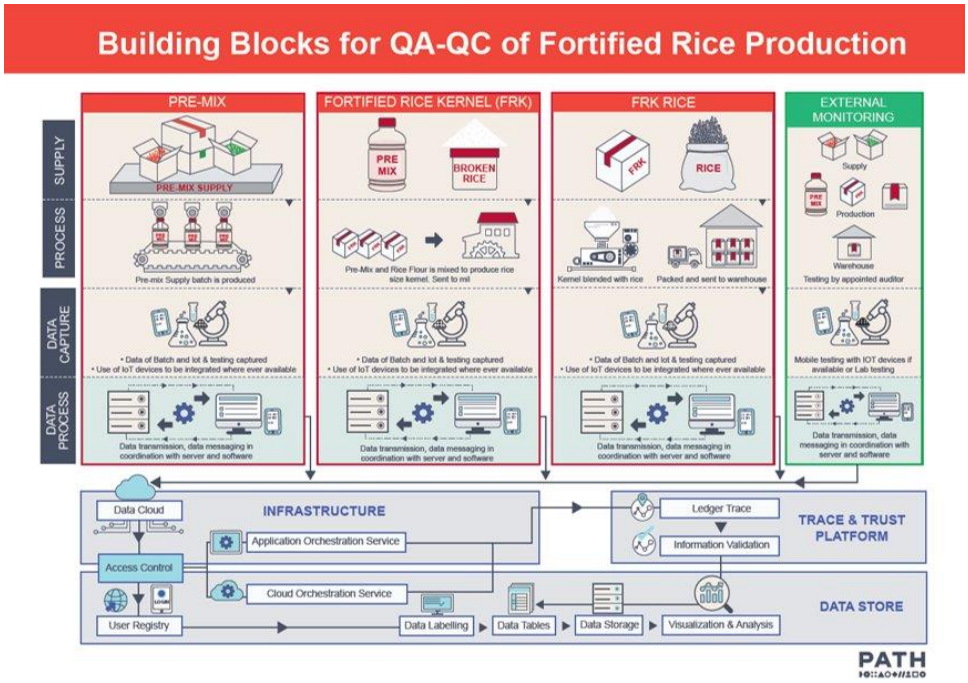
Rice fortification process internally has following modules.

1. Pre-Mix Manufacturer
2. FRK Manufacturer
3. Miller
4. Warehouse
5. Testing Lab
6. Monitoring/ Inspection

The functionalities at each module are described in detail in next sections.

3. Work flow of process

The flow of process for Rice Fortification throughout the supply chain is depicted in the below diagram.



Modular connectivity between various modules is as shown in below figure.

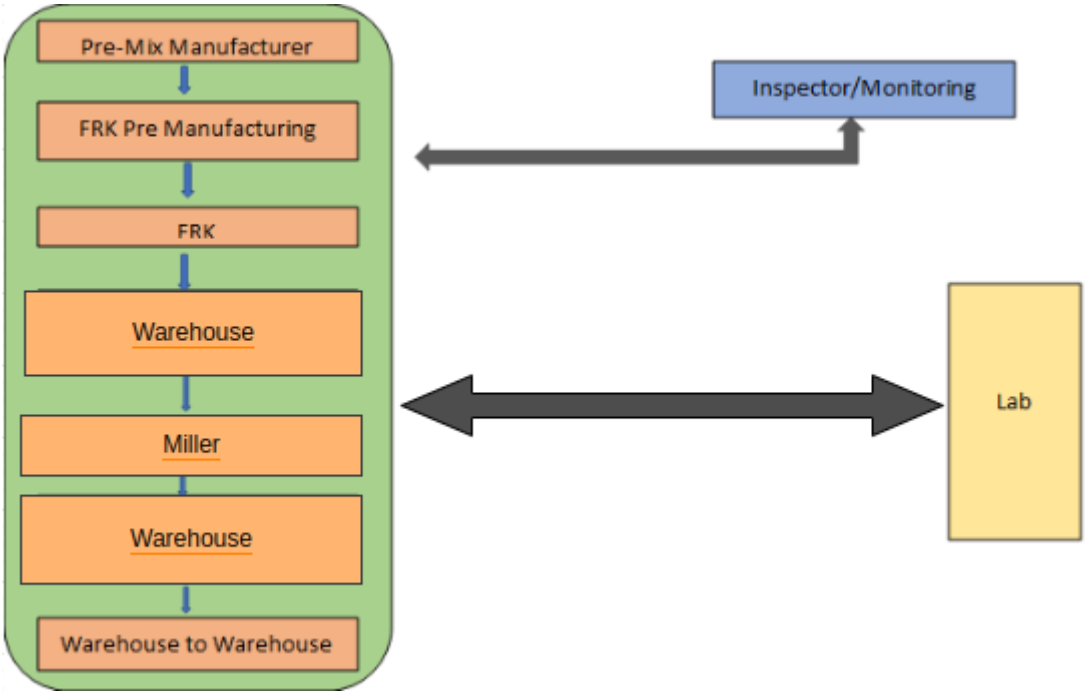


Figure: Flow chart for Rice Fortification

4. Project Phases

The product will be developed in 2 phases. Phase I will be an MVP, defined in mutual consultation with the TAG. The MVP will be used for the pilot phase. The MVP will be followed by a full-scale application, inputs from the pilot will be incorporated. The platform is built for both web application and Mobile application in Android. The application will allow users to access portal from any popular browser like IE, Firefox, and Google Chrome with operating systems like Windows, Android or Mac.

4.1. Phase 1 / MVP:

Phase 1 of the project includes development of MVP consisting of designing and development of an open-source digital platform for QA & QC of rice fortification, customise the platform in Indian context and conduct a Pilot.

The following modules will be developed in MVP (Phase 1):

1. Pre-Mix Manufacturer
2. FRK Manufacturer
3. Miller
4. Lab Module

The detailed description and functional requirements of these modules are given in the subsequent sections.

4.2. Phase 2:

Phase 2 of the product development consists of development of the additional modules and integrating with the modules developed under phase 1 (MVP).

The following modules will be developed in Phase 2 of the project:

1. Warehouse
2. Monitoring/ Inspection

The detailed description and functional requirements of these modules are given in the subsequent sections.

5. Generic Functionalities:

The system will have following generic functionalities across modules.

Table 1: Generic functionalities for the proposed application

Id	Functionality
GF 1	The application will have the functionality to on-board any user and allow access to the modules based on type of registration
GF 2	Only Authorized users shall be allowed to access the system based on Role-based Access Control (RBAC)
GF 2.1	The application will have necessary internet security standards and protocols in place with complete audit trail
GF 3	The Application will have option to add Geospatial information
GF 4	Before implementing the application, registered organization will have option to add all necessary checklist, compliance parameters, accreditation, restrictions etc.
GF 4.1	The organization adopting the system will also have governing power to block or blacklist any non-compliant organization
GF 5	Once linked and interoperable, system will automatically evaluate the registration and certification of the registered user/ organization i.e., Labs validity or food production licenses
GF 6	The application will provide traceability of each material used at any point of time with links to any associated lab reports or Evaluation report by Inspector
GF 7	The application will have capability to select a random lab for the Quality Test from sample collection point. The selection of Lab should be configurable so that if any state want to assign Lab on anonymization basis, system should allow it. Also, testing can be a mandatory or non-mandatory functionality based on State's call. System should be built in such a way that testing and hiding Lab details should be configurable at state level.
GF 7.1	The Lab will be from the empanelled list in the geography (Manual and Auto, as desired by adopter)
GF 8	The application will mask the details of sample collected and Lab it was sent for testing until Lab submits the findings on portal to generate report.
GF 8.1	Masked information will be randomized to prevent identification of any pattern. (Manual and Auto, as desired by adopter)
GF 9	The application will auto-populate information associated with the batch including link to the Lab report (i.e., If a FRK Manufacturer selects batch no. for Pre-Mix, associated details to be auto filled).
GF 10	The application will acknowledge Batch numbers based on failure and success of lab tests
GF 11	Inbuilt checks and balances should be incorporated in the application to ensure that the succeeding step can be carried out only if the preceding steps were successfully complied with, as per the defined workflow.
GF 12	Lab reports will have a provision to download when required.

GF 13	A dashboard will be available for the overall system to show key parameters of the system - As per adopters customized system
GF 14	The application will be able to use unique identifier (Batch no) to eliminate any possibility of data duplication
GF 15	The application will allow to upload documents in form of PDF file and/or scanned images which ever module it is applicable
GF 16	The application will have a training window for any user to learn the system process step by step (Module specific)
GF 17	The application will provide notifications through 1. Mobile Phone (SMS/Push Notification), Email, On Screen (Web Notification)
GF 18	The application will allow users to access portal from any popular browser like IE, Firefox, and Google Chrome.
GF 19	The application will be able to be access on any operating systems like Windows, Android or Mac
GF 20	The application will be able to maintain audit trail of users including but not limited to recording the IP address, type of device, type of browser, the date and time of access to the site, Geo-coordinates (in case of using via Mobile App) the pages/functionality user has accessed.
GF 21	The application will provide the dynamic-querying capability to the users.
GF 22	The application will provide the user to export the search results in the format selected by the user like doc, pdf, and spreadsheet in printer friendly format with page numbers printed on every page.
GF 23	If a user performs a quick or advanced search, the system must not include in the search result list any record which the user does not have the right to access
GF 24	The application will allow user to conduct an advanced search based on sub parameters on major data fields
GF 25	The application will present customized dashboards and reports to the users based on their role
GF 26	The application will allow user to view alerts/events/reminders
GF 27	The application will have adequate security features built in the architecture to ensure that it cannot be hacked or manipulated and complied with local government guidelines
GF 28	The application will be ready to be interoperable with existing government platforms at time of deployment.
GF 29	System should allow admins to input the demand for Pre-mixture/FRK/Fortified rice at various states and track what is been achieved(off take) vs what is targeted(Alloted).
GF 30	System should allow admin to map Pre-mixture vendors to FRK vendors, FRK vendors to Millers, Millers to Warehouse. This system should allow vendors to dispatch the goods to next level even if mapping is not given based on State's interest.

6. Common Functionalities across all the modules:

The application is planned to consist of eight different modules as mentioned above. These modules will be integrated to ensure better traceability. The following are the functionalities that are common across all the modules:

Table 2: Description of functionalities common across all proposed modules

ID	Functionality
CF 1.1	The functionality to edit profile of the organization which can include Name, address and any other information which can be used for Transaction and receipts. The sensitive details like license, certifications should not be editable. There should be a way to import the new vendors into the system through API or CSV upload functionality so that data specific to organizations can be updated periodically.
CF 1.2	The functionality to allow addition and registration of other users within an organization profile (organizational admin) to ensure the trace function is created up to the user level
CF 1.3	In each applicable module, system will generate a batch number automatically based State/adopter Customized criteria
CF 1.4	Each Module will be able to generate an acknowledgment receipt after successful confirmation of receipt of commodities/samples etc.
CF 1.5	The application will acknowledge details of available batch for any transaction process like, testing information, weight received vs available, Batch and Lot, Mixture of two batches in a lot etc.
CF 1.6	At every stage/module QR Code is generated which allows access to the label information once scanned. The QR code should be printable and attached to manufactured boxes/bags.
CF 1.7	Module will use automatic triggers to stop non-compliance like Stage wise compulsory steps (Lab test) need to be completed before dispatch of lot from respective batch.

7. Module-wise Functional Requirements

The digitization of the supply chain in Rice Fortification will be achieved in eight modules. The functional requirement of each module is described in the subsequent sections.

7.1 Pre-Mix Manufacturer Module:

In the process of fortification, rice is fortified with and vitamins that are available in a powdered form known as premix. This premix is manufactured at the Pre-Mix manufacturing unit under controlled conditions to achieve high quality produce to meet the standards / requirements outlined by concerned authorities.

Premix manufacturing unit obtains raw material from supplier, the raw material is then processed to manufacture premix. This premix then becomes the input for the FRK

manufacturing unit. This module will have provision for lab testing of the sample at any specific stage.

As a part of digitization, all the pre-mix manufacturers in the empanelled list must follow the criteria laid by the Government of India. The pre-mixture can be dispatched to FRK vendors only after completing the Lab tests with approved result. While dispatching pre-mixture to FRK vendor, pre-mixture manufacturer has to share the CoA document stating the quality of pre-mixture is meeting the requirements for FRK manufacturing. FRK manufacturer can further send the sample of pre-mixture for test and if it result as not acceptable, FRK will send the pre-mixture back to Premix manufacturer in which case pre-mixture vendor has to accept the lot back and resend quality approved pre-mixture.

7.1.1 Functional Requirements:

The functional requirements of the premix manufacturing units are described below:

Table 3: Functional requirements of Premix manufacturing module

Req ID	Actions
Req 1.1	Premix Manufacturer to get raw material from Supplier and this is to be configurable
Req 1.2	Raw material should be selectable for different types of fortification
Req 1.3	Need to have Option to select Chemical Component from the list (B12, Iron, Folic Acid and Premix Base)
Req 1.3.1	User should be able to fill Chemical components details Viz., Manufacturer, Batch no, Quantity, Manufacturing date, Expiry date, etc.
Req 1.4	Once Premix completed - System to assign batch number, Quantity manufactured and date of manufacturing, expiry date, along with Profile details etc.
Req 1.5	Manufacturer to have an option for requesting batch sample for testing
Req 1.5.1	Manufacturer should be able to track the status of lab test (whether lab is assigned or pending)
Req 1.6	Lab test should be configurable for Mandatory & Non Mandatory
Req 1.7	If sample is cleared in Lab test - Module to allow lot for dispatch of that batch premix (to respective FRK manufacturer) along with COA
Req 1.8	Premix should be able to manage/access raw material inventory (availability and usage to be tracked).

7.1.2 Module Specific Requirements:

In addition to the functional requirements, the module also requires provision of module specific requirements pertaining to premix module. This includes features like configuration of sample extraction, assigning consignments etc.

Table 4: Module Specific Functional requirements of Premix manufacturing module

MSF 1 - Module Specific Functionality	
Req ID	**Actions**
MSF 1.1	Provision to update information of Premix manufacturer - registration / approval process workflow defined in consultation with Technical Advisory Group (TAG). A csv based upload option should be given to update license/registration details of all pre-mixture manufacturer vendors
MSF1.2	Need to capture details of sample extraction sample extraction by, sample extraction date-time, batch / lot number of Premix manufacturer
MSF 1.3	Need to capture details like Batch Number, Name of Manufacturer, Date of manufacturing, Date of CoA, Name of Lab who issued CoA, Rating of Manufacturer.
MSF 1.3.1	System should automatically calculate the expiry of Premix based on the input given by user at the time of manufacturing.
MSF 1.4	System should be able to add dispatch information (Batch number, Lot number (Auto sequenced), Lot Quantity, Lot processor, Delivery address/ organisation, etc.)

7.1.3 Input Fields in the Pre-Mixture Generation Form:

Below are the details collected as input at Premix manufacturing unit while preparing pre-mixture.

Table 5: Data collected at Premix manufacturing unit

S No	Data elements to be captured at Pre-Mix	Auto-Populate	Validation	Remark
1	Name of the Premix Vendor	Yes		
2	FSSAI License	Yes		
3	CoA	No		Upload
4	Complete Address	Yes		
5	Either Manufacturer/Trader/Broker	Yes		
6	Manufacturer is Accredited by any agency or Not	Yes		
7	Date of Manufacturing	No		
8	Date of Expiry/Best Before/Shelf Life	No		
9	1 Package Unit Size of Batch	No	5-25 KG	can be multiple ex: 5KG & 10KG
10	Batch Size	No	No of Packages	(100*5KG)+ (50*10 KG)= 1 Ton
11	% of Premix need to be put for FRK (Maximum up to 3%)	No	2%	

12	Batch No from Pre-Mix Manufacturer	No		Pre-Mix will enter	
13	Technical Specification Sheet	No	Mandatory	Upload	
14	Material Safety Data Sheet	No	Mandatory	Upload	
15	Premix Batch No.	Yes		Bar code generated	
Test					
16	Data sample sent	No			by Pre-Mix
17	Sample Receiving confirmation	No			by LAB
18	Date sample received by LAB	No			
19	Premix Batch No.	Yes			
20	Test Date	No		From Dropdown	
21	Test Name	Yes		parameters as per test report from the document, only micronutrients	
22	Person name who performed Test	No			
23	Upload Report	No		File Upload option	
Rejected Batch Receiving					
24	Received	No		Yes/No	
25	receiving Date	No			
26	Quantity	Yes			
Send Batch					
27	Sent to	No		FRK List	
28	Sent date	No			
29	Quantity	No			

7.2 FRK Manufacturer Module:

FRK module receives its raw material from premix manufacturers. FRK manufacturer should receive the pre-mixtures from approved vendors only whose license is still valid and CoA should be enclosed along with pre-mixture bag/batch. Once the material is received, FRK manufacturer should be able to fetch the lab reports to verify them or should have a provision to request for lab testing of the raw material (premix) obtained. This raw material is then used in the manufacturing of Fortified Rice Kernels which are then sent for lab testing for quality analysis if needed. The manufactured FRK becomes the input for Miller where it is mixed with the rice flour. The manufactured FRK can be dispatched to Miller only after obtaining the test reports as approved. While dispatching the FRK to miller, FRK vendor has to share CoA of pre-mixture and lab test report of FRK

along with the bags of FRK. Test again being subjected to States approach. There is a wastage of raw materials as the process is effective only after the machinery reaching to certain predefined temperature. Until then the raw material couldn't be converted into FRK. System should have a provision to mention the wastage while generating the FRK.

7.2.1 Functional Requirements:

The functional requirements of this module are described below:

Table 6: Functional requirements of FRK manufacturing module

Req ID	Actions
Req 2.1	FRK manufacturer to verifying lab reports and other details.
Req 2.1.1	FRK manufacturer to receive the Pre-Mixture and accept the delivery. If Lab reports of Pre-mixture is not enclosed(as per states approach), FRK manufacturer can send the sample for tests. If test result is positive that the quality of Pre-Mixture is good, then FRK should accept the lot. Otherwise, FRK manufacturer can reject the lot and send back to pre-Mixture vendor with a valid reason. CoA has to be received along with pre-mixture bags.
Req 2.2	FRK manufacturer to select the Pre-Mix lot and Rice flour
Req 2.2.1	System should auto populate premix batch no, Lab reports, Quantity, expiry dates etc.
Req 2.2.2	System to mark the quantity of pre-mix used for the specific FRK-Manufacture Batch.
Req 2.2.3	System to assign batch number, Quantity manufactured and date of manufacturing, expiry date, along with Profile details etc.
Req 2.3	FRK Manufacturer to have an option for requesting batch sample for testing
Req 2.4	Lab test should be configurable for Mandatory & Non Mandatory. Allocation of Lab for testing can be anonymous based on state approach.
Req 2.4.1	Manufacturer should be able to track the status of lab test (whether lab is assigned or pending)
Req 2.5	If sample is cleared in Lab test - Module to allow lot for dispatch of that batch FRK to Miller/Warehouse along with CoA of pre-mixture and Lab results of FRK
Req 2.6	FRK manufacturer should be able to manage/access Premix inventory (availability and usage to be tracked).
Req 2.7	There is a wastage of raw materials as the process is effective only after the machinery reaching to certain predefined temperature. Until then the raw material couldn't be converted into FRK. System should have a provision to mention the wastage while generating the FRK.

7.2.2 Module Specific Requirements

Following are some specific requirements that are particularly applicable to FRK module as described below:

Table 7: Module Specific Functional requirements of FRK manufacturing module

MSF 2 - Module Specific Functionality	
Req ID	**Actions**
MSF 2.1	Provision to update information of FRK manufacturer - registration / approval process workflow defined in consultation with Technical Advisory Group (TAG)
MSF 2.2	Need to capture details of sample extraction sample extraction by, , batch / lot number of FRK manufacturer
MSF 2.3	System should be able to add dispatch information (Batch number, Lot number (Auto sequenced), Lot Quantity, Lot processor,

7.2.3 Input Fields in the FRK Generation form:

In the FRK manufacturing unit, two different forms are maintained to record data at two stages namely:

- FRK Pre manufacturing
- FRK

The following are the details collected at each stage:

7.1.1.1. FRK Pre Manufacturing:

Data collected at FRK manufacturing unit at Pre Manufacturing stage is as mentioned in below table.

Table 8: Data collected at FRK manufacturing unit at Pre Manufacturing stage

S No	Data elements to be captured at FRK	Auto-Populate	Validation	Remark
1	Name of the FRK Producer	Yes		
2	Pre-Mix batch No	Yes	only after valid coA and Lab Report	
3	CoA, TS, MSDS documents of Pre-mIx	Yes		From Batch No
4	Premix Vendor Name	Yes	Masked	From Batch No
5	% of Premix to be used as suggested by Pre-mix manufacturer	Yes		From Batch No

6	Expiry Date of Pre-Mix	Yes		From Batch No	
7	Receiving Confirmation	No			
8	Receiving Date	No			
Acknowledgement					
9	Pre-mix lab report	Yes		From Batch No	
10	Acceptance of Pre-Mix batch	No	if Yes in 10		
11	Rejection Reason	No	If No in 11	in case rejected show back to pre-mix as rejected	
12	Acceptance/Rejection date of Pre-Mix batch	No			
Test if(No in acknowledgement on basis of report)					
13	Sample sent Date	No	Not more than 1 kg	in KGs	by FRK
14	Sample received date	No			by LAB
15	Premix Batch No.	Yes			
16	Test Date	No			
17	Test Name	Yes		From Dropdown	
18	Person name who performed Test	Yes			
19	Upload Report	No		File Upload option	

If test report is not attached with the sample received from Premix manufacturer, the FRK manufacturer can request for a lab test and based on the lab report at this stage, the acknowledgement can be sent to Premix manufacturer. The following table shows the details of the acknowledge form filled at this stage.

Table 8.1: Data collected at FRK manufacturing unit at Pre Manufacturing stage (after lab test)

Acknowledgement on basis of report from LAB				
21	Lab report	Yes		From sample Batch No
22	Acceptance of Pre-Mix batch	No	if Yes	If lab report is not fine, lot can be sent back to Pre-Mixture. If lab report is positive, lot has to be accepted.

23	Rejection Reason	No		If lab report is not fine, lot can be sent back to Pre-Mixture.
24	Acceptance/rejection date of Pre-Mix batch	No	if Yes	

7.1.1.2. FRK

Data collected at FRK manufacturing unit at Manufacturing stage is mentioned in below table.

Table 9: Data collected at FRK manufacturing unit at manufacturing stage

S No	Data elements to be captured at FRK	Auto-Populate	Validation	Remark
1	Name of the FRK Producer	Yes		
2	FSSAI License	Yes		
3	Complete Address	Yes		
4	Accredited by any agency or Not	Yes		
5	Manufacturer is Accredited by any agency or Not	Yes		
6	Pre-Mix batch No	Yes		Received and Accepted Only, Can be multiple
7	% of Premix to be used as suggested by Pre-mix manufacturer	Yes		From Batch No
8	Expiry Date of Pre-Mix	Yes		From Batch No
9	Quantity of Pre-Mix Used	No	Cannot be used beyond batch size	
10	Quantity of Broken Rice Used	No		
11	Date of Manufacturing	No		
12	Date of Expiry/Best Before/Shelf Life	No		
13	1 Package Unit Size of Batch	No	25-50 KG	can be multiple ex: 25KG & 50KG

14	Batch Size	No	No of Packages	(2*25KG)+ (1*50 KG)= 100 KG	
15	Batch No from FRK Manufacturer	No		entered	
16	FRK Batch No.	Yes		Barcode system generated	
	%age of FRK to be mixed for Miller	No			
Test					
17	Date sample sent	No			by FRK
18	Sample Receiving date				by LAB
19	FRK Batch No.	Yes			
20	Test Date	No			
21	Test Name	Yes		From Dropdown	
22	Person name who performed Test	No			
23	Upload Report	No		File Upload option	
Rejected Lot Receiving					
24	Received	No		Yes/No	
25	receiving Date	No			
26	Quantity	Yes			
Send Batch					
27	Sent to	No		Miller List	
28	Sent date	No			
29	Quantity	No			

Additional check on FRK as per guideline: at every 10 MT of quantity a new coA is required at vendor end, unless that the production cannot flow further

7.2.4 Example for Proportioning Used in Manufacturing FRK:

Table 10: Depiction of ratios and proportions used in FRK manufacturing

	Pre-mix	Total	Balance	Using	Left	Pre-Mix Quantity	Broken Rice Quantity	FRK Quantity Produced	bag Size	Bag No	Batch 1 FRK
Many to One	P1	100KG	10KG	10Kg	0KG	25kG	1250KG- at 2%- Premix	1275KG	25KG Bags	31	775
	P2	500KG	500KG	15kg	485KG				50 KG Bags	10	500

One to Many	P3	1Ton	1 Ton	100KG	900KG	100 KG	5Ton	5100KG	**bag Size**	**Bag No**	**Batch 3 FRK**
									25KG Bags	200	5000
									50 KG Bags	2	100
		1Ton	900KG	100KG	800KG	100 KG	5Ton	5100KG	**bag Size**	**Bag No**	**Batch 4 FRK**
									25KG Bags	1	25
									50 KG Bags	10	5000
Many to Many	P4 P2	100KG 500KG	10KG 485KG	10KG 15KG	0KG 470KG	25KG	1250KG	1275KG	**bag Size**	**Bag No**	**Batch 3 FRK**
									25KG Bags	31	775
									50 KG Bags	10	500
	P2	500KG	470KG	100KG	370KG	100KG	5Ton	5100 KG	**bag Size**	**Bag No**	**Batch 4 FRK**
									25KG Bags	200	5000
									50 KG Bags	2	100

7.3 Miller Module:

The miller gets its raw materials from the FRK manufacturer which is then tested (if required) or verified (from lab reports) and then utilized as input/ raw material for manufacturing of fortified rice. In addition to the fortified rice kernels, the miller also gets rice which is then blended with the FRK in ratios specified by the Govt. of India. The manufactured fortified rice can be dispatched to warehouse only after obtaining the test reports as approved. However, the testing can be configurable at state level and can be decided based on state decision/interest. Miller has to submit CoA, test reports of FRK along with fortified rice while sending batch to warehouse. If the quality of fortified rice is rejected during testing at warehouse, the lot will be rejected and sent back to Miller.

7.3.1 Functional Requirements:

The functional specifications for the miller module are described below:

Table 11: Functional requirements of Miller module

Req ID	Actions

Req 3.1	While receiving FRK, miller has to receive lab test report of FRK & CoA of pre-mixture along with FRK. Miller to verifying lab reports and other details – weight
Req 3.1.1	Miller to acknowledge the receipt of delivery
Req 3.2	Miller should be able to select FRK lot
Req 3.2.1	System should auto populate FRK batch no, Lab reports, Quantity, expiry dates etc.
Req 3.2.2	System to assign batch number, Quantity manufactured and date of manufacturing, expiry date, along with Profile details etc.
Req 3.3	Lab test should be configurable for Mandatory & Non Mandatory
Req 3.4	Miller should be able to track the status of lab test (whether lab is assigned or pending)
Req 3.5	batch to be ready for the dispatch to the warehouse lots as required/ request by the warehouse
Req 3.6	Miller should be able to manage/access FRK inventory (availability and usage to be tracked).

7.3.2 Module Specific Requirements:

The module also requires specific functionalities to ensure better traceability, quality assurance and quality control as listed below:

Table 12: Module Specific Functional requirements of Miller module

MSF 3 - Module Specific Functionality	
Req ID	**Actions**
MSF 3.1	Provision to update information of Miller - registration / approval process workflow defined in consultation with Technical Advisory Group (TAG)
MSF 3.2	Need to capture details of sample extraction sample extraction by, batch / lot number of Miller
MSF 3.2.1	Need to capture details while handing over consignment to transporter - consignment / Miller have to complete the test from the lab that is internally associated at Miller organization and get the Miller efficiency test completed. The fortified rice can be dispatched to Warehouse only if the Miller efficiency test meets the required checklist/test pass criteria. Miller efficiency test can be a physical test where ratios on colour of rice, broken rice moister etc. will be monitored. A chemical test can also be conducted if required.
MSF 3.3	Need to capture details like Batch Number, Name of Manufacturer, Date of manufacturing, Date of CoA, Name of Lab who issued CoA, Rating of Manufacturer.
MSF 3.4	System should be able to add dispatch information (Batch number, Lot number (Auto sequenced), Lot Quantity, Lot processor, Delivery address/ organisation, Delivery date, Transporter details etc.)

MSF 3.5	An internal lab should be configurable at each Miller level where the testing of Miller efficiency on fortified rice can be taken place.

7.3.3 Input Fields in the Fortified Rice Generation Form at Miller:

The Miller uses two different forms for data collection at two stages, namely

- Miller Pre Manufacturing
- Miller

The following details are captured at each stage respectively

7.3.3.1 Miller Pre-Manufacturing:

Data collected by Miller at Pre-Manufacturing stage is mentioned in below table.

Table 13: Data collected by Miller at Pre-Manufacturing stage

S No	Data elements to be captured at FRK	Auto-Populate	Validation	Remark	
1	Name of the Miller	Yes			
2	FRK batch No	Yes	only after valid Lab Report		
3	CoA of FRK	Yes		From Batch No	
4	FRK Vendor Name	Yes	Masked	From Batch No	
6	Expiry Date of FRK	Yes		From Batch No	
7	Receiving Confirmation	No			
8	Receiving Date	No			
Acknowledgement					
9	FRK lab report	Yes		From Batch No	
10	Acknowledge on basis of report	No		Yes/No	
11	Acceptance of FRK batch	No	if Yes in 10	in case rejected show back to FRK as rejected	
12	Rejection Reason	No	if No in 11	in case of rejection	
13	Acceptance/Rejection date of FRK batch	No	if Yes in 11		
Test if(No in acknowledgement on basis of report)					
14	Sample sent date	No			by Miller
15	Sample Received Date	No			by Lab
16	FRK Batch No.	Yes			
17	Test Date	No			
18	Test Name	Yes		From Dropdown	

20	Person name who performed Test	No		
21	Upload Report	No		File Upload option
Acknowledgement on basis of report from LAB				
22	Lab report	Yes		From Batch No
23	Acceptance of FRK batch	No	if Yes	if lab report is not fine, lot responsibility of FRK
24	Rejection Reason	No	if No	if lab report is fine, lot responsibility of Miller
25	Acceptance/Rejection date of FRK batch	No	if Yes	

7.3.3.2 Miller:

Data collected at Miller Manufacturing stage is mentioned in below table.

Table 14: Data collected at Miller Manufacturing stage

S No	Data elements to be captured at Miller	Auto-Populate	Validation	Remark
1	Name of the Miller	Yes		
2	FSSAI License	Yes		
3	Complete Address	Yes		
4	FRK batch No	Yes		Received and Accepted Only, Can be multiple
5	Expiry Date of FRK	Yes	alert if already expired, it should not be more than 3 months from the date of manufacturing of FRK	From Batch No
6	Quantity of FRK Used	No	Cannot be used beyond batch size	
7	Quantity of Rice Used	No		
8	Date of Manufacturing	No	Not beyond 2 weeks of current date	
9	Date of Expiry/Best Before/Shelf Life	No	1 year	
10	1 Package Unit Size of Batch	No	25-50 KG	can be multiple ex: 25KG & 50KG
11	Batch Size	No	No of Packages	(2*25KG)+ (1*50 KG)= 100 KG
12	Batch No by Miller	No		Self
13	Miller Batch No.	Yes		Barcode auto generated

Rejected Lot Receiving				
14	Received	No		Yes/No
15	receiving Date	No		
16	Quantity	Yes		
Send Batch				
17	Sent to	No		Warehouse List
18	Sent date	No	Not beyond 3 days of current date	
19	Quantity	No		

7.3.4 Example for Proportioning Used in Fortified Rice at Miller:

Table 15: Depiction of ratios and proportions used in Miller*

	FRK	Total	Left	FRK Quantity	Rice Quantity	Fortified Rice Quantity Produced	bag Size	Batch 1 Miller	
Many to One	F1	100KG	10KG	25kG	1500KG	1525KG	25KG Bags	1025	
	F2	500KG	15KG				50 KG Bags	500	
One to Many								**Batch 3 Miller**	**Batch 2 Miller**
	F3	1Ton	100KG	100 KG	1Ton	1100KG	25KG Bags	2500	0
							50 KG Bags	500	1900

These are sample no's, actual ratio is 1:100 KG

*The actual ratio considered for proportioning in Miller is 1:100. The numerical values provided in the table above is for reference purpose only.

7.4 Warehouse Module:

The manufactured material from Millers is sent to warehouses along with CoA of pre-mixture and lab test report of FRK which then verifies the lab reports (or may request for lab test again), weights, lot and batch numbers, expiration dates etc. and acknowledges the receipt. Warehouse module temporarily stores the fortified rice before distributing it to the stakeholders. This module requires functionalities like verification details of the lot received, requesting a lab test for the received samples, data entry and selection options

for recipient list etc. A warehouse can send batch/lot to another warehouse based on the need. A physical test will be conducted at warehouse after receiving the lot from Miller. In physical test the ration of fortified rice, broken rice, discoloured rice and moister in rice etc. will be examined. The same can be sent for chemical tests if required. Warehouse will have internal lab to do these physical tests.

7.4.1 Functional Requirements:

The functional requirements of the warehouse module are listed below:

Table 16: Functional requirements of Warehouse module

Req ID	Actions
Req 4.1	Warehouse to verify lab reports, weight and other details. Miller has to submit CoA of pre-mixture, FRK lab reports along with the lot while submitting the lot to warehouse
Req 4.1.1	Warehouse to acknowledge the receipt of delivery
Req 4.2	Warehouse should be able to request for lab reports for the submitted lot by submitting a sample in sample collection point in internal lab that is associated to warehouse
Req 4.3	Warehouse should be able to select the recipient for further distribution of the in-stock lot of fortified rice. Warehouse can dispatch the fortified rice to another warehouse based on the need

7.4.2 Module Specific Requirements:

In addition to the above-mentioned functional requirements this module also need specific functionalities like capturing details of the sample extraction, batch/lot numbers from which sample is extracted, and lab etc. to name a few. The detailed list of module specific list of warehouse module is given below:

Table 17: Module Specific Functional requirements of Warehouse module

MSF 4 - Module Specific Functionality	
Req ID	**Actions**
MSF 4.1	System should have a provision to capture details of sample hand over to the transporter for lab testing - sample extraction by, batch / lot number of Premix manufacturer and consignment / docket number of Transporter.
MSF 4.2	System should be able to input the receiver's details and create an automatic list for future usage
MSF 4.3	An internal lab should be configurable at each Warehouse level where the testing of fortified rice can be taken place.

7.5 Universal Lab testing interface:

The Universal Lab testing interface ensures that the sample tests are conducted in an unbiased manner. This module is used by the agencies to request for lab tests to be conducted on various samples. This module should have an empanelled list of registered laboratories where sample testing can be conducted.

When a test request is raised by an agency, the system should ensure:

- Lab should be assigned anonymously
- Sample should be dispatch to the assigned lab in an anonymous manner.

This module should have functionalities like generating a QR code-based sample ID to maintain the anonymity of the sample and lab details, generate masked labels for samples, auto assigning labs and logistics partner etc.

7.5.1 Functional Requirements:

A detailed list of this module is given below:

Table 18: Functional requirements of Universal Lab Testing Interface module

Req ID	**Actions**
Req 5.1	This sub-module will be used by the agency requesting for a lab test – should be able to send status or notification to the agencies on receiving request for lab test.
Req 5.2	System should be able to generate a QR code-based sample ID for the samples submitted by various agencies
Req 5.2.1	Need to mask the details of the agency requesting for the test.
Req 5.2.2	Need to generate a masked label which contains, Sample Date, Sample Type, Sample received date, Sample Received by etc.
Req 5.3	Tracking provision for the initiating agency
Req 5.3.1	Need to display sample assigned to lab
Req 5.3.2	Need to display sample under testing and status
Req 5.3.3	Need to display Sample lab test result
Req 5.4	System should be able to automatically assign the sample to a lab.
Req 5.6	Need to have an algorithm-based sample assignment sub module with a provision for manual override.
Req 5.6.1	Algorithm shall be designed after discussion with TAG
Req 5.7	Masked sample will be sent to Lab using a Logistic partner

7.5.2 Module Specific Functionalities:

The functionalities specific to this module are as described below:

Table 19: Module Specific Functional requirements of Universal Lab Testing Interface module

MSF 5 - Module Specific Functionality	
Req ID	**Actions**
MSF 5.1	Provision to accept samples from any type of stakeholder
MSF 5.2	A scanning functionality should be available to quickly capture details regarding the sample received
MSF 5.3	System should send an acknowledgement regarding sample received to the actual stakeholder

MSF 5.4	System should auto generate a new label with information a) Sample type b) sample received date c) sample manufacturing date d) Sample number
MSF 5.5	System should be able to book a delivery with logistics module after generating label
MSF 5.6	System should suggest which lab the sample will be sent to and path way to sample handing over (to lab) is available. **(In case logistics module is not integrated)**
MSF 5.7	System should update the receipt once the sample is handed over to Lab.

8. Lab Module:

When a lab test request is raised by a registered agency, the universal lab testing interface assigns the sample to a registered laboratory. On receiving the sample, the lab should be able to scan the sample and send notifications to the stakeholders. This module requires features like provision for input values (test results), auto evaluate the result based on the input values, auto generate the report etc.

8.1. Functional Requirements:

A detailed list of the functional requirements is listed below:

Table 22: Functional requirements of Lab module

Req ID	**Actions**
Req 7.1	Sample to be scanned
Req 7.1.1	Stakeholder to receive notification/sample status (Testing in process) without any information associated with Lab
Req 7.2	Need to conduct the test and process the result by scanning the masked QR code.
Req 7.3	Provision to input values: Scanned code, associated form - test results, sample type
Req 7.3.1	System to auto evaluate the test result Pass/Fail
Req 7.4	System to generate a report containing information: actual Batch and Lab process i.e., Sample received, Sample test date, lab assistant, lab details etc.
Req 7.4.1	Report should be visible to all concerned stakeholders in the system.
Req 7.5	Test request raised by Inspector/Monitoring module should be prioritised in this module to reduce turnaround time

8.2 Module Specific Requirements:

In addition to the above-mentioned list of functionalities, this module requires additional functionalities such as ability to internalise masked information to actual information after addition of lab findings, provision for labs to input key findings and results etc., provision to upload reports in various formats etc. A detailed list of all the module specific requirements is given below:

Table 23: Module Specific Functional requirements of Lab module

MSF 7 - Module Specific Functionality	
Req ID	**Actions**
MSF 7.1	System should be able to internalise Masked information to actual information once Lab finding data are added.
MSF 7.2	System should generate labels, with the required details with anonymized information of the micronutrient premix Manufacturer, FRK manufacturers, rice millers and warehouse, which can be printed and attached on the sample.
MSF 7.3	Quality lab should have provision to enter key result parameters in the module
MSF 7.3.1	Quality lab should have provision to upload the reports
MSF 7.3.2	System should have the inbuilt validation logic to decide to pass/fail for the sample based on the result parameters entered by the Quality lab.
MSF 7.4	System should generate masked receipt/acknowledgement for the sample received (receipt should not contain information on lab name or parties involved in the process).
MSF 7.4.1	System should send Masked receipt/ acknowledgement should be sent to the stakeholder on receiving the test sample
MSF 7.5.	System should be able to verify if the parameters are within the range or not
MSF 7.6	Provision to auto generate report once lab findings are submitted with Pass/Fail Stamp

8.3 Input Fields in Lab Report Forms:

When a Lab test is performed on various samples received from registered agencies, the lab also maintains records of basic data related to the sample on which the respective tests are conducted. The details captured in the labs along with the test reports for different agencies are given in the following tables.

Table 24: Data filled by the respective Lab for Premix Manufacturer

Test					
1	Date sample sent	Yes			by Pre-Mix
2	Sample Receiving confirmation	No			by LAB
3	Date sample received by LAB	No			
4	Premix Batch No.	Yes			
5	Test Date	No		From Dropdown	
6	Test Name	No		parameters as per test report from the document, only micronutrients	

7	Person name who performed Test	Yes			
8	Upload Report	No		File Upload option	

Table 25: Data filled by the respective Lab for FRK Manufacturer at Pre-manufacturing Stage

Test					
S No	**Data elements to be captured at FRK**	**Auto-Populate**	**Validation**	**Remark**	
1	Sample sent Date	No			by FRK
2	Sample received date	No			by LAB
3	Premix Batch No.	Yes			
4	Test Date	No			
5	Test Name	Yes		From Dropdown	
6	Person name who performed Test	Yes			
7	Upload Report	No		File Upload option	

Table 26: Data filled by the respective Lab for FRK Manufacturer at Post manufacturing Stage

Test					
S No	**Data elements to be captured at FRK**	**Auto-Populate**	**Validation**	**Remark**	
1	Date sample sent	No			by FRK
2	Sample Receiving date				by LAB
3	FRK Batch No.	Yes			
4	Test Date	No			
5	Test Name	Yes		From Dropdown	
6	Person name who performed Test	No			

7	Upload Report	No		File Upload option	

Table 27: Data filled by the respective Lab for Miller at Pre manufacturing Stage

Test					
S No	**Data elements to be captured at FRK**	**Auto-Populate**	**Validation**	**Remark**	
1	Sample sent date	No			by Miller
2	Sample Received Date	No			by Lab
3	FRK Batch No.	Yes			
4	Test Date	No			
5	Test Name	Yes		From Dropdown	
6	Person name who performed Test	No			
7	Upload Report	No		File Upload option	

9. Monitoring/ Inspection Module:

Inspection module is a special module that is being developed to monitor the quality of the product at different stages of the supply chain. This module is used by the visiting inspector and it should provide features like ability to enter agency details, batch/lot number picked by the inspector for testing purpose, maintain batch wise traceable information for each sample throughout the supply chain for better visualization etc. List of checklists for various stages of inspection to be added to the system so that Inspectors can perform monitoring against the given checklist.

9.1. Functional Requirements:

The detailed functional requirements of this module is listed below:

Table 29: Functional requirements of Monitoring/ Inspection Module

Req ID	**Actions**
Req 8.1	Provision to enter details of visiting inspector - agency details, batch etc.

Req 8.2	System to maintain batch wise traceable information for each sample from pre-mix manufacturer, FRK producer, rice Millers for visualization.
Req 8.3	List of checklists for various stages of inspection to be added to the system so that Inspectors can perform monitoring against the given checklist.

9.2 Module Specific Requirements:

This module should also require additional specific features to ensure better traceability. The detailed list of module specific requirements for Monitoring/inspector module is given below:

Table 30: Module Specific Functional requirements of Monitoring/ Inspection Module

MSF 8 - Module Specific Functionality	
Req ID	**Actions**
MSF 8.1	Provision to select any material like (Pre-mix/ FRK etc.) is required.

10. Traceability:

As the complete process of generation of fortified rice involves through various modules, the system should allow its users to trace the history of each batch/lot/bag/box backwords. Who is the pre-mixture vendor, what raw materials used, who is the FRK manufacturing vendor, who is the Miller etc. details along with list of tests performed at various stages and their respective lab reports should be accessible by scanning the QR-code on the bag at warehouse level. The traceability should also happen at various levels by showcasing the details of vendors/materials/tests conducted till that phase. Government agencies may involve at various stages to link pre-mixture vendors to FRK vendors and FRK vendors to Millers based on the demand in various states and productivity of rice and pre-mixture and FRK in various states. A high level reports can be provided to Government agencies to see list of registered vendors for pre-mixture, FRK and Millers to make better procurements. This procurement process can be varied state to state based on the policies in place at state/central government.

11. List of Stakeholders

Following user groups may use Fortified Rice Quality Management System application.

1. Food Corporation of India (Quality Control, Procurement & Warehouses)
2. State Agencies (Procurement, Warehouses & Quality Control)
3. NABL Accredited, FSSAI recognized Laboratories
4. Pre-mix Manufacturers
5. FRK Manufacturers
6. Rice Mills

7. NIFTEM (Quality Assurance Unit)
8. CFTRI (Quality Testing Unit and linked Sampling Cells)
9. Department of Food & Public Distribution (MIS)

12. Laboratories:

Following are the list of laboratories that can provide approval/licenses to the Labs that can use Fortified Rice Quality Management System application.

1. NABL accredited laboratories
2. FSSAI registered laboratories

13. Non-Functional Requirements

The below table provides number users in each category who can access the Fortified Rice Quality Management System application.

Table 31: Number of users under each category

User	Number
Pre-mix Manufacturers	150
FRK Manufacturers	500
Millers	25000
FCI – TA	2000
State – TA	6000
Food Inspectors	1000
Other Users	100

14. Annexure A

14.1. Details of Testing

Levels per Kg of fortified rice kernels

Table I: Reference ranges for Micronutrient

Micro-nutrient	Reference Range	Test Value	Reference Test Method (AOAC/IS methods)	Test Method Followed
Iron (Micronized Ferric Pyrophosphate)	2800-4250 mg/kg		FSSAI.FR.16.001.2022	
Folic Acid	7500-12500 µq/kg		FSSAI.FR.16.002.2022	
Vitamin 812 (Cyanocobala	75-125 µg/kg		FSSAI.FR.16.003.2022	

mine or Hydroxycobalamine)				

Table II: Reference ranges for various physical attributes of Rice used in Rice Fortification

S No	Physical Attributes	Reference Range	Test Value	Reference Test Method	Remarks
1	Moisture Content %	12%		IS 4333(Part 2)	
2	Broken Fortified Rice Kernels	1%		IS 4333(Part 1)	
3	Foreign matter	0.001%		IS 17782:2021	
4	Damaged grains	Absent		IS 4333(Part 1)	
5	Discolored grains	Absent		IS 4333(Part 1)	
6	Chalky grains	Absent		IS 4333(Part 1)	
7	Admixture	Absent		IS 4333(Part 1)	
8*	Uric Acid, mg/Kg, on mass basis, not more than	100.0			
9*	Yeast and Mould Count (cfu/q)	$1*10^2$			
10*	Aerobic Plate Count (cfu/q)	$1*10^4$			
11	Length (mm)	-			
12	Breadth (mm)	-			
13	Thousand Kernel Weight	-			
14	True density	-			
15	Prepared from (Raw/Parboiled) Rice	-			

* The reference range is as per the limits mentioned by FSSAI

For parameters 11-14 the FRK should match the parameter of conventional rice to which FRK is to be blended.

14.2. Quality Control matrix of Premix, FRKs and Fortified Rice

Table III: Quality Control matrix of Premix, FRKs and Fortified Rice

	Timing of testing	Type of tests	Sample to be collected by	Place of testing	Place of sample collection	Approved by and action taken on approval	Action (If not approved and/or test/s is failed)

Supply of premix	Before dispatch of Premix	Physico - chemical requirements Micronutrient composition	Premix manufacturer	FSSAI-notified NABL accredited lab	Premix manufacturer facility	FRK manufacturer **Action**: A batch of p remix is shipped to the FRK manufacturer	**Action:** Rejection of a batch of premix and production of a new batch of premix by the premix manufacturer
Supply of FRK	Before dispatch of FRK	Physical attributes Micronutrients testing Microbiological testing	FRK manufacturer	Physical attributes (the internal quality lab of FRK manufacturer or FSSAI-notified NABL accredited lab) Micronutrients testing (FSSAI notified NABL accredited lab) Microbiological testing (FSSAI notified NABL accredited lab)	FRK manufacturer facility	Rice miller (in case the rice miller is procuring the FRKs) Procurement agency in case the state is procuring the FRKs centrally. **Action:** A batch of FRKs ls shipped to the rice mill or the procurement agency.	**Action:** Rejection of a batch of FRKs and production of a new batch of FRKs by the FRK manufacturer
	At the time of receipt of FRKs	Micronutrient testing	Rice Miller/ Procurement agency	FSSAI-notified NABL. accredited lab	Rice mill/place of storage	Rice miller/ Procurement agency **Action:** Continued use of a received batch of FRKs for blending with conventional rice	**Action:** Rejection of the batch of FRKs and production of a new batch of FRKs by the FRK manufacture. Any action by the procurement agencies should be

							under the consultation with Ministry.
Production of the Fortified rice	During the Blending of FRK with CMR	Blending ratio through BET (hourly basis)	Rice miller	Internal quality lab/ facility of the rice miller	Rice miller facility	Internal checks/ approval by the rice miller State Food and Civil Supplies Department may do random checks of the records **Action:** Continued production of fortified rice	**Action:** Necessary corrective action to be taken by the rice miller at the blending equipment to achieve the ratio of 1:100. Rejection of a batch of fortified rice and production of a new batch of fortified rice by the rice miller
Supply of the fortified rice	At the time of receipt at the storage point	Physical attributes/ refractions including blending ratio Weight Stencilling prescriptions	Procuring agency (FCI/ state agencies, as the case may be)	Internal quality lab	FCI /state storage point	Verification of CoA of premix and FRKs by the FCI or the State procurement agency (as applicable) **Action:** Acceptance of the lot / batch of fortified rice	**Action:** Rejection of a lot of fortified rice and production of a new lot of fortified rice by the rice miller and other penal provisions under consultation with the ministry
	After receipt, before dispatch to the next point in supply chain	Micronutrient testing	Procuring agency (FCI/ state agencies, as the case may be)	FSSAI-notified NABL accredited lab	FCI /state storage point	**Action:** Continued storage of fortified rice at the FCI/State godowns.	**Action:** Rejection of a lot of fortified rice and production of a new lot of fortified rice by the rice miller

							and other penal provisions under consultation with the ministry
Monitoring of quality control in FRKs at the FRK manufacturer	Monthly basis	Microbiological &Micronutrient testing Quality inspections	Food Safety officer / State Food and Civil Supplies Department	Microbiological/ Micronutrient testing (FSSAI approved NABL accredited lab)	FRK manufacturing unit	**Action:** Continued production of FRKs by the FRK manufacturer	**Action:** As per the existing guidelines/ provisions
Monitoring of quality control in fortified rice at the FPS	Monthly basis	Micronutrient testing& microbiological Quality inspections including verifying records of blending ratio, CoAs of FRK, and premix.	Food Safety officer / State Food and Civil Supplies Department	Micronutrient & microbiological testing (FSSAI notified NABL accredited lab)	FPS	**Action:** Continue distribution.	**Action:** As per the existing guidelines/ provisions
Monitoring of quality standards of FR and FRK at FRK manufacturer /rice mill/FSD/FPS /Rail heads/truck heads/Procurement centers/other transit points	Periodic and surprise check	Quality inspections	Department of Food & Public Distribution	Testing at departmental labs/FSSAI notified, NABL accredited lab	FRK manufacturer/ rice mill/FSD/FPS/ Rail heads/truck heads/Procurement centers/ other transit points	**Action:** Continued production of fortified rice by the rice miller/ storage/ distribution as applicable	As per the guidelines issued by letter dated 16-07 -2027 for Monitoring the quality of Food Grain Stocks procured under DCP. The same will be followed for centralized procurement.