RESULTS AND DISCUSSION

This chapter presents the findings of the research in accordance with the major objective of the study for each of the phases described earlier**.** The overall objective of the research was to improve food and nutrition security using public**-**private partnership in rural households**.**

Study was conducted in four clusters of rural Vadodara from July 2015 to February 2017. Based on the objectives of the study, results and discussions have been divided into two phases:

Phase I: Understanding the food and nutrition security (FNS) status and predictors of undernutrition of the mother**-**child pairs in a rural setup - presented under the following sections:

A. Description of the ecosystems (natural and Government) in the study area
B. Background information and scenario of food and nutrition security in the rural households enrolled for the study (Availability, Accessibility, Affordability, Utilization, Stability)
C. Evaluation of predictors of undernutrition (wasting, stunting, underweight)

Phase II: Identification of Positive Deviant Behaviours (PDBs) and promotion of mothers with identified PDBs– a community trial for improving Food and Nutrition Security using Public Private Partnership **–** presented under the following sections:

A. Identification of the positive deviant behaviors among mother-child pairs enrolled under the study
B. Results of the impact of capacity building and infrastructure development to improve food and nutrition security through interventions as a part of public-private partnership in rural households

RESULTS PHASE I: UNDERSTANDING THE FOOD AND NUTRITION SECURITY STATUS AND PREDICTORS OF UNDERNUTRITION OF THE MOTHER-CHILD PAIRS IN A RURAL SETUP

Food and nutrition security (FNS) was assessed using various indicators defined by IFPRI (2015) and predictors of Undernutrition were identified.

The clusters selected in the present study were purposively selected as a part of the public-private partnership project and were selected based on their similar cultural backgrounds from a block of rural Vadodara, Western India as discussed in the methods chapter. All households with mothers and children <5y (n=160) were enrolled with the help of the local Government's ICDS (Integrated Child Development Services) run *anganwadi centre* (n=3) (n=160).

Section A: Description of the eco-system (natural and government) in the study area

Natural eco-system

The four clusters covered in the present study were a part of Ekalbara village, in Padra Taluka, in Vadodara district, Eastern Gujarat, Western India. It lies between latitudes 21° 45' and 22° 45' North and longitudes 72° 48' and 74° 15' East.

Soil

Majority of the geographical area is under cultivation indicating the district as important agricultural district. The Mahi River passes through the area. The study area falls under alluvium formation, which is very fertile and thus soils of the district are suitable for agriculture. Despite of all these, due to presence of industry, agricultural practices were not satisfactory in the study area.

Climate

The climate of the study area can be described as hot and humid. During winter season, it is never too cold with temperature remaining over 10 degrees. January is the coldest

month of the year and May is the hottest. It is hot in the period from March to October with temperatures hovering over 35°C, with little respite during monsoon in June, which lasts till the end of September. During last ten years, the average rainfall has been recorded in the range of 1000 mm.

Water management/Irrigation practice

The agriculture is said to be, "the gambling of the monsoon" as it is controlled by monsoon rainfall which at several times are uncertain, irregular and uneven or unequal. Total annual rainfall in the district occurs in three or four months, i.e. from June to September. Thus, irrigation for crop production during the rest eight months becomes very essential.

Agriculture

In Kharif season, crops like Paddy, Cotton, pulses, and Maize are grown. In the district, Cotton occupies around 40% of area under Kharif crops. Four main Rabi crops namely Wheat, Tobacco, Sugarcane and Maize are grown amng which wheat and Sugarcane are the main crops. In Summer Season mainly crops like groundnut and Bajri are grown.

Existing government program ICDS

All the ICDS workers were interviewed using semi-structured and open-ended questionnaire to determine the functionary's perspective regarding ICDS implementation in the study area.

Profile of the functionaries and infrastructure of the AWC

Overall, there were 3 *anganwadi centres* (AWC) in the study area, each having one *anganwadi worker* (AWW), one *anganwadi helper* and one assistant recruited especially for growth mornitoring of children**.** They were all married and hindu, *Anganwadi workers* were all aged between 35-40 years, educated upto secondary level **(**10^{th} std**)**, and had more than 5 years of work experience**.** All three AWCs had pakka roof, provision of drinking water, electricity, drainage facilities as well as utensils for cooking/ serving. Separate kitchen was present in two out of three AWCs**.** Though sanitary latrines were present in all three AWCs, only one was functional and that also was not child friendly**.** All the AWCs were equipped with various NHE (Nutrition

Health Education) materials such as charts on birds, animals (wild & pet), vegetables, fruits, transport, numbers, shapes, festivals, flowers, posters on healthy lifestyle, zoo, story-telling poster (Lion and rat), games etc.

Current implementation of selected ICDS services

Various services provided by ICDS in the study area were listed and explained in detail in table 4.1.1 which indicated the current implementation of the scheme in the area as recorded from the personal interviews of the ICDS workers and personal observations. It was observed that though supplementary nutrition and pre-school non formal education were delivered properly, nutrition and health education to mothers was not satisfactory and home visits for that purpose also not done by the workers.

Table 4.1.1: **Services provided by ICDS in the study area from functionaries' perspective**

Expected job functions	**Activities conducted**	**Quality of service**	**Frequency of performing the activities**
Health Check-up Camp	Yes, at all 3 AWCs	This service provided by the CSR team of local industry in the AWCs	No fixed date
Treatment of common illness and minor ailments	Only at 1 out of 3 AWCs	Only at one AWC, where there was no separate health centre, during mamta day treatment of common illness was done by ASHA and ANM Otherwise there was no case where mother came for treatment of their ill child	-
Referral Services	Yes	AWWs said they refer people to the health centre whenever required	-
Growth monitoring	Yes, at all 3 AWCs	They use growth chart for growth monitoring of the children, separate growth charts are used for boys and girls**.** Only weights are measured and recorded regularly.	Monthly
Mamta day celebration	Only at 1 out of 3 AWC	In other 2 area, mamta day was celebrated in the separate health centre and not in AWC, IFA tablets also distributed there	Monthly
Conducting Home visits for NHE	No	No home visits were made by the AWW for imparting NHE to the women**.** They only paid	-

		home visits to call the children to participate in AWC programmes	
Health related information to mothers	Yes in all 3 AWCs	Mainly health related information provided to mothers when they come for supplementary food collection very occasionally specially when mothers are interested to know. AWWs said, mothers were very reluctant to come to AWC due to lack of time, distance from household as well as awareness regarding its services and benefits**.**	Occasionally
IFA tablet distribution and ante-natal care programmes	One out of 3 AWCs	IFA tablets distribution and antenatal care programmes carried out at the health centre and AWC for all he pregnant mothers who come**.** Regarding adolescent girls, they said distribution is less as adolescent girls are not aware about IFA tablets and they are all very reluctant consuming it as they don**'**t like the taste, suffer from nausea and don**'**t understand the necessity of consuming it**.**	Daily
Preparation and distribution of supplementary food	Yes, in all 3 AWCs	Helper prepared the food, AWW did not have to spend time for this service**.** Standard measurements were not used **(**for measuring the raw ingredients and for distribution**).**	Daily
Pre**-**school non formal education activities	Yes, in all 3 AWC	PSE was not conducted for any fixed time duration; the AWWs had no pre- decided sequence of activities for each day. No motor development skills were taught.	Daily
Record keeping	Yes, in all 3 AWCs	After the children left the AWC, the AWWs filled records and registers	Daily
Inspection of children for cleanliness	Yes, in all 3 AWCs	AWWs teach the children regarding good hygiene though inspection was not that strict in the time of practices of those hygiene behaviour	Daily

Knowledge and perceptions of ICDS functionaries

Table 4.1.2 indicates that ICDS functionaries had proper knowledge regarding 3 basic IYCF practices, initiation of breastfeeding, exclusive breastfeeding for 1st 6 months and

initiation of complementary feeding**.** However, more empowerment needed to sensitize regarding micro-nutrient deficiency and micronutrient rich food sources.

Table 4.1.2: Questions asked to AWWs to assess their knowledge and the answers given by them

Serial No	**Questions asked to AWWs**	**Answers given**	**n(%)**
1	What should be average weight for a new born?	>2.5 kg	3(100)
2	When the breastmilk should be initiated to a new born?	Within an hour after birth	3(100)
3	How long should the exclusive breastfeeding have continued?	1st 6 months after birth,	3(100)
4.	At what age the child should be initiated complementary food?	After the completion of 6th month	3(100)
5.	What food should be given initially to the child as complementary food?	Dahl bhaat, khichdi, shaak, soft food	3(100)
6.	How much supplementary food should be given to a malnourished child?	No clear idea	0 (0)
7.	How ORS has to be prepared at home?	1 packet ORS in 1lt water	100 (3)
8.	What are the iron rich foods available in the area?	One AWW said red colour food and others couldn't answer	33.3 (1)
9.	What disease can be caused by vitamin A deficiency?	Not answered by any of the 3	0 (0)
10.	What is the average height of a 1year old child?	All said they have to check	0 (0)
11.	What is the ideal age for marriage of a girl?	18 years	100 (3)
12.	Spacing between two children	3years	100 (3)

*Figure in parentheses denotes percentage

Opinion of ICDS functionaries regarding ICDS services

The AWWs were asked about ideas and suggestions and their opinion regarding how to improve the services and infrastructure of ICDS mentioned in table 4.1.3 It was observed that though they were very enthusiastic regarding more nutrition study materials and games, they were all very reluctant to do any long-term modifications in the programme for sustainable change**.** They were all satisfied with the space provided for AWC as well as the no of employers**.**

Table 4.1.3: Opinions of AWWs regarding functioning of ICDS

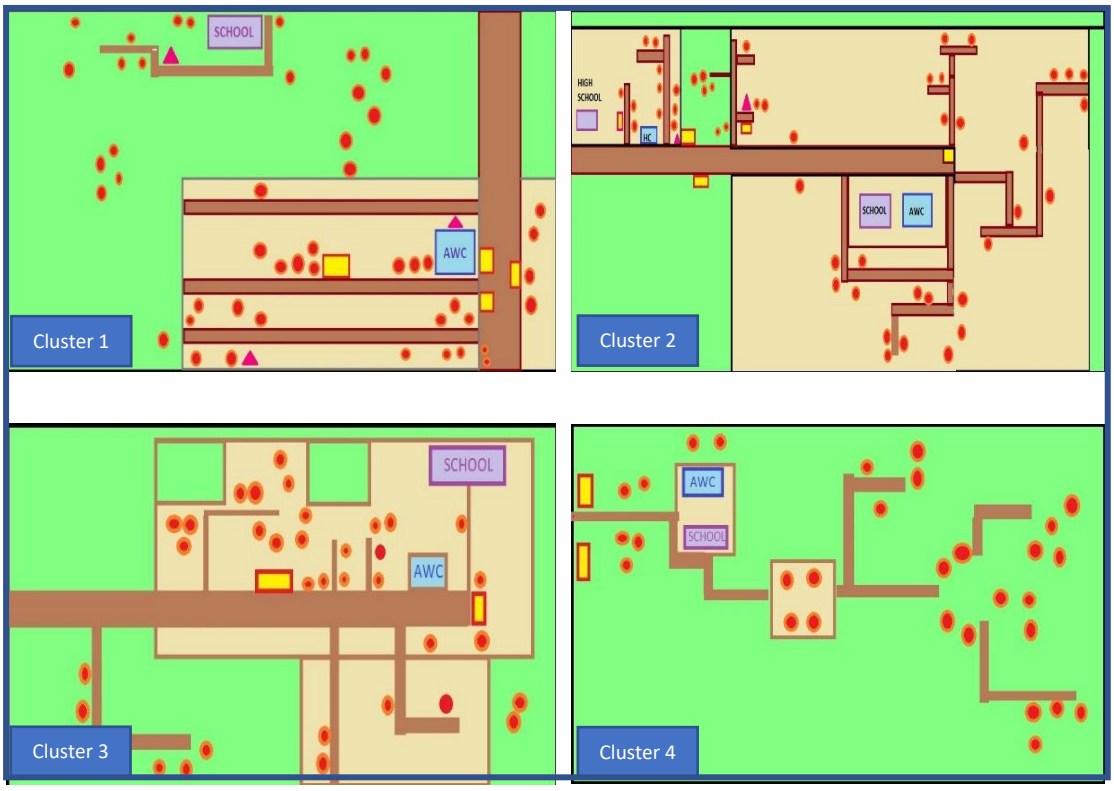
Serial No	**Parameter related to functioning of AW**	**Views of AWWs**	**n(%)**
1	Do you think more AWWs are needed for smooth and effective implementation of the program?	Only one among three said needed	1(33.33)
2	Do you think enough place is there in the AWC for the children?	All were satisfied, only when more children come they face difficulties	3(100)
3	Do you think more materials should be provided for education purpose?	All said yes, more charts, posters and games, as then it will be easier for them to involve children in various activities	3(100)
4	Do you think the participation of the beneficiaries in the AWC is satisfactory?	All said no, they said mothers are not aware enough regarding the benefits of the services, and reluctant to send their children	0 (0)
5	Do you think the proper pre-school education is provided to the children in AWC	All said yes	3(100)
6	Do you think health and nutrition education is properly provided by you?	All said yes	3(100)
7	Do you think more variety should be there in the supplementary food provided by the AWC?	All said no, there are enough variety and they make food according to the weekly food charts provided to them from ICDS	0 (0)
8.	What is your idea to improve the facilities of AWC?	No clear answer given, they said meetings can be arranged, mothers can be sensitized	0 (0)

*Figure in parentheses denotes percentage

Thus, overall as per the study the result of the situational analysis of existing government program ICDS revealed that in the study area, only 3 ICDS centres or anganwadi centres were present resulted in less utilization of ICDS in one village cluster (cluster 4) due to distance issue. In all 3 AWCs basic ICDS services were but Nutrition health education to mothers by the AWWs and regular home visit for that purpose was not satisfactory. IFA tablets distribution was not satisfactory especially among adolescent girls and AWWs had very less knowledge regarding micronutrient rich foods and micronutrient malnutrition.

The mother-child pairs distribution from 4 village clusters was presented in following figures (4.1.1).

Figure 4.1.1: Distribution of mother-child pairs enrolled for the study



**Green area indicates agricultural field, brown lines indicate roads, red circles indicate households selected for the study, violet boxes indicate schools, blue boxes indicate *Anganwadi centre*, yellow boxes indicate shops

The age range of the mother child pair enrolled for the present study were presented in the following figures (Figure 4.1.2 & Figure 4.1.3).

Figure 4.1.2: Age range of children selected for the study

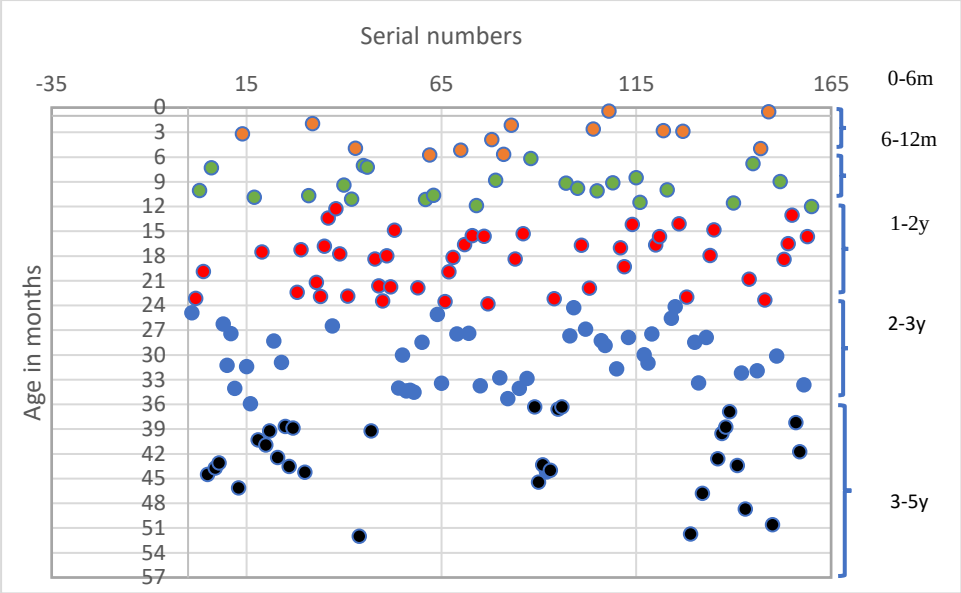
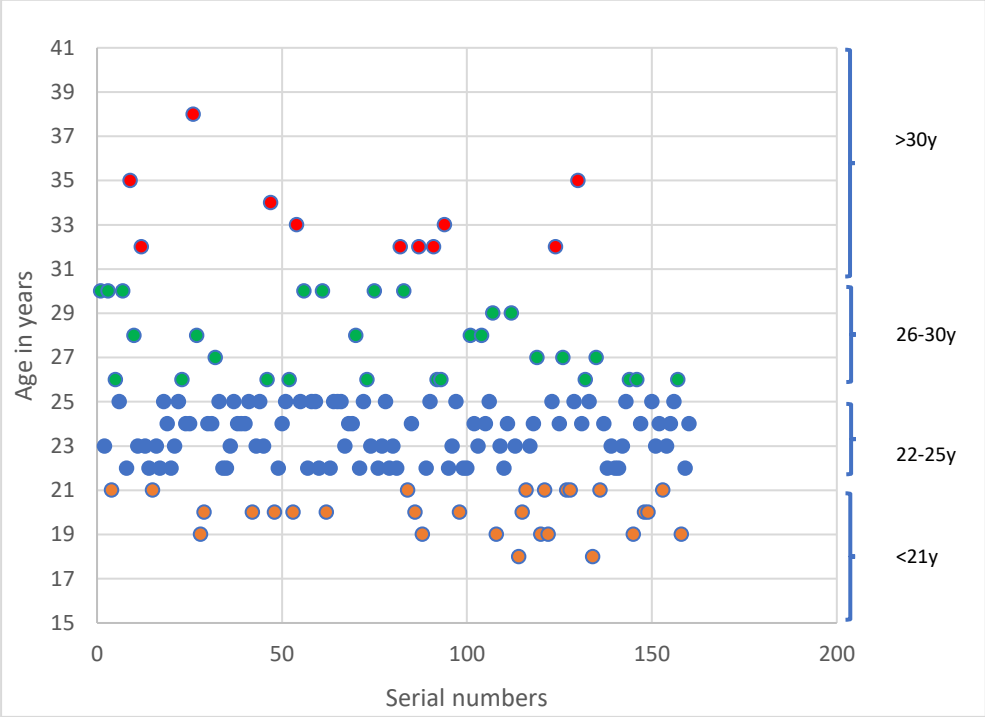


Figure 4.1.3: Age range of mothers selected for the study



The results were discussed below in the following sub-sections:

Section B: Understanding the scenario of Food and Nutrition Security (FNS) in the rural households enrolled for the study (availability, accessibility, affordability, utilization, stability)

Results of Background information of the mothers-children pairs

Table 4.1.4 indicates that majority of mothers were in the range of 22-25 year (57.5%) with two children (42.5%) and completed secondary education (52.5%). Majority of mothers were married before 18 years (53%) and 23**%** had their 1st child before they were 18 years old**.** Based on the obstetrics history, miscarriages were reported in 7**%**, low birth weight baby (LBW) in 20**%**, premature delivery in 7**%** and institutional delivery 91.25%. However, 90% of women had no records of significant weight gain during pregnancy and only 22**.**5**%** women reported to have consumed more than routine foods during their pregnancy**.**

Background information of children revealed that 52**%** of the children were boys while 48**%** were girls, lived in a joint family (68.75%) setting, of which 46**.**2**%** had 6**-**10 members in the family**.** Among 160 children, 20% weighed less than 2.5kg at birth and also 23% weighed more than 3kg indicating the possibility of dual burden of malnutrition (Table 4.1.5).

Table 4.1.4: Background Information of mothers

Background Information of mothers			
Mother's age		n=160	**%**
	18-21	28	17.5
	22-25	92	57.5
	26-30	29	18.1
	>30	11	6.9
Mothers' education	Illeterate	17	10.63
	Primary	52	32.50
	Secondary	84	52.50
	Higher Secondary	5	3.13
	Graduate	2	1.25
Age when 1st child was born		N=160	**%**
	<18	38	23.75
	18-21	90	56.25
	>21	32	20
No of children		N=160	**%**
	One	61	38.13
	Two	68	42.50
	Three	19	11.88
	Four	8	5.00
	Five	4	2.50
History of delivering LBW baby		N=160	**%**
	Yes	20	12.5
	No	140	87.5
History of pre-mature delivery		N=160	**%**
	Yes	7	4.38
	No	153	95.63
Changes in diet during pregnancy		N=160	**%**
	More than you normally do	36	22.5
	Less than normal	112	70
	Same as before	12	7.5

Table 4.1.5: Background Information of child

Background Information of child			
Child's age		n=160	**%**
	0-6 months	14	8.8
	>6 months-1year	23	14.4
	>1year-2years	45	28.1
	>2year-3years	46	28.8
	>3years-5years	32	20.0
Child's gender		N=160	**%**
	Male	83	51.88
	Female	77	48.13
Type of family		N=160	**%**
	Nuclear	50	31.25
	Joint	110	68.75
Family size		N=160	**%**
	less than/equal to five	69	43.13
	less than/equal to ten	74	46.25
	more than ten	17	10.63
Place of delivery of the enrolled child		N=160	**%**
	Govt. Hospital	49	30.63
	Private hospital	97	60.63
	Home	14	8.75
Birth weight of the child		N=157	**%**
	<2.5kg	32	20.38
	2.5kg	35	22.29
	2.6kg-3kg	54	34.39
	>3kg	36	22.93
Birth registration		N=160	**%**
	Yes	160	100
	No	0	0

Results of scenario of food and nutrition security in the rural households enrolled for the study (Availability, Accessibility, Affordability, Utilization, Stability)

Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO policy brief, 2006). It has four components-availability, accessibility, utilization and stability which are presented in the following sections: -

The indicators used to assess the Food availability at household and community level were: -

- Agricultural practices
- Livestock, local shops and market
- Provision of Food aid (functioning of ICDS)

The indicators used to assess the Food affordability at household level were: -

- Income and possession of electronic gadgets and vehicles by the HHs

The indicators used to assess the Food accessibility at household and community level were: -

- Roads
- Drinking water

The indicators used to assess the Food utilization at household and individual level were: -

- Household dietary diversity (HDD)
- Household dietary pattern
- Infant and young child nutrition
- Dietary pattern of children
- Hygiene and sanitation practices
- Nutritional status of mothers
- Status of maternal anemia
- Nutritional status of children

Agricultural practices

Among 160 households (HHs), 58% had farms wherein with maximum percentage in cluster 1 (81.3%) and 4 (100%). However, agriculture was main source of income for only 18.75% households, majority were from cluster 1 (35%) (Figure 4.1.4 & Figure 4.1.5) as all produce was used only for personal consumption.

Figure 4.1.4: Cluster wise Agricultural and non-agricultural household distribution

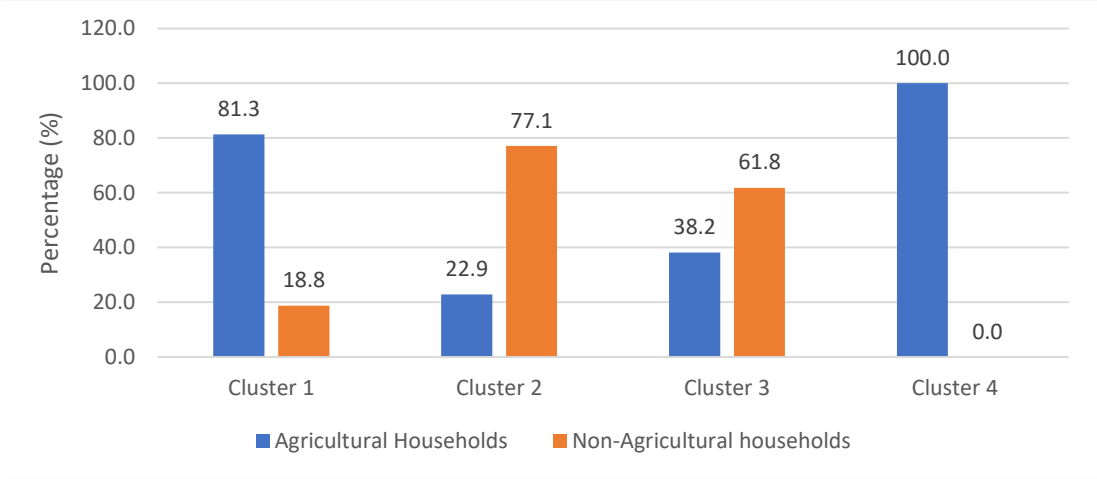


Figure 4.1.5: Food and agriculture as main source of income

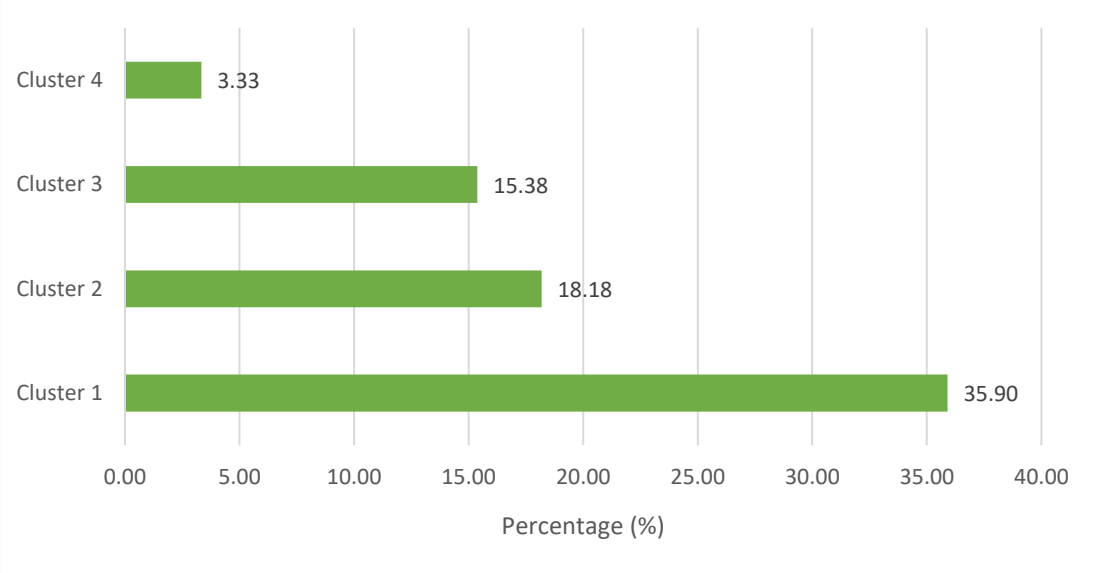


Table 4.1.6 indicates that only 13.13% fathers of the children enrolled in the present study were farmers and only 23.75% mothers were involved in farming in their own land.

Mothers and other villagers reported that the agricultural field in the study area was not agriculture friendly due to soil and water pollution. As it was an industrial area, crops which were cultivated were not sufficient both for income generation of the family as well as self-dependency regarding daily diet of the family. Main cultivated crops in the study area were bajra (pearl-millet) (56%), tindola (50%) and grass (58%). Also, cultivation of brinjal, ladies' finger, bottle gourd, drumstick, cauliflower, cluster beans, and methi(fenugreek) were recorded.

Verbatims about agricultural produce

"*Company na karane pani ane jameen nu pradushan vadhyu chhe ane jameen bin-upjau bani chhe*". (Presence of industry created water and soil pollutin and made soil non agriculture friendly).

Table 4.1.6: Agricultural practices at household level

Agriculture and livestock			
Possession of agricultural land		n=160	**%**
	Yes	93	58.12
	No	67	41.87
Main source of income		N=160	**%**
	Agriculture	30	18.75
	Labour	43	26.88
	Industrial worker	79	49.38
	Others (small business, catering etc)	8	5.00
Mother's profession		N=160	**%**
	Housewife	112	70
	Farmer	38	23.75
	Agricultural labour	8	5
	Other (small business)	2	1.25
Father's profession		N=160	**%**
	Unemployed	5	3.13
	Farmer	21	13.13
	Agricultural labour	3	1.88
	Daily labour	39	24.38
	Industrial worker	77	48.13
	Other (small business, catering etc)	15	9.38

Glimpses of women involved in agricultural practices (Image 4.1-4.2)

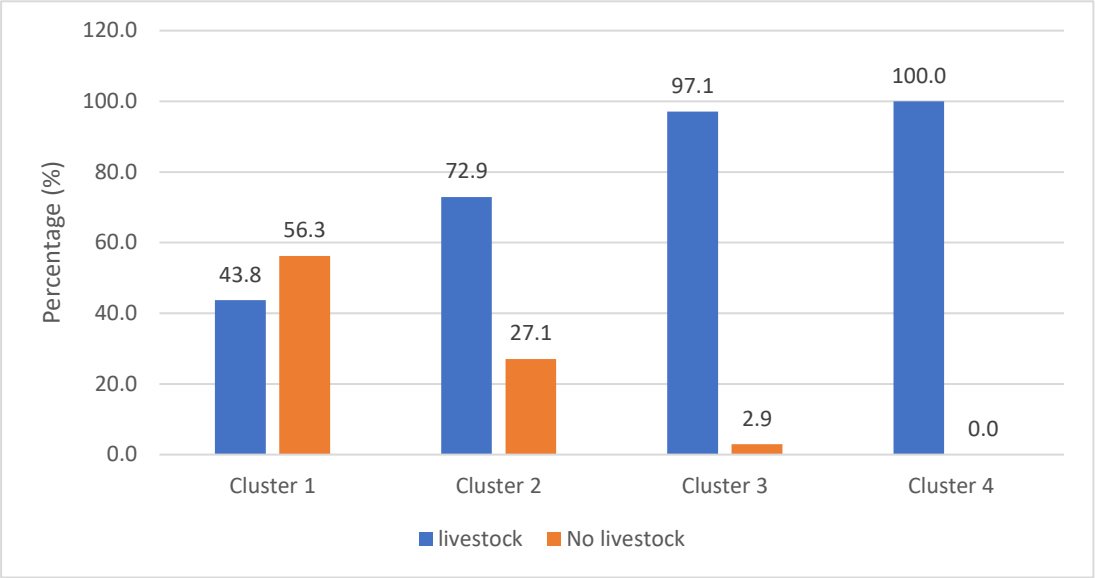
Thus, overall as per the study the result of the situational analysis of agricultural practices, revealed that only 58% households had farms and agriculture was main source of income for only 18.7% households. Among the 160 mothers, 28% involved in farming whereas among their husbands only 15% involved in farming.

Livestock, local shops and market

Major livestocks in the area under the study were buffaloes (74.37%), goats (4.2%) and hens (2.52%) which were mainly possessed by Households of Cluster 3 and 4 as seen in figure 4.1.6.

Overall 12 small shops selling food were available in 4 village clusters as seen in the cluster maps (Figure 4.1.1) which sold packaged food items such as biscuits, chips, cakes, chocolates of local brands. Limited vegetables such as brinjal, potato, onion, ridge-gourd were also available. The nearest wholesale market was situated in 8.5km distance from all four village clusters in Padra which was also the headquarter for the clusters.

Figure 4.1.6: Livestock in the households of selected clusters



Glimpses of local shop and market nearby (Image 4.3-4.4)

Thus, overall as per the study the result of the situational analysis of livestock and market availability assessment revealed that buffalos were main livestock (74.3%) in the village from which the households acquire milk. Mainly packaged foods and limited vegetables and staple foods were available in the local shops. Wholesale markets were nearby and could be accessed by cycles/two wheelers.

Food aid (Functioning of ICDS)

At the time of the study, under the ICDS scheme, Gujarat Governemnt provided micronutrient fortified extruded blended food as Take-Home Ration to all the children under 6 years, adolescent girls, pregnant and lactating mothers. This was also included and studied as an indicator of food security as food aid. Indepth interviews of both *anganwadi workers* (AWW) as well as benificiaries covered in the study to assess the consumption and utilization patterns of the energy dense extruded fortified blended "Ready to Cook" food *BalBhog, Sukhadi, Sheera* and *Upma* packets which were available free of cost from their respective *Anganwadi centers* (AWCs). Record was also maintained about the nutrient supplementation from AWCs to the beneficiaries such iron-folic acid tablets.

Iron-Folic Acid (IFA) Tablet Consumption

Results indicated that only 55% mothers reported to have received 60-90 IFA tablets, 15**%** complained to have received less than 30 and of these 38**%** reported to have consumed < 30 tablets due to various reasons such as they did not like the taste, suffer from nausea and vomiting feeling etc. However, 63**%** mothers had received counselling regarding how to consume IFA tablets of which 76.25 **%** had received that counselling from AWWs, 13.75% from ANM and 8.75% reported to have received counselling form doctors (Table 4.1.7).

Glimpses of IFA tablet strips in available in AWCs (Image 4.5-4.6)


4.5


4.6

Table 4.1.7: IFA Tablets consumption by mothers during their pregnancy

IFA Tablets consumption			
No of IFA tablets received		n=160	**%**
	<30	24	15.0
	30-60	38	23.8
	60-90	89	55.6
	>90	9	5.6
No of IFA tablets consumed		n=160	**%**
	<30	61	38.13
	30-60	45	28.13
	60-90	47	29.38
	>90	7	4.38
reason behind not consuming at least 90 tablets		n=107	**%**
	do not like/forgot to take	31	28.97
	nausea/vomiting/dark stool	49	45.79
	availability/accessibility problem in AWC	25	23.36
	Other	2	1.87
counselling regarding how to consume IFA		n=160	**%**
	Yes	102	63.75
	No	58	36.25
IFA counselling done by		n=160	**%**
	AWW/ASHA	122	76.25
	ANM	22	13.75
	Doctor	14	8.75
	Other	2	1.25
From which month IFA started consuming		n=152	**%**
	1st trimester	50	32.89
	2nd trimester	99	65.13
	3rd trimester	3	1.97

Supplementary food consumption

Dense Micronutrient Fortified Extruded Blended Take Home Ration (THR) like Sukhdi (desi sweet prepared from Wheat flour, oil and jaggery) (1 packet of 1 kg per month), Sheera (3 packets of 500 gm each) and Upma (2 packets of 500 gm each) were provided to pregnant women, lactating mothers and adolescent girls. Enriched with all the essential macro and micronutrients needed for a proper mental and physical development like iron, protein, vitamin A, Calcium, Thiamine, Riboflavin, Niacin, Vitamin C and Folic Acid etc., these "Ready to Cook" pre-mixes only take few minutes to prepare nutritious and tasty recipes. More than 70 different types of recipes can be prepared from these pre-mix packets.

Table 4.1.8 indicated that 86.9% mothers reported to receive THR, during their pregnancy and lactation period. Among them only 25% received all packets (1 packet sukhdi, 3 packets sheera and 2 packets upma) in one month. Only 61% mothers admitted that they consumed those THR given from AWC regularly during pregnancy and lactation**.** There were various reasons came out as non**-**consumption of THR by pregnant and lactating mothers**.** Sharing with family members was one of the main reasons of non**-**consumption**.** Also, many of them were not aware and did not receive it from AWC and did not even ask for it or went to collect it**.**

Energy Dense Micronutrient Fortified Extruded Blended Food (Balbhog) was provided as Take-Home Ration (THR) to children aged 6 months to 3 years (7 packets per month, i.e. 3.5kg) on Mamta Diwas. Each packet weighs 500 gms. The shelf life of these premixes was 4 months. It can be easily prepared by mixing it with hot milk or water.

Table 4.1.8 indicates that among all, 85**%** received balbhog packets from AWC but only 17**%** received 7 packets per month**.** Only 57**%** children consumed balbhog regularly in proper quantity**.** This indicates lack of nutrition and health education to mothers and unawareness regarding the services of ICDS. Children sometimes don**'**t like balbhog and they tend to share with their siblings which were main reason for their non**-**consumption.

Glimpses of Take-home rations provided by ICDS (Image 4.7-4.8)

Hot cooked breakfast was provided to children in the age group of 3-6 years. Also, 80 gram of freshly prepared hot cooked afternoon meal within limit of Rs 3 / day / beneficiary was prepared by *Anganwadi workers* and *Anganwadi helpers* and provided to 3 – 6 years children at the AWCs. In order to fortify meal with protein, tuver dal, chana etc were incorporated in cyclic menu of AWCs. Among 32 children aged 3-6y in the study only 10 (31%) frequently visited AWC and consumed suplemnetary nutrition provided by ICDS.

Glimpses of supplementary nutrition provided in AWC (Image 4.9-4.12)

Table 4.1.8: Supplementary food consumption by mothers during their pregnancy and by children (6months-3years)

Supplementary food consumption			
THR received by mothers during pregnancy & lactation		n=160	**%**
	Yes	139	86.88
	No	21	13.13
All THR packets (1sukhdi+3sheera+2upma) received in one month		n=139	**%**
	Yes	36	25.90
	No	103	74.10
Regularly received during pregnancy		n=160	**%**
	Yes	3	1.88
	No	157	98.13
Consumption of THR by mothers		n=160	**%**
	Yes	99	61.88
	No	61	38.13
Reason for non-consumption of		n=61	**%**
	Shared with family members	23	37.70
	did not like	17	27.87
	did not receive from AWC	21	34.43
Balbhog received from AWC		N=160	**%**
	Yes	136	85.00
	No	13	8.13
	not applicable	11	6.88
All 7 packets of balbhog received in one month		n=136	**%**
	Yes	24	17.65
	No	112	82.35
Consumption of balbhog **(**N=149**)**		N=149	**%**
	Yes	86	57.72
	No	63	42.28
Reason for non-consumption of balbhog		n=63	**%**
	did not start eating	9	14.29
	did not like	16	25.40
	requies time to prepare	4	6.35
	shared with siblings	20	31.75
	feed cattle	1	1.59
	did not receive from AWC	13	20.63
Supplementary nutrition received by 3-6y children in AWC		n=32	%
	Frequently	10	31.25
	Sometimes	9	28.12
	Very rare	3	9.37
	Rare	10	31.25

Thus, overall as per the study the result of the situational analysis of food aid assessment revealed Iron-Folic acid (IFA) tablet distribution and supplementary nutrition services were provided from the AWCs but the utilization of these services by the beneficiaries in the study area was not satisfactory as only 33% mothers regularly consumed IFA tablets, 61% consumed take home raions (THR) provided by ICDS during their pregnancy and lactation period. Only 57% children of 6monthns-3years consumed balbhog (THR) and only 31% children of 3-6years consumed freshly prepared hot cooked meal in the AWC on regular basis.

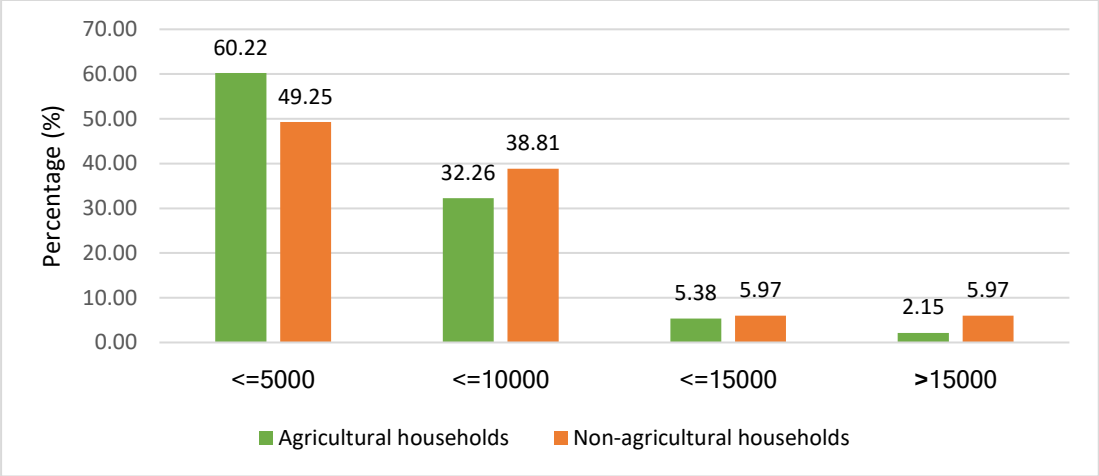
Income and possession of electronic gadgets and vehicles by the HHs

Based on the personal interview results, 55**%** HHs had a monthly family income less than or equal to 5000 rupees and with 8.75**%** mothers who contributed to family income as agricultural labourer. Depending on the per-capita income and majority family income Cut-offs were selected. Of the 160 HHs convered in the study 40**%** had one or more bicycle, 54**%** had a motorbike or a scooter, 71**%** HHs had television, 73**%** had refrigerators and 82.5**%** of the families had mobile phones (Table 4.1.9). Figure 4.1.7 indicates that family income of non-agricultural households was higher than agricultural households indicating that the area under the study was non-fertile and could not support agriculture.

Table 4.1.9. Income and possession of electronic gadgets and vehicles by the Households

Income and possession			
		n=160	%
Family income	<=5000	89	55.63
	<=10000	56	35.00
	<=15000	9	5.63
	>15000	6	3.75
Mothers' individual income	no income	146	91.25
	earn 500-3000 per month	14	8.75
Possession of cycle	No	96	60
	Yes	64	40
Possession of two-wheeler	No	73	45.63
	Yes	87	54.38
Possession of television	Yes	115	71.88
	No	45	28.13
Possession of refrigerator	Yes	42	26.25
	No	118	73.75
Possession of mobile phone	Yes	132	82.5

Figure 4.1.7: Family income of agricultural and non-agricultural households

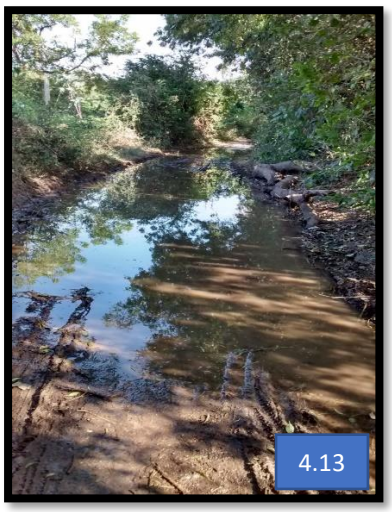


Thus, overall as per the study the result of the food affordability assessment revealed that, among 160 households, 55% had family income less than 5000 rupees and family income of non agricultural housheolds were more than agricultural households. Being agricultural labour, 8.75% mothers had individual income which were negligible.

Roads

The condition of *kuccha* (mud) roads within the village made accessibility to *AWC* difficult by all households as seen in the cluster map (Figure 4.1.1). Those HHs which were situated in the interior of the village and far from the shops and AWC as shown in maps reduced their mobility and food accessibility in rainy season.

Glimpses of road condition in the study area in rainy season (Image 4.13-4.14)



Thus, overall as per the study the result of the road assessment revealed. all the rural households in the study area were not connected by proper roads and in monsoon, the road condition got even worse.

Drinking water

Access to safe drinking water was poor in one cluster as only one handpump was present in one extreme side of the village from where villagers need to collect water. Also, in other clusters drinking water was directly available from water pipes on every alternative day and not daily.

Glimpses of drinking water sources in study area (Image 4.15-4.16)


4.15


4.16

Thus, the result of the drinking water acess assessment revealed that there was scope of improvement in this area.

Household dietary diversity:

This section presents the results of the Household dietary diversity. Household Dietary Diversity Score (HDDS) was calculated using FAO guidelines (FAO 2010) wherein the households and women who consumed at least 8 food groups daily (cut offs selected as per 50^{th} percentile) more than 7 food groups daily (cut offs selected as per 50^{th} percentile) among 12 food groups (cereals; pulses; GLVs; roots and tubers; vegetables; fruits; nuts and oilseeds; milk and milk products; nonveg; fats and oil; sugar; spices, condiments and beverages) scored as positive and indicating the habit of consuming diversified diet and proper food utilization and rest scored as negative indicating poor dietary diversity. In the same process, Women Dietary Diversity Score (WDDS) was also calculated.

A standardized food frequency questionnaire (FFQ) was used to extract data on household dietary diversity which was used to calculate the HDDS. Frequent consumption of Green leafy vegetables recorded for only 2**.**5**%** households, frequent vegetable **(**other than GLVs**)** consumption was there at 68**.**8**%** households, and milk and milk products were frequently consumed by only 50**%** households**.**

Results indicates that 43.1% households had a positive household dietary diversity score (HDDS) and 45.6% women scored positive in women dietary diversity score (WDDS).

Table 4.1.10 indicates weekly consumption of various foods and Table 4.1.11 indicates daily consumption of various foods by the enrolled households.

Table 4.1.10: Weekly (Frequent) consumption of foods in the households

Frequently (every week) consumed foods in the households			
		n=160	**%**
Cereals	Bajra	160	100.0
	Rice	160	100.0
	Wheat	154	96.3
	Rice Puffed	130	81.3
	rice flakes	128	80.0
	Semolina	21	13.1
	Maize	16	10.0
	Bread	3	1.9
Pulses	Green gram dahl	149	93.1
	Red gram dahl	147	91.9
	Green gram whole	144	90.0
	Bengal gram dahl	93	58.1
	Black gram dahl	33	20.6
	Field beans	23	14.4
	Fansi	11	6.9
	Peas	9	5.6
Green leafy vegetables	Curry leaves	146	91.3
	Coriander leaves	143	89.4
	Spinach	29	18.1
	Fenugreek leaves	23	14.4
	Drumstick leaves	13	8.1
	Caulflower greens	12	7.5
	Subhanibhaji	8	5.0
	Mint	7	4.4
	Radish leaves	6	3.8
	Colocasia leaves	5	3.1
	Bhindinapan	5	3.1
Roots and tubers	Potato	157	98.1
	Onion	156	97.5
	Carrot	32	20.0
	Radish	6	3.8
	Beetroot	5	3.1
	sweet potato	1	0.6
Vegetables	Tomato	149	93.1
	Brinjal	130	81.3
	Cauliflower	118	73.8
	Gilori	111	69.4
	bottle gourd	107	66.9
	Saragvo	107	66.9
	Cabbage	105	65.6
	bitter gourd	95	59.4
	Galka	94	58.8

	Bhindi	33	20.6
	Govar	27	16.9
	Kakdi	25	15.6
	Parwar	19	11.9
Fruits	Banana	127	79.4
	Lemon	126	78.8
	Apple	44	27.5
	Amla	9	5.6
	Grapes	9	5.6
	Orange	3	1.9
	Papaya	2	1.3
	sweet lime	2	1.3
	Guava	0	0.0
	Mango	0	0.0
	Pineapple	0	0.0
	Watermelon	0	0.0
Nuts and oilseeds	mustard seeds	67	41.9
	Groundnuts	41	25.6
	Til	10	6.3
	niger seeds	4	2.5
	coconut dry	3	1.9
Milk and milk products	Milk	153	95.6
	Chach	66	41.3
	Curd	58	36.3
Fats and oil	Oil	157	98.1
	Ghee	11	6.9
	Butter	2	1.3
Sugar	Sugar	159	99.4
	Jaggery	19	11.9
	Honey	2	1.3
Non vegetarian food	Chicken	9	5.6
	Egg	9	5.6
	Mutton	8	5.0
	Fish	8	5.0

Table 4.1.11: Daily consumption of various food in the households

Daily consumption of various foods in the households			
		n=160	**%**
Cereals		160	100
	Bajra (Pearl millet)	145	90.63
	Rice	143	89.38
	Wheat	74	46.25
	rice flakes	21	13.13
	Rice Puffed	14	8.75
Pulses		129	80.62
	Red gram dahl	110	68.75
	Green gram dahl	19	11.88
	Bengal gram dahl	4	2.50
	Black gram dahl	4	2.50
Green leafy vegetables		42	26.25
	Coriander leaves	48	30.00
	Curry leaves	39	24.38
	Spinach	5	3.13
	Mint	3	1.88
Roots and tubers		147	91.87
	Potato	136	85.00
	Onion	85	53.13
	Carrot	2	1.25
Vegetables		104	65
	Tomato	69	43.13
	Brinjal	27	16.88
	Cabbage	6	3.75
	bottle gourd	6	3.75
	Tindola	5	3.13
	Cauliflower	3	1.88
	Galka	2	1.25
	Cucumber	2	1.25
	Drumstick	2	1.25
Fruits		20	12.5
	Lemon	31	19.38
	Banana	17	10.63
	Orange	1	0.63
Nuts and oilseeds		13	8.12
	Groundnuts	8	5.00
	Gingelly seeds	6	3.75
	niger seeds	2	1.25
Milk and milk products		85	53.12
	Milk	90	56.25
	Butter milk	24	15.00
	Curd	18	11.25
Fats and oil		160	100
	Ghee	9	5.63
	Oil	137	85.63
Sugar		160	100
	Sugar	124	77.50
	Jaggery	14	8.75
Non vegetarian food		9	5.62
	Chicken	0	0.00
	Egg	0	0.00
	Mutton	0	0.00
	Fish	0	0.00
Spices, condiments, beverages		160	100.00

Households dietary pattern

Table 4.1.12 depicts the intra household food distribution patterns. Only 23% families dine together, men were served first in 8% HHs and men and children were served first in case of 41% housholds.

In case of 51**%** families, meals were composed of cereals, pulses and vegetables**.** At 38**%** households, only tea was consumed at breakfast**.** At 60**%** households, 3 meals were consumed by the members in a day**.**

Table 4.1.12: Household dietary pattern

Household dietary pattern			
Intra household food distribution (serving priorities)		n=160	**%**
	Men	14	8.75
	Men and children	67	41.87
	men, children and grandmothers	35	21.88
	Households that dine together occasionally	6	3.75
	Housholds that dine together regularly	38	23.75
Meal patterns (use of various food groups)		n=160	**%**
	Only cereal and pulses	2	1.25
	cereal/pulse/vegetable	83	51.88
	cereal/pulse/vegetable/milk occasionally	68	42.50
	cereals/pulse/vegetable/milk/sweet occasionally	6	3.75
	variety of foods prepared daily	1	0.63
Breakfast details		n=160	**%**
	No breakfast1	3	1.87
	Irregular breakfast	12	7.5
	only tea in breakfast	62	38.75
	tea with biscuits	60	37.5
	Regular breakfast	23	14.38
Diet pattern		n=160	**%**
	2 meals a day	23	14.38
	3 meals a day	96	60
	4 meals a day	41	25.63

Thus, overall as per the study the result of the household dietary diversity and dietary pattern revealed that, only 43.1% housheolds scored positive in HDDS and only 45.6% women scored positive in WDDS. Only 23% families dine together resulted in poor intra-houshold food distribution. Daily consumption of pearl millet or bajra (90%), rice (89%), wheat (46%), red gram dahl or tuver dahl (68%), potato (85%), onion (53%), tomato (43%), milk (56%), oil (85%), sugar (77%) was higher than other foods.

Infant and Young Child Nutrition (IYCN)

Table 4.1.14 indicated that, the initiation of breastfeeding within 1 hour was higher **(**52**%)**, 65**%** children were fed colostrum after birth**.** Practice of prelacteals was abundant and patasha water was the most commonly administered prelacteals **(**36**%).** Within 1st 6 months of child, 61**%** were given water and 17**.**5**%** were given top milk**.** Exclusive breastfeeding rates in the first six months were found to be very less (33**.**75**%).** Complementary feeding after six months of age was initiated among 68**.**49**%** children**.** 59**%** children were breastfed upto 2 years of age or more and 85**%** continued breastfeeding during illness of mothers or children**.** Feeding monitoring was done in case of 89**%** children and there were 56**%** mothers who got help in child care from other members of the family**.** Only 48.8% scored positive in Infant and Yound Child Nutrition Score based on 10 ideal IYCF practices defined by UNICEF explained in the methodology section of the thesis. Figure 4.1.3 indicated feeding monitoring, breastfeeding during illness, no top milk feeding within 1st 6 months of child were some of the most followed practices by mothers and were present in the community, whereas no water or pre-lacteal feeding**,** exclusive breastfeeding, colostrum feeding were some of the least followed practices, regarding which sensitization need to be done.

Table 4.1.13: Infant and Young Child Nutrition (IYCN) practices

Infant and Young Child Nutrition (IYCN)			
Initiation of breastfeeding		n=160	**%**
	never initiated	1	0.63
	within 1 hour	84	52.50
	within 1 day	26	16.25
	within 3days	28	17.50
	after 3 days	21	13.13
Colostrum feeding		n=160	**%**
	Fed	105	65.625
	Discarded	52	32.5
	not aware	3	1.875
Pre-lacteal feeding		n=160	**%**
	No	79	49.375
	yes, patassa water	59	36.875
	yes, jaggery/honey/glucose	9	5.625
	yes, water	11	6.875
	yes, ghutti	2	1.25
Practice of giving water in 1st 6 months		n=160	**%**
	Yes	98	61.25
	No	62	38.75
Practice of giving top milk in 1st 6 months		n=160	**%**
	Yes	28	17.5
	No	132	82.5
Practice of exclusive breastfeeding for 1st 6 months		n=160	**%**
	Yes	54	33.75
	No	106	66.25
Continued breastfeeding upto 2years**((**N=84**)**		n=84	**%**
	less than 2yrs	34	40.48
	till 2yrs	16	19.05
	more than 2yrs	34	40.48
Breastfeeding during illness			
	Yes	137	85.63
	No	23	14.38
Initiation of complementary feeding on 7th month		n=146	**%**
	Yes	100	68.49
	No	46	31.51
Feeding monitoring		N=143	**%**
	Yes	128	89.51
	No	15	10.49
IYCN score (calculated as described in methods)		n=160	%
	Positive	78	48.8
	Negative	82	51.3

Thus, overall as per the study the result of the situational analysis of Infant and Young Child Nutrition revealed that, only 48.8% scored positive in Infant and Yound Child Nutrition Score based on 10 ideal IYCF practices defined by UNICEF. Among 160 mothers, only 52% initiated breastfeeding within 1 hour, 65% fed colostrum, 33% practiced exclusive breastfeeding for 1st 6 months and 68% initiated complementary feeding after 6 months.

Dietary pattern of children

Table 4.1.14 demonstrates child feeding in different age group to understand the scenario in detail. Table 4.1.15 indicated that among the 160 households only 6**%** were non-vegetarian**.** Most frequently consumed food groups were cereals (100%) followed by pulses (95%) and vegetables (90%). Milk and milk production consumption was only 51% among children more than 6 months. Packaged food consumption was very common as 55**%** children frequently consumed packaged food but 66**%** children did not consume fermented or sprouted foods**.**

Table 4.1.14: Child feeding according to age

Age of child	Frequency of feeding				Amount eaten per feeding			
	1-2 times	3 times	4times	>4times	<=30gm	<=50gm	<=80gm	>80gm
>6-12months (23)	3 (13.04)	8 (34.78)	3 (13.04)	5 (21.74)	14 (60.87)	5 (21.74)	0 (0)	0 (0)
>12-24months (45)	10 (22.22)	16 (35.55)	10 (22.22)	8 (17.77)	24 (53.33)	18 (40)	1 (2.22)	1 (2.22)
>24-36months (46)	7 (15.22)	20 (43.48)	9 (19.56)	10 (21.74)	19 (41.3)	10 (21.74)	11 (23.91)	6 (13.04)
>36-60months	5 (15.62)	17 (53.12)	9 (28.12)	1 (3.12)	5 (15.62)	15 (46.87)	7 (21.87)	5 (15.62)

*Figure in parentheses denotes percentage

Table 4.1.15: Dietary pattern of children

Dietary pattern of children			
Pulses consumption		n=145	**%**
	Yes	138	95.17
	No	7	4.83
Milk and milk products consumption		n=145	**%**
	Yes	74	51.03
	No	71	48.97
Vegetable consumption		n=145	**%**
	Yes	131	90.34
	No	14	9.66
Fruits consumption		n=145	**%**
	Yes	121	83.45
	No	24	16.55
Non-vegetarian food consumption		n=145	**%**
	Yes	9	6.21
	No	136	93.79
Packaged food consumption		n=143	**%**
	No	28	19.58
	Sometimes	36	25.17
	Frequently	79	55.24

Thus, overall as per the study the result of the situational analysis of dietary pattern of children revealed that cereals (100%), pulses (95%) and vegetable (90%) consumption was higher among young children compared to milk and milk products (51%). Packaged food consumption (55%) was frequent among young children.

Hygiene and sanitation practices

Table 4.1.16 indicated that among the mother-child pairs, use of soap and food storage practices was good**.** But hand**-**wash practice with soap during food handling was not satisfactory as only 41.25**%** practiced it**.** Regarding water purification only 21**%** filtered or strained drinking water for purification**.** Open defecation was practiced by 37**.**5**%** households and 73**%** had separate kitchen with ventilation, 26**%** children had very dirty nails and 21**%** had very dirty clothes**.** Only 10**.**62**%** children used to wear footwear always outside home and 10,62% mothers used to wear footwear while going far. Only 31.9% had positive hygiene and sanitation score based on 8 good practices explained in the methodology section. Figure 4.1.4 indicated that use of separate kitchen, use of soap, drinking water purification were some of the most followed hygiene and sanitation practices whereas sanitary latrine facility, cleanliness of clothes and use of shoes were some of the least followed practices present in the study area.

Table 4.1.16. Hygiene and sanitation practices among mother-child pairs

Table4.1.16**:** Hygiene and sanitation practices			
		n=160	**%**
Use of soap	no, never	1	0.63
	yes, but very rare	10	6.25
	yes, only for bathing	2	1.25
	yes, bathing and clothes washing	26	16.25
	yes, for all purpose including handwashing	121	75.63
Hand-wash with soap	No	38	23.75
	yes, after toilet/defecation	56	35
	yes, defecation as well as when dealing with food	66	41.25
Drinking Water purification by straining	Yes	34	21.25
	No	126	78.75
Sanitary latrine	with in built water facility	36	22.5
	with no water facility	48	30
	No sanitary latrine	76	47.5
Separate kitchen	No, sleeping & cooking in same room	25	15.63
	yes, but without ventilation	17	10.63
	yes, with ventilation	118	73.75
Cleanliness of nails	Clean	60	37.5
	Dirty	100	62.5
Cleanliness of clothes	Clean	65	40.63
	Dirty	95	59.37
Use of shoes/sandals **(**child**)**	Never	1	0.625
	Occasionally	110	68.75
	while going far	32	20
	Always	17	10.625
Use of shoes/sandals (mother)	Never	107	66.875
	Occasionally	36	22.5
	while going far	17	10.625
	Always	0	0
Storage of cooked food till it gets served	Covered	104	65
	Uncovered	56	35
Hygiene and Sanitation Score (calculated as described in methods)	Positive	51	31.9
	Negative	109	68.1

Thus, overall as per the study the result of the situational analysis of hygiene and sanitation practices revealed that practice of hand-wash with soap was not satisfactory (41.25%). Only 21% filtered or strained drinking water for purification and open defecation was practiced by 37.5% households.

Nutritional status of mothers

Mother's BMI were calculated according to WHO BMI and Asia-Pacific BMI by measuring height and weight of the mothers. Results revealed that among 160 mothers, more than half **(**54**%)** were underweight **(**BMI<18.5**)** as indicated in table 4.1.17. Figure 4.1.8 shows distribution of individual BMI of 160 mothers to provide a clear picture of mothers' undernutrition status**.**

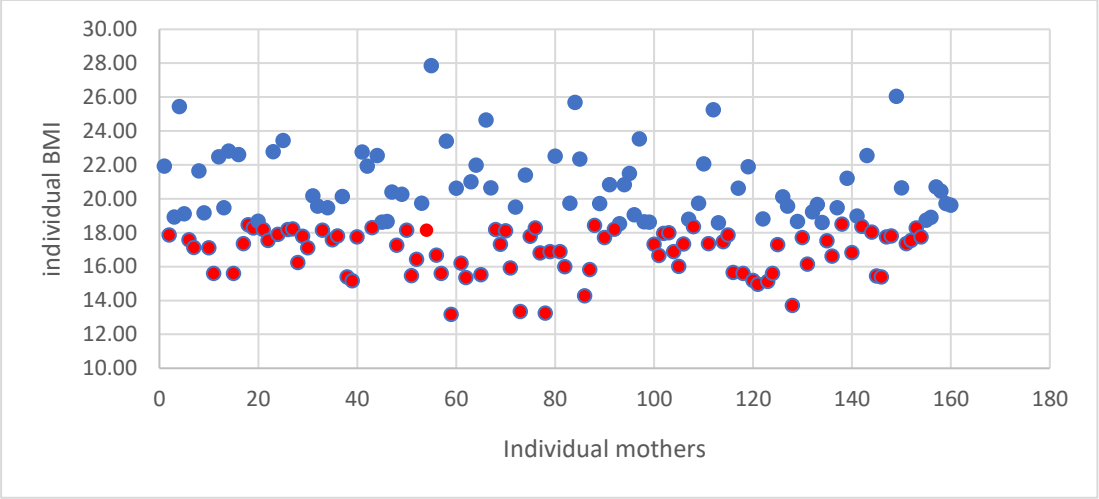
Table 4.1.17: Nutritional status of enrolled mothers

	WHO		**Asia-pacific**	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
Underweight	87	54.4	87	54.4
Normal	68	42.5	64	40
Overweight	5	3.12	4	2.5
Obese	0	0	5	3.12

Underweight: BMI<18.5; Normal: BMI 18.5-24.9; Overweight: BMI 24.9-29.9; Obese: BMI>30

Source: WHO, 2006; Underweight: BMI<18.5; Normal: BMI 18.5-22.9; Overweight: BMI 23-24.9; Obese: BMI ≥25, Asia pacific, 2006

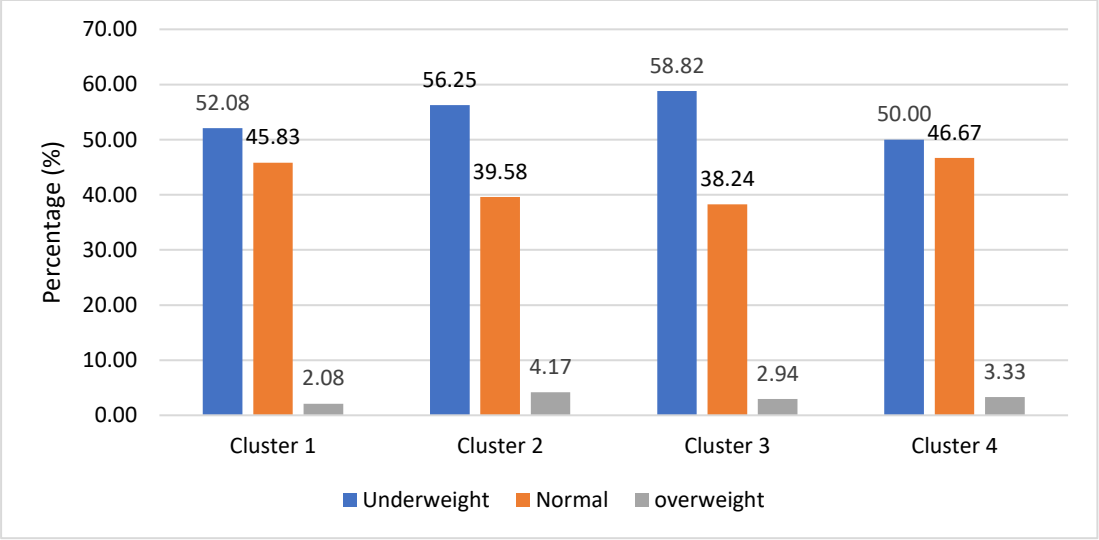
Figure 4.1.8: Prevalence of Mothers undernutrition (individual BMI)



Red colour denotes underweight mothers with BMI<18.9 Blue colour denotes not underweight mothers with BMI ≥18.9

Figure 4.1.9 revealed that in cluster 3, mother's undernutrition was highest (58%) following by cluster 2 (56%), whereas mother with normal BMI were more in cluster 4 (46%) and cluster 1 (45%).

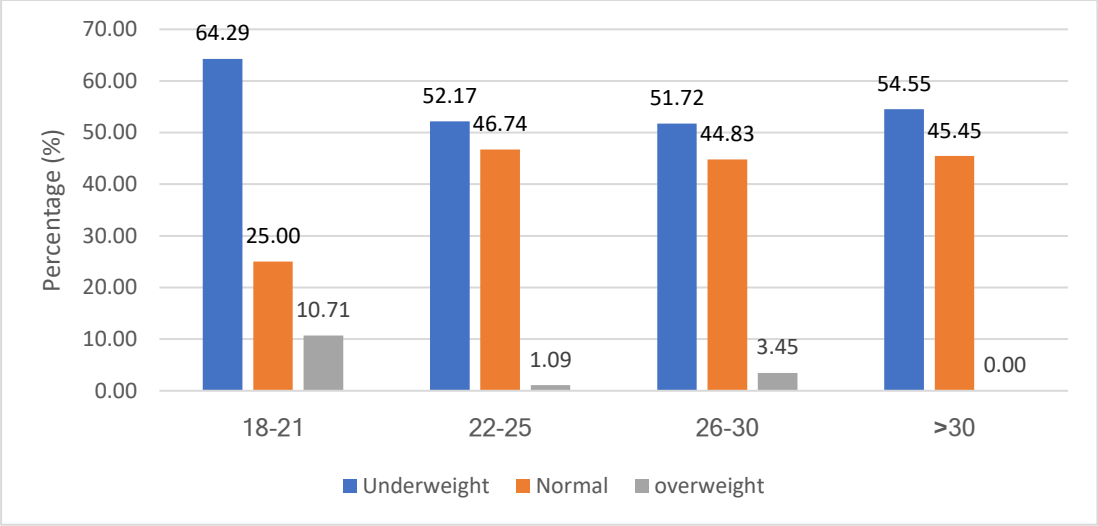
Figure 4.1.9: Village wise undernutrition status of mothers



Underweight: BMI<18.5; Normal: BMI 18.5-24.9; Overweight: BMI >24.9 Source: WHO, 2006

Figure 4.1.10 revealed that mother's undernutrition was more in the age group of 18-21, which was the youngest age group. Therefore, pre-conceptual nutrition and adolescent nutrition need to be given utmost importance to improve both mothers and childs undernutriton.

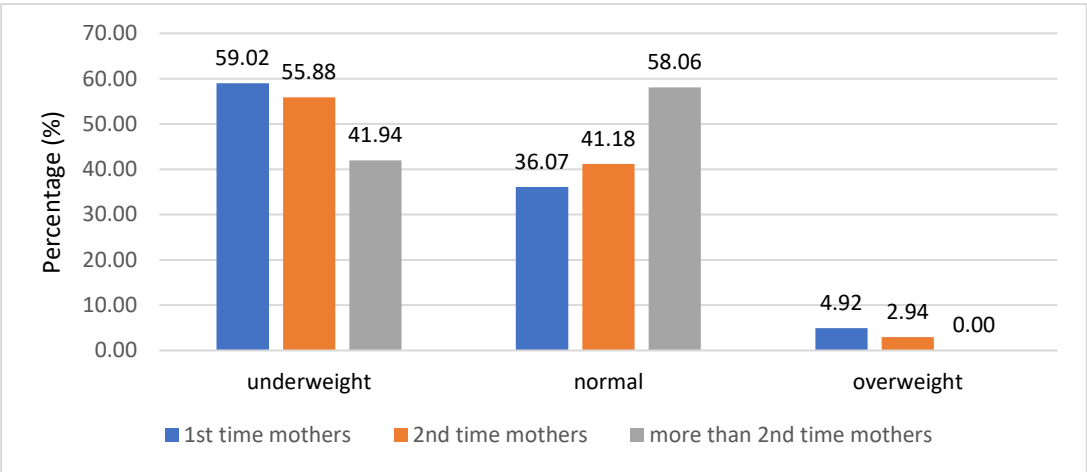
Figure 4.1.10: Age wise undernutrition status of mothers



Underweight: BMI<18.5; Normal: BMI 18.5-24.9; Overweight: BMI >24.9 Source: WHO, 2006

Results revealed that undernutrition was more among 1st time mothers as compared to others, hence pre-conceptual and adolescent nutrition need to be focused (Figure 4.1.11).

Figure 4.1.11: Parity and undernutrition status of mothers



Underweight: BMI<18.5; Normal: BMI 18.5-24.9; Overweight: BMI >24.9 Source: WHO, 2006

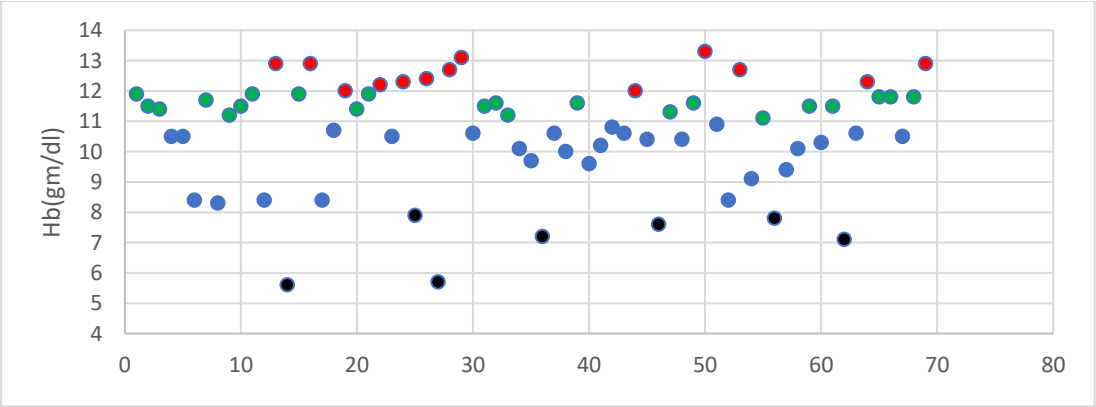
Thus, overall as per the study the result of the situational analysis of mothers' nutritional status revealed that, 54% mothers were underweight (BMI<18.5) among 160 mothers. Undernutrition was higher (64%) in the younger age group (18-21yrs) and 1st time mothers indicating (59%) urgent need to focus on pre-conceptual and adolescence nutrition.

Status of maternal anemia

A sub sample of 69 mothers were selected for biochemical assessment on the basis of their consent. They were from 2 village clusters, cluster 1 and cluster 2.

Biochemical assessment of the mothers under study area revealed that 80**%** were anaemic **(**Hb <12g/dL, WHO standard**)** and among the anaemic mothers, 12**%** were severely anaemic **(**Hb <8g/dL, WHO standard**)**, 48**%** were moderately anaemic **(**Hb 8-10.9g/dL, WHO standard**)** and 39**%** were mildly anaemic **(**Hb 11-11.9g/dL, WHO standard**).** Severely anemic mothers were reported to the ICDS centre for providing referral services and also their names were provided to the CSR cell of local private organization for further treatment and monitoring**.** Figure 4.1.12 demonstrates individual Hb level indicating the status of maternal anemia.

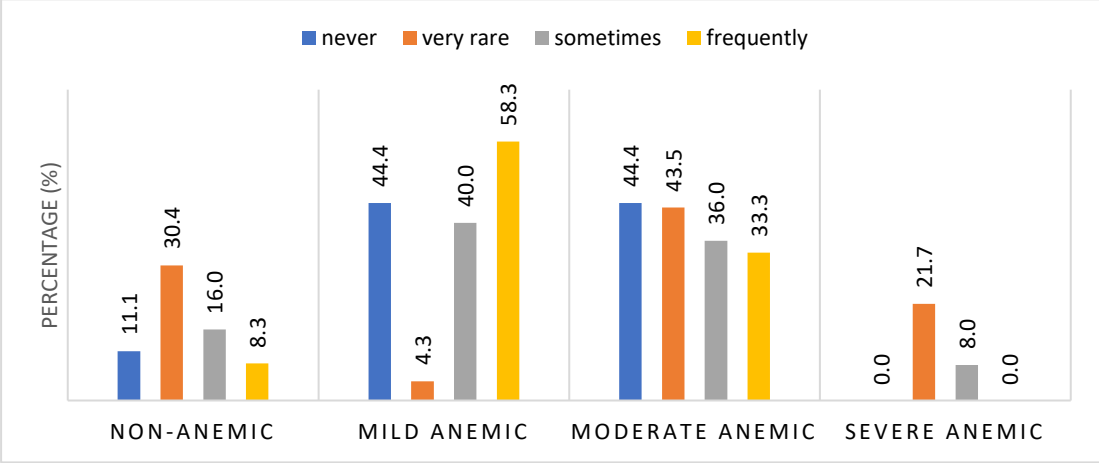
Figure 4.1.12: Prevalence of maternal anemia (Individual Hb level)



Deep blue colour denotes severe anemia(Hb<8g/dL), Blue colour debnotes moderate anemia (Hb 8-10.9g/dL), Green colour denotes mild anemia (Hb 11-11.9g/dL, red colour denotes not anemic (Hb≥12g/dL) Reference: WHO, 2006

Figure 4.1.13. revealed association between maternal anemia and participation in ICDS activities of mothers. Mothers with very rare participation in ICDS programs were more prone to be severely anemic (21.7%).

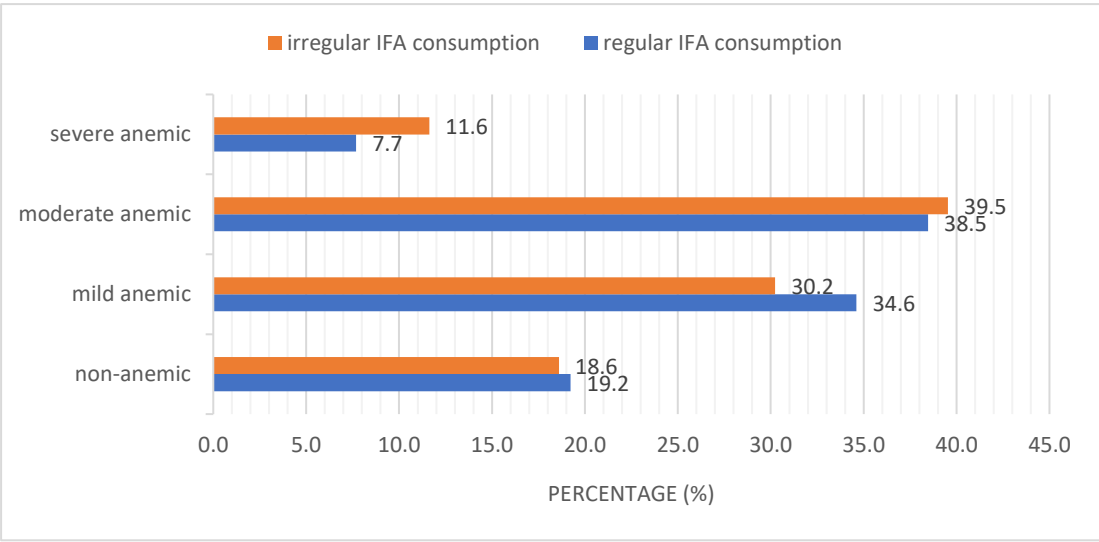
Figure 4.1.13: Association between maternal anemia & ICDS participation



Non-anemic: Hb≥12g/dL; Mild anemic: Hb 11-11.9g/dL; Moderate anemic: Hb: 8-10.9g/dL; Severe anemic: Hb<8g/dL Reference: WHO 2006

Figure 4.1.14 revealed that anemia especially severe anemia was more among mothers who did not consume IFA tablets regulars during their pregnancy and lactation period.

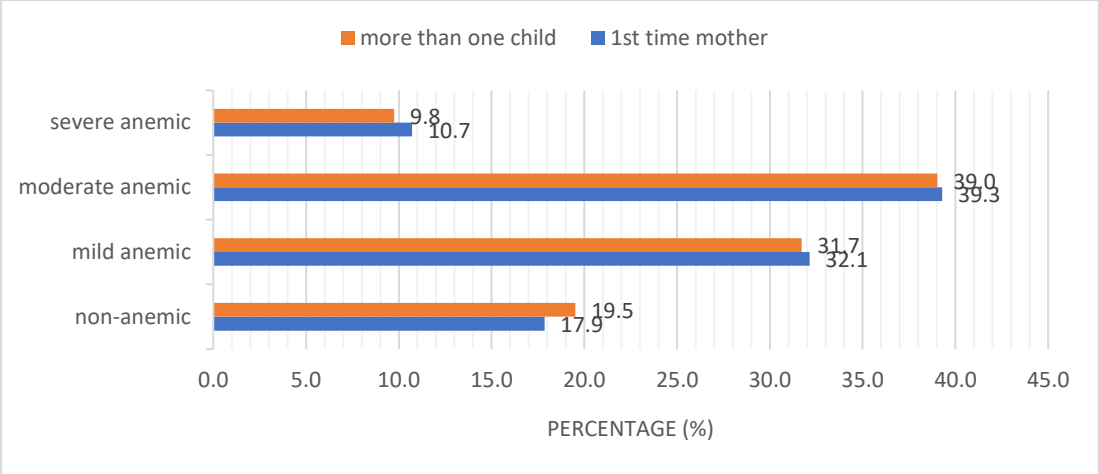
Figure 4.1.14: Association between maternal anemia and IFA tablets consumption



Non-anemic: Hb≥12g/dL; Mild anemic: Hb 11-11.9g/dL; Moderate anemic: Hb: 8-10.9g/dL; Severe anemic: Hb<8g/dL Reference: WHO, 2006

Figure 4.1.15 revealed 1st time mothers were more prone to be anemic compared to others.

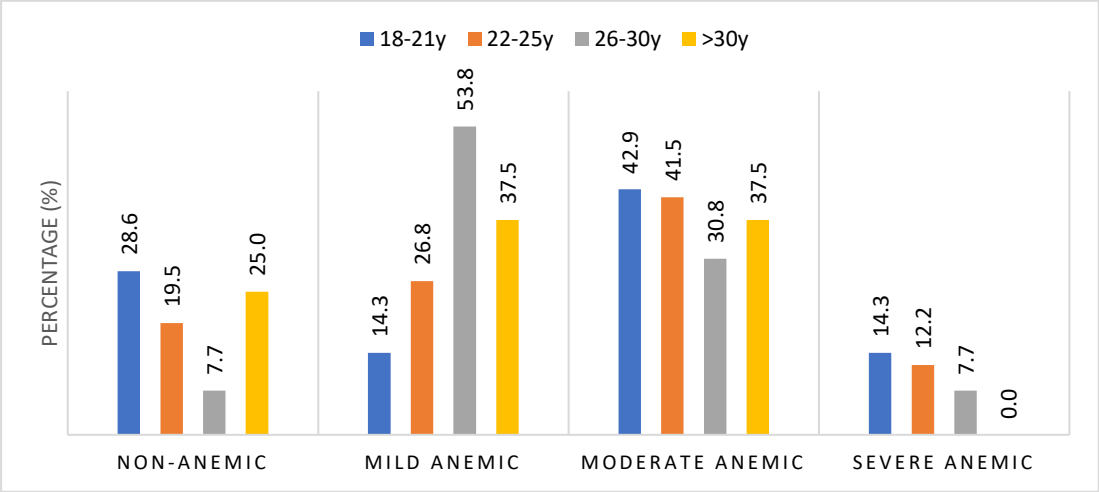
Figure 4.1.15: Association between maternal anemia and parity of mothers



Non-anemic: Hb≥12g/dL; Mild anemic: Hb 11-11.9g/dL; Moderate anemic: Hb: 8-10.9g/dL; Severe anemic: Hb<8g/dL Reference: WHO, 2006

Figure 4.1.16 revealed that severe and moderate anemia was more prevalent among younger mothers aged between 18-21 years.

Figure 4.1.16: Association between maternal anemia and age of mothers



Non-anemic: Hb≥12g/dL; Mild anemic: Hb 11-11.9g/dL; Moderate anemic: Hb: 8-10.9g/dL; Severe anemic: Hb<8g/dL Reference: WHO, 2006

Thus, overall as per the study the result of the situational analysis of maternal anemia revealed that among 160, 80% mothers were anaemic (Hb <12g/dL, WHO standard). There was not significant but mild association between ICDS participation, regular consumption of IFA tablets, age of the mothers and anemia status.

Nutritional status of children

The weight and height of children under 59 months are used as proxy measures for the general health of the entire population (WHO, 2000). Therefore, nutritional status (stunting, wasting, underweight status) of children was calculated by measuring their weight and height comparing with their specific age. Results revealed that the mean weight and height of the children was 8.83kg and 77.42cm respectively. Among 160 children 36% were wasted, 60% were stunted and 59% were underweight (as per WHO new child growth standards, 2006 with z score <-2SD). Table 4.1.18 showed the nutritional status of children in various age groups.

Figure 4.1.17, 4.1.18 and 4.1.19 shows individual weight for height, height for age and weight for age z score of each child which gives a clear picture of the individual nutritional status of the study area.

Figure 4.1.20 indicated that, among the underweight children (weight for age <-2SD), 54.73% were >2y vs 45.25% who were <2y, while 6.31% were <6months of age indicating the onset of undernourishment due to chronic energy deprivation. The children whose weight for age were more than -2SD among them, 40% were >2y and a majority of 60% were <2y which reveals that undernutrition rate is higher among older children who don't depend upon breastfeeding anymore and require diversified diet and healthy diet pattern. Same was applicable in case of stunting. Stunting increased with age in the study area, but wasting rate reduced after 2 years. Hence it can be stated that chronic undernourishment was promiment in the older age groups, where as acute undernourishment was observed more in younger age group. Figure 4.1.21 indicated that there was not much significant difference in undernutrition among male and female children.

Table 4.1.19 indicates moderate wasted (WHZ less than -2SD) and severe wasted (WHZ less than -3SD), moderate stunted and severe stunted, moderate underweight and severe underweight children in the study area. Among 160 children, 20% were

moderately wasted and 16.88% severely wasted, 28% were moderately stunted and 32% were severely stunted. 28% were moderately underweight and 31% were severely underweight. Children aged 6-12 months were more prone to be moderately undernourished and children aged 12-18 months were more prone to be severely undernourished. Hence, timely initiation of complementary feeding and maintaining its quality, quantity and frequency is very important for nutritional status of children. Stunting as chronic undernourishment was higher in older age group. There was not much difference observed among genders. Cluster 1 had a greater number of moderate and severe undernourished children.

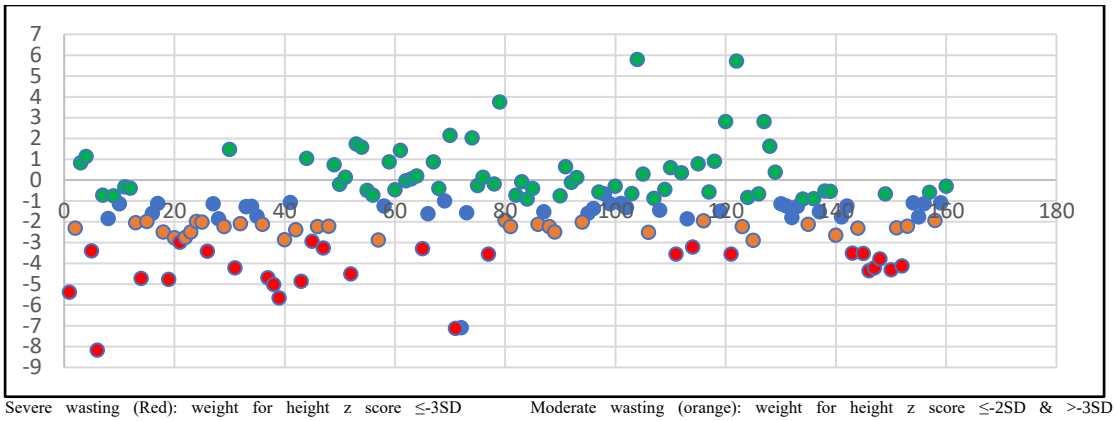
Weight-for-height (wasting) provides the clearest picture of acute malnutrition in a population at a specific point in time. Moderate Acute Malnutrition (MAM) is identified by moderate wasting (Weight for height z score <-2SD and ≥-3SD) for children 0-59 months (or for children 6-59 months, MUAC <125mm and ≥115 mm). Severe Acute Malnutrition (SAM) is identified by severe wasting (weight for height z score <-3SD for children 0-59months (or for children 6-59months, MUAC <115mm) or the presence of bilateral pitting edema. Global Acute Malnutrition (GAM) is the presence of both MAM and SAM in a population (WHO, 2000). In the present study MAM and SAM were identified using only the weight for height parameter. Table 4.1.20 indicates 20% MAM (moderate acture malnourished), 16.88% SAM (severe acute malnourished) and total 36.88% GAM (Globally acture malnourished) children present in the study area which is a major cause of concern as a GAM value of more than 10 percent indicates an emergency (WHO, 2000), where as in the present study the GAM value was much higher than that and immediate action needed to be taken.

All the severe undernourished children in the study area were provided referral services.

Table 4.1.18: Nutritional Status of Children

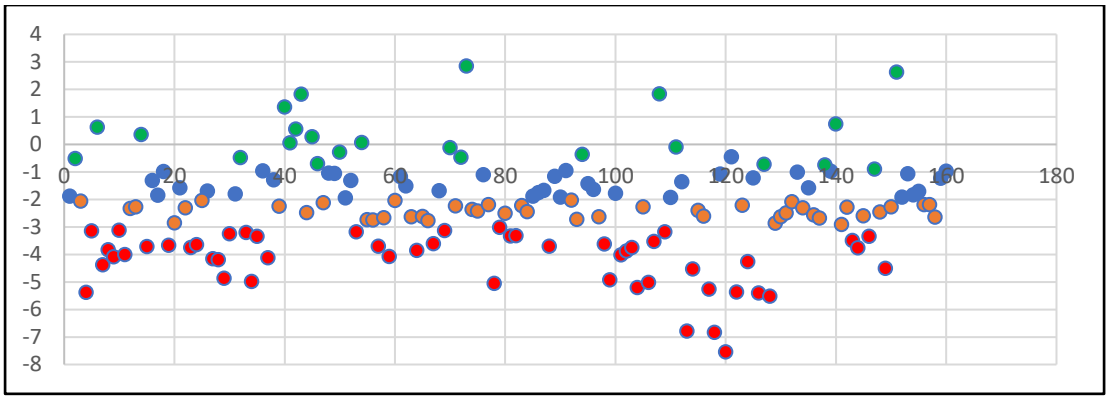
Z score	Weight for height		Height for age		Weight for age	
	N	%	N	%	N	%
0-6months=14						
N	8	57.14	7	50.00	5	35.71
-1	1	7.14	1	7.14	3	21.43
-2	2	14.29	1	7.14	2	14.29
-3	3	21.43	5	35.71	4	28.57
>6-12months=23						
N	10	43.48	6	26.09	5	21.74
-1	2	8.70	5	21.74	7	30.43
-2	7	30.43	9	39.13	6	26.09
-3	4	17.39	3	13.04	5	21.74
>12-18months=24						
N	7	29.17	5	20.83	5	20.83
-1	6	25.00	8	33.33	4	16.67
-2	4	16.67	3	12.50	5	20.83
-3	7	29.17	8	33.33	10	41.67
>18-24 months =23						
N	10	43.48	4	17.39	4	17.39
-1	5	21.74	6	26.09	7	30.43
-2	5	21.74	4	17.39	6	26.09
-3	3	13.04	9	39.13	6	26.09
>24-30 months=22						
N	9	40.91	1	4.55	0	0.00
-1	7	31.82	4	18.18	5	22.73
-2	3	13.64	4	18.18	8	36.36
-3	3	13.64	13	59.09	9	40.91
>30-36 months=22						
N	8	36.36	2	9.09	3	13.64
-1	8	36.36	4	18.18	5	22.73
-2	4	18.18	9	40.91	8	36.36
-3	2	9.09	7	31.82	6	27.27
>36-42months=14						
N	3	21.43	3	21.43	2	14.29
-1	5	35.71	4	28.57	3	21.43
-2	5	35.71	6	42.86	6	42.86
-3	1	7.14	1	7.14	3	21.43
>42-48 months=14						
N	7	50.00	1	7.14	2	14.29
-1	3	21.43	2	14.29	3	21.43
-2	2	14.29	6	42.86	4	28.57
-3	2	14.29	5	35.71	5	35.71
>48-54 months=4						
N	2	50	0	0	1	25
-1	0	0	0	0	1	25
-2	0	0	3	75	0	0
-3	2	50	1	25	2	50
Total=160						
N	64	40.00	30	18.13	27	16.88
-1	37	23.13	33	21.25	38	23.75
-2	32	20.00	45	28.13	45	28.13
-3	27	16.88	52	32.50	50	31.25

Figure 4.1.17: Prevalence of wasting (weight for height z score of 160 children)



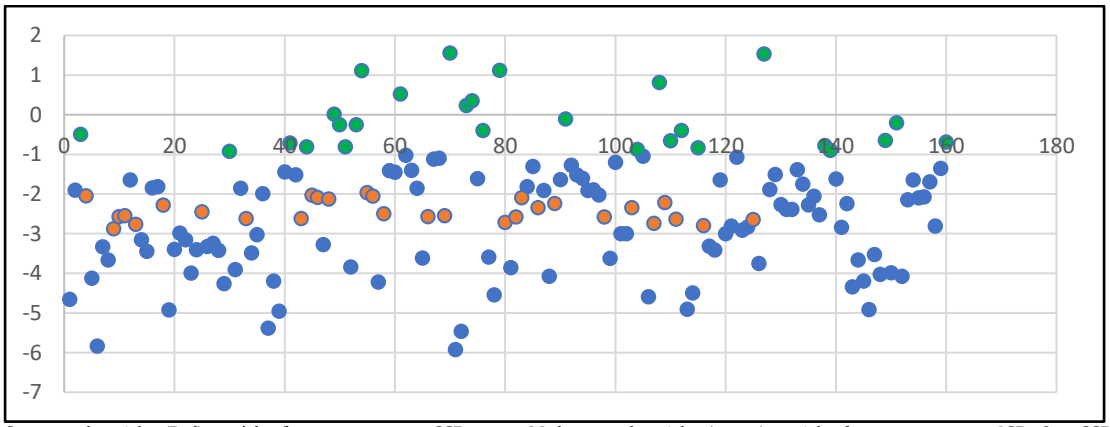
Severe wasting (Red): weight for height z score ≤-3SD Moderate wasting (orange): weight for height z score ≤-2SD & >-3SD
Mild wasting (blue): weight for height z score ≤-1SD & >-2SD Normal (green): weight for height z score >-1SD Reference: WHO, 2006

Figure 4.1.18: Prevalence of stunting (height for age z score of 160 children)



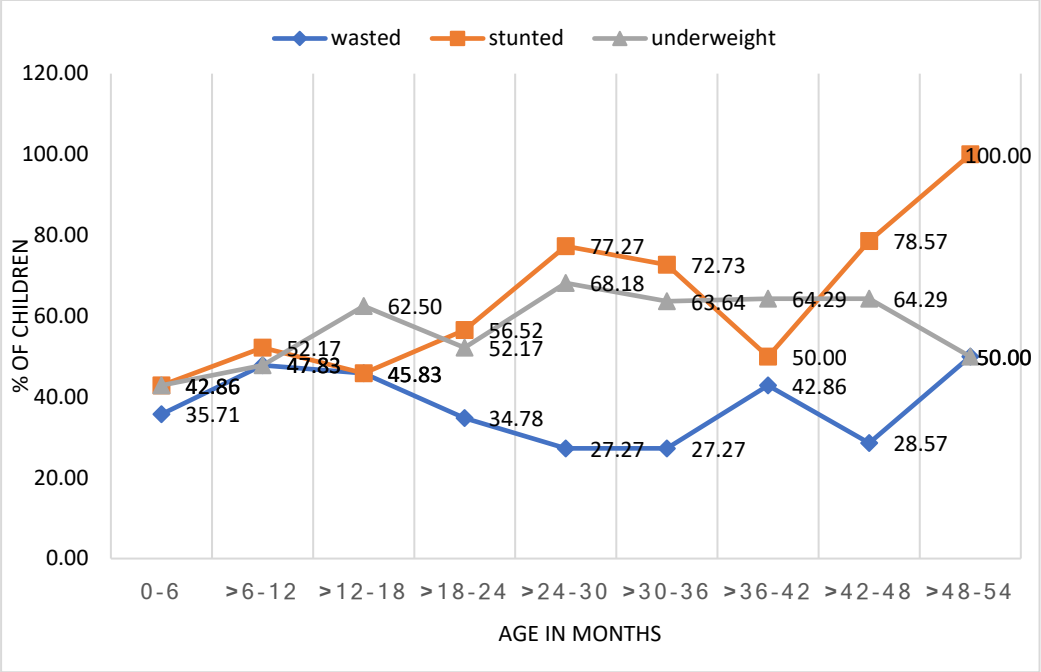
Severe stunting (Red): height for age z score ≤-3SD Moderate stunting (orange): height for age z score ≤-2SD & >-3SD
Mild stunting (blue): height for age z score ≤-1SD & >-2SD Normal (green): height for age z score >-1SD Reference: WHO, 2006

Figure 4.1.19: Prevalence of underweight (weight for age z score of 160 children)



Severe underweight (Red): weight for age z score ≤-3SD Moderate underweight (orange): weight for age z score ≤-2SD & >-3SD
Mild underweight (blue): weight for age z score ≤-1SD & >-2SD Normal (green): weight for age z score >-1SD Reference: WHO, 2006

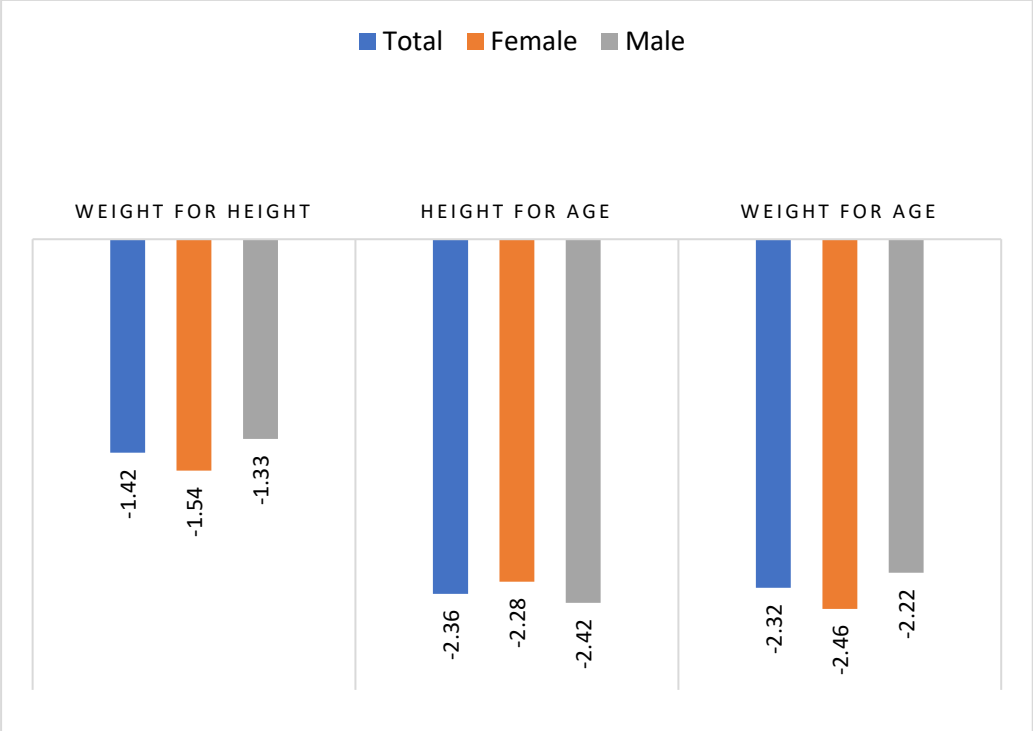
Figure 4.1.20: Percent undernutrition in different age groups



Wasted: weight for height ≤-2SD Stunted: height for age ≤-2SD Underweight: weight for age ≤-2SD

Reference: WHO, 2006

Figure 4.1.21: Gender wise distribution of undernutrition (mean weight for age z scores) of the children



Wasted: weight for height ≤-2SD Stunted: height for age ≤-2SD Underweight: weight for age ≤-2SD

Reference: WHO, 2006

Table 4.1.19: Prevalence of child undernutrition as per age, gender and cluster

Moderately and severely wasted, stunted and underweight children in the study area						
	wasted		stunted		underweight	
	moderate	severe	moderate	severe	moderate	severe
AGE						
0-6m (14)	2(14.29%)	3(21.43%)	1(7.14%)	5(35.71%)	2(14.29%)	4(28.57%)
>6-12m=23	7(30.43%)	4(17.39%)	9(39.13%)	3(13.04%)	6(26.09%)	5(21.74%)
>12-18m=24	4(16.67%)	7(29.17%)	3(12.50%)	8(33.33%)	5(20.83%)	10(41.67%)
>18-24 m=23	5(21.74%)	3(13.04%)	4(17.39%)	9(39.13%)	6(26.09%)	6(26.09%)
>24-30 m=22	3(13.64%)	3(13.64%)	4(18.18%)	13(59.0%)	8(36.36%)	9(40.91%)
>30-36 m=22	4(18.18%)	2(9.09%)	9(40.91%)	7(31.82%)	8(36.36%)	6(27.27%)
>36-42 m =14	5(35.71%)	1(7.14%)	6(42.86%)	1(7.14%)	6(42.86%)	3(21.43%)
>42-48 m=14	2(14.29%)	2(14.29%)	6 (42.86%)	5(35.71%)	4 (28.57%)	5 (35.71%)
>48-54 m=4	0(0%)	2 (50%)	3(75%)	1 (25%)	0 (0%)	2 (50%)
GENDER						
Male=86	16(18.6%)	15(17.44%)	27(31.39%)	26(30.2%)	22(25.58%)	27(31.39%)
Female=74	16(21.62%)	12(16.22%)	18(24.32%)	26(35.1%)	23(31.08%)	23(31.08%)
CLUSTER						
Cluster 1=48	18(37.5%)	12(25%)	9(18.75%)	19(39.5%)	13 (27.08%)	23 (47.91%)
Cluster 2=48	6(12.5%)	5(10.42%)	16(33.33%)	11(22.9%)	9(18.75%)	9(18.75%)
Cluster 3=34	3 (8.82%)	3 (8.82%)	7 (20.59%)	18(52.9%)	12 (35.29%)	10 (29.41%)
Cluster 4=30	5 (16.66%)	7 (23.33%)	13 (43.33%)	4(13.33%)	11(36.66%)	8 (26.66%)
Total=160	32(20%)	27 (16.88%)	45(28.13%)	52(32.5%)	45 (28.13%)	50 (31.25%)

*Figure in parentheses denotes percentage

Severe wastedt: weight for height z score ≤-3SD; Moderate wastedt: weight for height z score ≤-2SD & >-3SD; Severe stunted: height for age z score ≤-3SD; Moderate stunted: height for age z score ≤-2SD & >-3SD; Severe underweight: weight for age z score ≤-3SD; Moderate underweight: weight for age z score ≤-2SD & >-3SD; Reference: WHO, 2006

Table 4.1.20: Prevalence of MAM and SAM children as per age, gender and cluster

MAM AND SAM CHILDREN IN THE STUDY AREA			
	MAM	SAM	GAM
AGE			
n(%) in all column			
0-6m (14)	2(14.29%)	3(21.43%)	5(35.72%)
>6-12m=23	7(30.43%)	4(17.39%)	11(47.82%)
>12-18m=24	4(16.67%)	7(29.17%)	11(45.84%)
>18-24 m=23	5(21.74%)	3(13.04%)	8 (34.78%)
>24-30 m=22	3(13.64%)	3(13.64%)	6 (27.28%)
>30-36 m=22	4(18.18%)	2(9.09%)	6 (27.27%)
>36-42 m =14	5(35.71%)	1(7.14%)	6 942.85%)
>42-48 m=14	2(14.29%)	2(14.29%)	4 (28.58%)
>48-54 m=4	0(0%)	2 (50%)	2 (50%)
GENDER			
Male=86	16(18.6%)	15(17.44%)	36.04%
Female=74	16(21.62%)	12(16.22%)	37.84%
CLUSTER			
Cluster 1=48	18(37.5%)	12(25%)	62.5%
Cluster 2=48	6(12.5%)	5(10.42%)	22.92%
Cluster 3=34	3 (8.82%)	3 (8.82%)	17.64%
Cluster 4=30	5 (16.66%)	7 (23.33%)	39.99%
Total=160	32(20%)	27 (16.88%)	36.88%

*Figure in parentheses denotes percentage

Severe acute malnourished (SAM): weight for height z score ≤-3SD Moderate acute malnourished (MAM): weight for height z score ≤-2SD & >-3SD Global acute malnourished (GAM): SAM+MAM

Thus, overall as per the study the result of the situational analysis of nutritional status of children revealed that among 160 children 36% were wasted, 60% were stunted and 59% were underweight (as per WHO new child growth standards, 2006 with z score <-2SD). Undernutrition rate as higher (54%) among older children (>2yrs).

Highlights of Phase I results Section B

- AAAUS (Availability, Accesssibility, Affordability, Utilization, Stability) were assessed as indicators of FNS. Among them food utilization was found to be poorest which need to be improved through integrated strategies.
- Among **food availability** indicators, mainly agricultural practices and supplementary nutrition through food aid were major points of concern. Being an industrial area, possible soil and water pollution resulted in poor agriculte and less people involved in farming. Supplementary nutrition coverage through food aid was not 100%.
- Among **food accessibility** indicators, food sources were accessible through road connectivity, hence not a major concern, drinking water access was poor in one cluster.
- Among **food affordability** indicators, despite being low per capita income and family income and very less mothers' individual income, economic access to local staple foods, local low cost green leafy vegetables or fruits was possible.
- The key indicators [poor household dietary diversity (56.88%), poor IYCN score (51.3%), poor hygiene and sanitation score (68.1%), poor nutritional status of mothers (54.4%) and children (36% wasted, 60% stunted, 59% underweight), poor maternal anemia (80%)] of **food utilization** indicated urgent need of an integrated approach as the status was far away from WHO global targets and poorer than national and regional NFHS data.
- Presence of safety net programs in the area such as ICDS, PDS, MDM etc ensures **food stability**.

Section C: Evaluation of predictors of undernutrition

Association of various parameters with nutritional status of mothers

Results revealed (Table 4.1.21) that mother's nutritional status had significant association with child's wasting ($p<0.01$**), household dietary diversity ($p<0.001$***) and women dietary diversity ($p<0.001$***). Women who used to consume variety of foods had better nutritional status.

Table 4.1.21: Association of various parameters with nutritional status of mothers

Sr. No	Indicators	Mothers with normal BMI (>18.5) N=73		Underweight mothers (<18.5) N=87		*P* Chi- Square test
		N	%	N	%	
1	**HDDS**					
a)	Positive	44	60.27	25	28.74	0.000***
b)	Negative	29	39.73	62	71.26	
2	**WDDS**					
a)	positive	46	63.01	27	31.03	0.000***
b)	negative	27	36.99	60	68.96	
3	**Child's wasting**					
a)	Not wasted	54	73.97	47	54.02	0.009**
b)	wasted	19	26.03	40	45.98	
4	**Childs stunting**					
a)	Not stunted	26	35.62	37	42.53	0.373 NS
b)	stunted	47	64.38	50	57.47	
5	**Childs undernutrition**					
a)	Not underweight	35	47.95	30	34.48	0.084 NS
b)	underweight	38	52.05	57	65.52	

NS indicates Non significant($p>0.05$). * indicates $p<0.05$ (significant); ** indicates $p<0.01$ (highly significant); *** indicates $p<0.001$ (very highly significant)

Association of various parameters with weight for height (wasting) of children

Among 160 children 63.12**% (**n=101**)** were normal **(**WHZ>**-**2SD**)** and 36.88**% (**n=59**)** were wasted **(**WHZ<**-**2SD**).** Result revealed family income of 66.1**%** of wasted children was ≤5000 Rupees as compared to 49.5**%** not wasted children indicating that family income can contribute to better nutritional status of the child as it increases the affordability of nutritious food. Higher percentage of not wasted children **(**44.55**%)** scored positive HDDS compared to wasted children **(**40.68**%)** indicating diversified diet can contribute to better weight for height of children. Exclusive breastfeeding practice within 1st 6 months after birth was higher among not wasted children **(**37**.**62**%)** as compared to wasted children (27.12%)**.** This result signifies that even though, breastfeeding initiated as per standard guidelines, child can still become wasted if exclusive breastfeeding **(**not providing any kind of pre**-**lacteals water or food**)** for 1st 6 months are not practiced appropriately**.** There was no significant association between hygiene and sanitation practices of mother child pairs and wasting status of children though practice of hand**-**wash with soap during food handling **(**not wasted 42.57%, wasted 38.98**%)** was higher among not wasted children (Table 4.1.22).

Table 4.1.22: Association of various parameters with weight for height of children

Sr. No	Indicators	Normal Children (weight for height >-2)		Wasted Children (weight for height <-2)		*P* Chi- Square test
		N	%	N	%	
1	**Family Income**					
a)	≤ 5000	50	49.5%	39	66.10%	0.135 NS
b)	5001/- to 10,000/-	41	40.59%	15	25.42%	
c)	10,001/- to 15,000/-	5	4.95%	4	6.78%	
d)	> 15,000/-	5	4.95%	1	1.69%	
2	**HDDS**					
a)	Positive	45	44.55%	24	40.68%	0.633 NS
b)	Negative	56	55.44%	35	59.32%	
3	**Exclusive Breastfeeding**					
a)	Yes	38	37.62%	16	27.12%	0.175 NS
b)	No	63	62.38%	43	72.88%	
4	**Practice of hand-wash**					
a)	Only with water	26	25.74%	12	20.34%	0.488 NS
b)	With soap only during defecation	32	31.68%	24	40.68%	
c)	With soap during food handling	43	42.57%	23	38.98%	

*NS:*Non significant(p>0.05). * indicates p<0.05 (significant); ** indicates p<0.01 (highly significant); *** indicates p<0.001 (very highly significant)

Association of various parameters with height for age (stunting) of children

Among 160 children 39.38**% (**n=63**)** were normal **(**HAZ>**-**2SD**)** and 60.63**% (**n=97**)** were stunted **(**HAZ<**-**2SD**).** Result revealed that family income of 55.67% of stunted children was **≤**5000 Rupees as compared to 55.56**%** not stunted children indicating that family income had no significant association with child stunting, therefore problem of child stunting can be reduced even in a poor resourced community by changing their practices. Household dietary diversity was not significantly associated with height for age of children**.** But higher percentage of not stunted children **(**49.21**%)** scored positive DDS compared to stunted children **(**39.18**%)** indicating diversified diet can contribute to better height for age of children. There was no significant association between IYCN practices and height for age of children. Result revealed significant association **(**p<0**.**05**)** between cleanliness of nails and clothes of children and their height for age**.** Clean nails were observed among 49.21**%** not stunted children as compared to only 29.9**%** stunted children**.** Clean clothes were observed among 52.38% not stunted children as compared to only 32.99% stunted children (Table 4.1.23).

Table 4.1.23: Association of various parameters with height for age (stunting) of children

Sr. No	Indicators	Normal Children (height for age >-2)		Stunted Children (height for age <-2)		*P* Chi- Square test
		N	%	N	%	
1	**Family Income**					
a)	≤ 5000	35	55.56%	54	55.67%	0.927 NS
b)	5001/- to 10,000/-	21	33.33%	35	36.08%	
c)	10,001/- to 15,000/-	4	6.35%	5	5.15%	
d)	> 15,000/-	3	4.76%	3	3.09%	
2	**Dietary diversity score**					
a)	Positive	31	49.21%	38	39.18%	0.097 NS
b)	Negative	32	50.79%	59	60.82%	
3	**Exclusive Breastfeeding**					
a)	Yes	23	36.51%	31	31.96%	0.552 NS
b)	No	40	63.49%	66	68.04%	
4	**Cleanliness of nails**					
a)	Clean	31	49.21%	29	29.90%	0.047*
b)	Dirty	32	50.79%	68	70.10%	
5	**Cleanliness of clothes**					
a)	Clean	33	52.38%	32	32.99%	0.046*
b)	Dirty	30	47.62%	65	67.01%	

NS Non significant(p>0.05). * indicates p<0.05 (significant); ** indicates p<0.01 (highly significant); *** indicates p<0.001 (very highly significant)

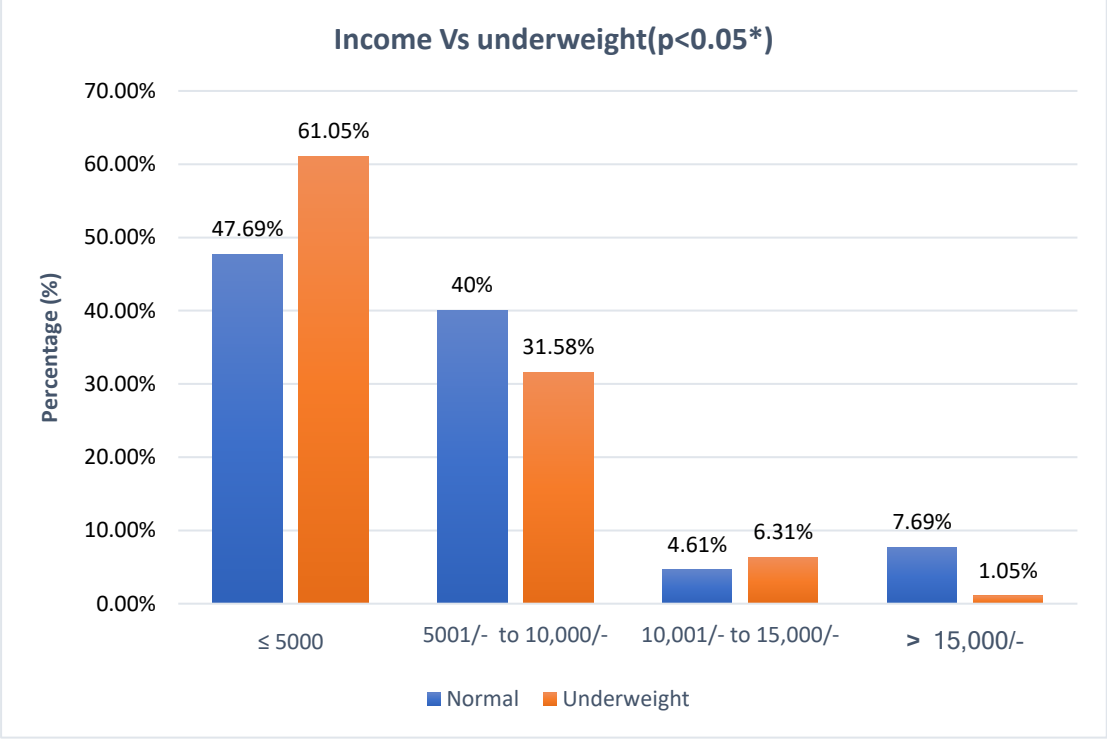
Association of various parameters with weight for age (underweight) of children

Among 160 children 40.63**%** **(**n=65**)** were normal **(**WAZ>**-**2SD**)** and 59.38**%** **(**n=95**)** were underweight **(**WAZ<**-**2SD**).**

Association between family income and weight for age of children

Family income of majority **(**61**%)** of underweight children was ≤5000 Rupees as compared to 47**%** not underweight children indicating that family income can contribute to better nutritional status of the child as it increases the affordability of nutritious food (Figure 4.1.22).

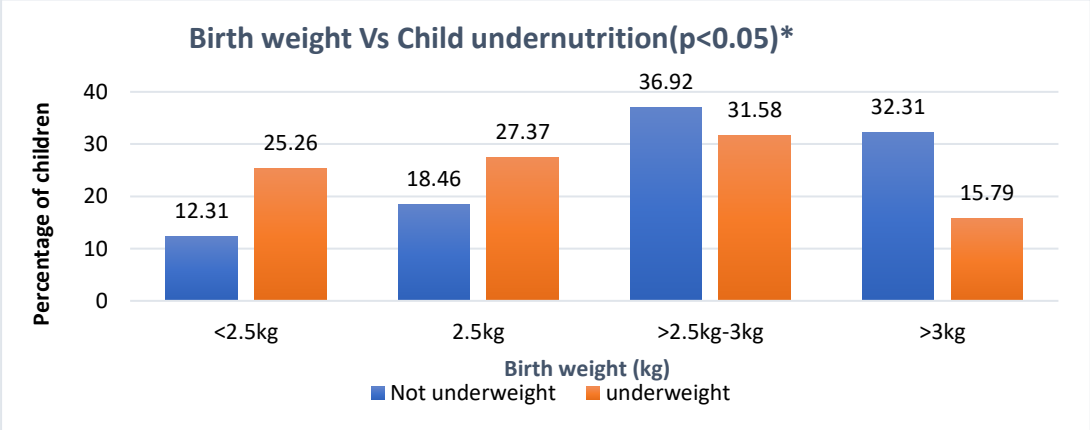
Figure 4.1.22: Association between family income and weight for age (underweight) of children



Association between child's birth weight and weight for age

Figure 4.1.23 indicated that, among the underweight children, 25**%** were low birth weight whereas among the not underweight children only 12**%** were low birth weight which corroborates with the findings that limited resources in poor communities may lead to chronic undernutrition during pregnancy and may result in poor birth outcomes**.**

Figure 4.1.23: Association between child's birth weight and weight for age (underweight) of children



Association between household dietary pattern and household dietary diversity with weight for age of children

Table 4.1.24 indicated that there was a significant difference **(**p<0**.**05**)** in intra household food distribution and household dietary diversity**.** Only men were fed well in majority of households having underweight children **(**4**.**61**%**among not underweight, 11**.**5**%** among underweight**).** Consumption of breakfast was poor among both not underweight and underweight group as only tea or very little snacks were consumed in majority of the households**.** Four meals were consumed in higher percentage of households having not underweight children **(**30**.**7**%** among not underweight, 22**%** among underweight**).** Household dietary diversity score was significantly correlated **(**p<0**.**05**)** with child undernutrition as higher percentage of not underweight children **(**53**.**85**%)** scored positive DDS compared to underweight children **(**35**.**79**%).**

Table 4.1.24: Correlation of household dietary pattern with weight for age of children

Sr. No	Dietary pattern Indicators	Normal Children (weight for age >-2)		Underweight Children (weight for age <-2)		*P* Chi-Square test
		N	%	N	%	
1	**Intra household food distribution (serving priorities)**					
a)	Men	3	4.61%	11	11.58%	0.040*
b)	Men and children	23	35.38%	44	46.31%	
c)	men, children and grandmothers	14	21.54%	21	22.1%	
d)	Households that dine together occasionally	5	7.69%	1	1.05%	
e)	Housholds that dine together regularly	20	30.77%	18	18.95%	
3	**Consumption of breakfast**					
a)	No breakfast	1	1.54%	2	2.1%	0.977 NS
b)	Irregular Breakfast	4	6.15%	8	8.42%	
	Breakfast with tea	26	40%	36	37.9%	
c)	Breakfast with Tea & biscuits	24	36.92%	36	37.9%	
e)	Regular Breakfast	10	15.38%	13	13.68%	
4	**Diet Pattern**					
a)	2 meals a day	9	13.84%	14	14.74%	0.463 NS
b)	3 meals a day	36	55.38%	60	66.67%	
c)	4 meals a day	20	30.77%	21	22.1%	
5	**Dietary diversity score**					
a)	Positive	35	53.85%	34	35.79%	0.025*
b)	Negative	30	46.15%	61	64.21%	

*NS*Non significant(p>0.05). * indicates p<0.05 (significant); ** indicates p<0.01 (highly significant); *** indicates p<0.001 (very highly significant)

Association between IYCN practices of mothers and weight for age of children

Table 4.1.25 indicated that among 65 not underweight children 73**.**8**%** were initiated breastfeeding within one day after birth compared to 65**.**2**%** underweight children**.** Incidence of colostrum feeding was higher among underweight children **(**68**.**42**%)** as compared to not underweight children (61**.**5**%**). Practice of giving pre**-**lacteals **(**p<0**.**05**)**, water **(**p<0**.**01**)** and top milk within 1st 6 months was higher among underweight children **(**71**.**5**%**, 69**.**4**%**, 20**%** respectively**)** as compared to not underweight children **(**53**.**8**%**, 49**.**2**%**, 13**.**8**%** respectively**).** Exclusive breastfeeding practice within 1st 6 months after birth was significantly **(**p<0**.**05**)** higher among not underweight children **(**44**.**6**%)** as compared to underweight children (26**.**3**%).** This result signifies that even though, initial child feeding practices were followed as per standard guidelines, child can still become undernourished at later age if other important positive child feeding behaviours like exclusive breastfeeding **(**not providing any kind of pre**-**lacteals water or food**)** for 1st 6 months are not practiced appropriately**.**

Other child feeding practices like continued breastfeeding up to 2y, breastfeeding during illness and practice of initiation of complementary feeding after 6 months were satisfactory for both underweight and not underweight children, and packaged food consumption was higher among both the groups**.** Among 160 children, mothers of 74**.**7**%** underweight children were not at all aware of ORS treatment compared to 61**.**5**%** not underweight children **(**p<0**.**05**).** Therefore, proper knowledge regarding ORS and its practice during diarrhoeal infection can create a difference in child nutrition as incidence of frequent diarrhoeal infection leads to weight reduction and poor nutritional status**.**

Table 4.1.25: Association between IYCN practices of mothers and weight for age of children

IYCN practices of mothers and weight for age of children						
Sr. No	**IYCN Indicators**	**Normal Children (weight for age >-2)**		**Underweight Children (weight for age <-2)**		***P*** **Chi- Square test**
		N	%	N	%	
1	**Initiation of breastfeeding**					
a)	Never initiated	0	0.0%	1	1.05%	0.42 NS
b)	Within 1 hour	34	52.3%	50	52.63%	
c)	Within 1 day	14	21.54%	12	12.63%	
d)	Within 3 days	11	16.92%	17	17.89%	
e)	After 3 days	6	9.23%	15	15.79%	
2	**Colostrum Feeding**					
a)	Fed	40	61.54%	65	68.42%	0.605 NS
b)	Discarded	24	36.92%	28	29.47%	
c)	Not aware	1	1.54%	2	2.1%	
3	**Practice of Prelacteals**					
a)	Yes	35	53.85%	68	71.58%	0.021*
b)	No	30	46.15%	27	28.42%	
4	**Practice of giving water in 1st 6 months**					
a)	Yes	32	49.23%	66	69.47%	0.010**
b)	No	33	50.77%	29	30.53%	
5	**Practice of giving top milk in 1st 6 months**					
a)	Yes	9	13.85%	19	20%	0.31 NS
b)	No	56	86.15%	76	80%	
6	**Exclusive Breastfeeding**					
a)	Yes	29	44.61%	25	26.31%	0.016*
b)	No	36	55.38%	70	73.68%	
7	**Continued breastfeeding upto 2 years**					
a)	Till 2 years	10	15.38%	24	25.26%	0.299 NS
b)	Before 2 years	12	18.46%	22	23.16%	
c)	After 2 years	7	10.77%	9	9.47%	
d)	Not applicable	36	55.8%	40	42.1%	
8	**Breastfeeding during illness**					
a)	Provided	54	83.07%	83	87.37%	0.447 NS
b)	Not provided	11	16.9%	12	12.63%	
9	**Initiation of complementary feeding on 7th month**					
a)	Yes	40	61.54%	60	63.16%	0.75 NS
b)	No	18	27.69%	28	29.47%	
c)	Not applicable	7	10.77%	7	7.37%	
15	**Consumption of unhygienic food**					
a)	No	12	18.46%	19	20%	0.77 NS
b)	Sometimes	14	21.54%	21	22.1%	
c)	Frequently	31	47.69%	48	50.53%	
	Not applicable	8	12.3%	7	7.37%	
18	**Knowledge and practice regarding ORS**					
a)	Not aware	40	61.54%	71	74.74%	0.040*
b)	Aware but don't know how to prepare	7	10.77%	2	2.1%	
c)	Aware and know how to prepare	18	27.69%	22	23.16%	

*NS*Non significant($p>0.05$). * indicates $p<0.05$ (significant); ** indicates $p<0.01$ (highly significant); *** indicates $p<0.001$ (very highly significant)

Association between hygiene & sanitation practices with WAZ of children

As regards Hygiene and sanitation practices, significant difference **(**p<0**.**01**)** was observed in case of cleanliness of clothes**.** Clothes were dirty **(**42**%)** and very dirty **(**25**%)** for majority of underweight children as compared to not underweight children **(**30**.**7**%** and 16**.**9**%** respectively**).** Practice of hand**-**wash with soap during food handling **(**not underweight 49**%**, underweight 35**%)** and presence of sanitary latrine with water facility **(**not underweight 29**%**, underweight 17**%)** were higher among not underweight children**.** Clean nails were observed among 46**%** not underweight children as compared to only 31**%** underweight children**.** This result reveals that hygiene and sanitation practices may affect child undernutrition and in the present study cleanliness of clothes significantly contributing child nutritional status and hence need to be promoted (Table 4.1.26).

Table 4.1.26: Association between hygiene and sanitation practices and weight for age of children

Correlation of hygiene and sanitation practices with weight for age of children						
Sr. No	**Hygiene and sanitation Indicators**	**Normal Children (weight for age >-2)**		**Underweight Children (weight for age <-2)**		***P*** **Chi-Square test**
		N	%	N	%	
1	**Practice of hand-wash**					
a)	Only with water	14	21.54%	24	25.26%	0.228 NS
b)	With soap only during defecation	19	29.23%	37	38.95%	
c)	With soap during food handling	32	49.23%	34	35.79%	
2	**Water purification with straining**					
a)	Yes	12	18.46%	22	23.16%	0.476 NS
b)	No	53	81.54%	73	76.84%	
3	**Sanitary Latrine**					
a)	Yes with water facility	19	29.23%	17	17.9%	0.237 NS
b)	Yes, but no water facility	16	24.62%	32	3.68%	
c)	No, Kaccha toilet	8	12.3%	8	8.42%	
d)	No, Field/Backyard	22	3.85%	38	40%	
4	**Status of nails**					
a)	Clean	30	46.15%	30	31.58%	0.173 NS
b)	Dirty	35	53.85%	65	68.42%	
5	**Status of clothes (Child)**					
a)	Clean	34	52.3%	31	32.63%	0.044*
b)	Dirty	31	47.69%	64	67.37%	

NS Non significant(p>0.05). * indicates p<0.05 (significant); ** indicates p<0.01 (highly significant); *** indicates p<0.001 (very highly significant)

Major predictors of undernutrition

Regression test revealed that practice of providing water within 1st 6 months after birth, exclusive breastfeeding practices for 1st 6 months after birth, intra household food distribution, dietary diversity, cleanliness of clothes of children and family income were major predictors of undernutrition (low weight for age) of children as indicated in table 4.1.27.

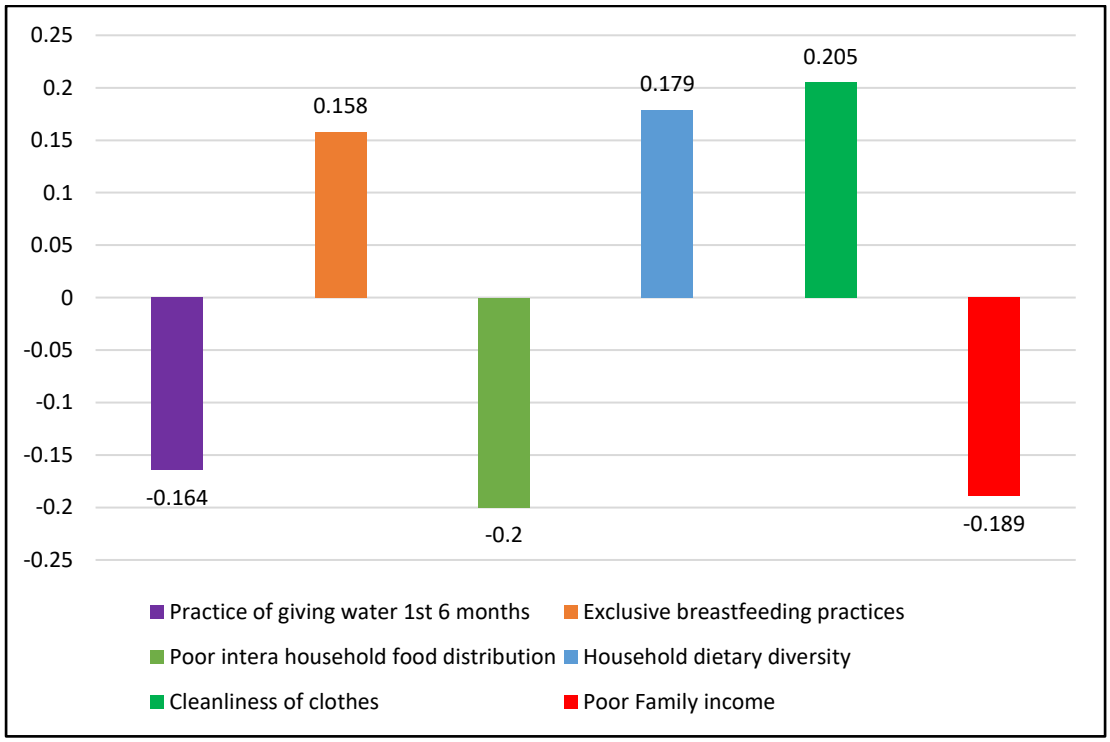
Table 4.1.27: Major predictors of Nutritional status of children (weight for age)

Predictors of nutritional status of children (weight for age)			
Variables entered	**Significant regressors**		
	Name	**Std β coefficient**	**Sig.**
Practice of pre-lacteals	Practice of giving water 1st 6 months	-.164	.039
Practice of giving water 1st 6 months			
exclusive breastfeeding practices	Exclusive breastfeeding practices	.158	.046
ORS knowledge			
Intra household food distribution	Intra household food distribution	-.200	.011
Dietary diversity score	Dietary diversity	.179	.023
Status of clothes	status of clothes	.205	.009
Family income	Family income	-.189	.016

Figure 4.1.24 further explained the negative or positive association between the predictors and weight for age of children. It shows that practice of giving water for 1st 6 months after birth was negatively associated with weight for age of children, hence more incidence of giving water resulted in less weight for age. Exclusive breastfeeding practice was positively associated with weight for age. More practice of exclusive breastfeeding resulted in improved weight for age. Improper intra household food distribution was negatively associated with weight for age, as more households feeding

only men well or giving preference to men regarding food than children and women had children with less weight for age. Dietary diversity and cleanliness of clothes were positively associated with weight for age as more diversified diet and more clean clothes resulted in more weight for age. Poor family income was negatively associated with weight for age. more family with monthly income less than 5000rupees resulted in less weight for age.

Figure 4.1.24: Predictors of nutritional status of children (weight for age)



Highlight of phase I results section B

- Mothers nutritional status significantly associated with child's wasting($p<0.01^{**}$), HDDS($p<0.001^{***}$) and WDDS($p<0.001^{***}$)
- Wasting and stunting status of children had no such significant association with any other factors or practices
- Weight for age was significantly associated with family income($p<0.05^{*}$), birth weight of child($p<0.05^{*}$), exclusive breastfeeding ($p<0.05^{*}$), intra household food distribution($p<0.05^{*}$), cleanliness of clothes($p<0.05^{*}$), household dietary diversity($p<0.05^{*}$).

Conclusions of phase 1 results

Gross food and nutrition insecurity were reported in the study area, wherein poor utilization of food was the major cause of concern, even after presence of abundant agricultural farm, existence of food aid and accessibility to various food resources. Therefore, Populations involved in agriculture, especially women and their children, need to be addressed and empowered by promoting good practices for improvement of Food and nutrition security **(**FNS**)** using an integrated approach**.**

Simple strategies such as positive deviance approach (PDA) can be effective in behaviour change and need to be promoted where there are limited resources**.** PPP **(**working in tandem with goals of CSR of industry, academicians and ongoing government programmes**)** can be effectively integrated for improving food and nutrition status of populations.

Therefore, the next section of result will be case control community trial involving positive deviant behaviours in 2 of the 4 clusters selected for the study and assessing the impact on food and nutrition security status of the rural households having mother child pairs.

DISCUSSION PHASE I

The results of phase 1 indicated gross undernutrition indicating poor utilization of available food due to poor IYCN practices, poor hygiene and sanitation practices, poor dietary diversity along with poor access to the available food security net in the area- ICDS supplementary nutrition affecting the nutritional status of the children in these rural communities.

FAO reported in 2018, that from 2015 to 2017 there was an increase in number of people facing chronic food deprivation, which reflects stagnation in many regions and progress towards ending hunger has stalled especially in the Asia-Pacific region. Even after setting sustainable development goals for 2030, in 2017 nearly half a billion Asians remain hungry (FAO, 2018).

India, an important country in this region, is still home to more than a quarter of the hungry people in the world despite rapid growth. Ensuring food and nutrition security is still a challenge for India, as its rapid growth has not translated into reduction in poverty, hunger and malnutrition, the three main sustainable development goals (IFPRI, 2019). In the phase 1 of the study, baseline data were collected from the study population by using the indicators (AAAUS) of food and nutrition security and results revealed the presence of household food insecurity due to poor food utilization in the study area. Previous study supports this result as it stated that though the country was successful in achieving self-sufficiency in food production and improved its capacity to cope with year to year fluctuations in food production, it could not solve the problem of household food insecurity among the vulnerable population especially the children and women in lower half of the expenditure class (Radhakrishna & Reddy, 2002), who were selected as study population in the present study also.

In the present study, food availability was assessed by indicators such as agricultural production, livestock and market availability and food aid; food accessibility was assessed by road condition and drinking water access; food affordability was assessed by socio-economic status and food utilization was assessed by household dietary diversity and dietary pattern, Infant and young child nutrition and dietary pattern of children, hygiene and sanitation practices, mothers nutritional status and maternal anemia and nutritional status of children.

While assessing food availability through agricultural practices, it revealed that only 58% households in the study area had farms and agriculture was main source of income for only 18.7% households. Among the 160 mothers, 28% involved in farming whereas among their husbands only 15% involved in farming indicating poor agricultural practices and less involvement of men in farming as well as less income generation from agriculture. This is a major concern as according to a previous study, global economic recession through reduced economic growth negatively impacts agricultural investment, although agricultural research and development is one of the most effective types of investment in reducing food and nutrition insecurity as well as poverty (von Braun, 2008).

As the manufacturing and services sectors become more important in the economy and employment in the agriculture sector started reducing, men move out of agriculture while women stay, which is the scenario of the present study also and as a result women's participation in agriculture expands (Slavchevska, 2016). This can work both as opportunity and challenge as increased involvement in agricultural work can empower women within their households but with increased responsibilities in agriculture without male labor and knowledge related agricultural practices results in failure (IFPRI, 2019).

In the present study, food aid in form of ICDS was also assessed to understand food availability. Previous study examined alternative scenarios of global food security along with the changing climate, bioenergy production trends, population predictions, and evolution of food preferences (Rosegrant et al., 2001). Finally, food aid both for emergency relief or addressing food deficits proved to be one of the major components of food security strategies in developing countries (del Ninno et al., 2007).

Indian Government has initiated several 'safety net programs' to increase availability, accessibility and stability of food such as Rashtriya Krishi Vikas Yojana to increase investment in agriculture, National Horticulture Mission to increase horticulture production, National food security mission focusing on rice, wheat and pulses production, National rural employment guarantee act (NREGA) focusing on rural livelihoods which in turn increases food affordability, School Mid-day meal program and Maa Annapoorna Scheme (distribution of 10kg food grains to elderly above 65 years). Food security act which promises 25kg rice or wheat at Rs 3/kg for families

below the poverty line (BPL) and Public distribution system (PDS) which currently targets BPL population (Pingali et al., 2019). There are micronutrient supplementation programs like Anemia prophylaxis program (distribution of IFA tablets to pregnant and lactating women, children and adolescent girls), Massive dose vitamin A program, Universal iodization of salt to combat iodine deficiency disease (http://nhm.gov.in/). Even in the presence of all the food aids and safety net programs, food and nutrition insecurity still exists in India.

ICDS is the world's largest program for the holistic development of children aged 0-6 years, expectant and lactating mothers and selected adolescent girls. It also aims at improving awareness of the community as a whole, and bring about behavior change (WCD, 2013).

In the study area, basic ICDS services were provided but Nutrition health education to mothers by the AWWs and regular home visit for that purpose was not satisfactory. Iron-Folic acid (IFA) tablet distribution and supplementary nutrition services were provided from the AWCs but the utilization of these services by the beneficiaries in the study area was not satisfactory as only 33% mothers regularly consumed IFA tablets, 61% consumed take home rations (THR) provided by ICDS during their pregnancy and lactation period. Only 57% children of 6monthns-3years consumed balbhog (THR) and only 31% children of 3-6years consumed freshly prepared hot cooked meal in the AWC on regular basis. Therefore, though ICDS was present in the area and delivered the services through anganwadi centres, there were certain gaps in the implementation of the program. Due to that reason, even in the presence of ICDS and its supplementary food distribution services, availability of food through this food aid was not completely satisfactory.

In a previous study done in Gujarat on ICDS evaluation, supplementary nutrition coverage was reported in 48.3% children (Chudasama et al., 2014) which is even lower than the present study. Almost equal coverage of supplementary nutrition was reported among pregnant and lactating mothers (87.0%) in the previous study (Chudasama et al., 2014). Studies have reported poor skills development of Anganwadi children as against the private nursery school children, which could be attributed to poor stimulating environment including lack of play materials, hence there is need to

improve the preschool environment of the Anganwadis which is recommended for our study as well (Thajnisa et al., 2007; Nair & Mehta, 2009).

Success of growth monitoring depend upon the extent to which counseling support, weighing scales and growth charts are available in AWCs (NIPCCD, 2006). Availability and accurate use of growth chart to assess the nutritional status of children in present study was higher than in some previous studies (Manhas & Dogra, 2006; Kapil et al., 19996). Distribution of Iron Folic Acid tablets to the beneficiaries was also higher than previous studies (Dixit et al., 2010; Surwade et al., 2013). According to RSOC 2013-14 India report, only 21.4% in rural India consumed 100 or more IFA tablets/syrup during pregnancy and only 17.3% received full ANC, which were higher in the present study (RSOC, 2013-14).

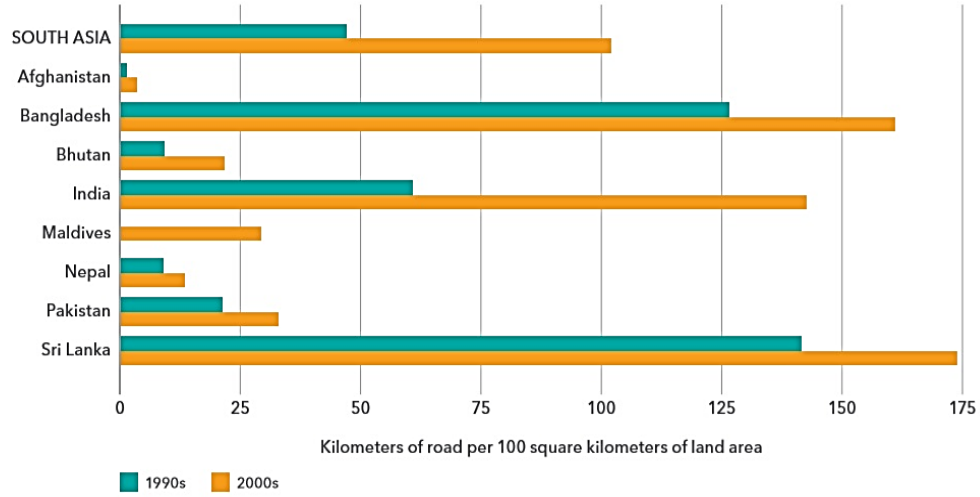
Considering the programmatic applications of the findings of this study, CDPO, supervisors, anganwadi workers and other grass-root level community workers need to be sensitized. Home visit by the anganwadi workers need to be promoted more, and if it's not taking place regularly, then that gap need to be identified and resolved. At programmatic level, more focus on adolescent girls, pregnant and lactating mothers need to be done as nourishment throughout 1000days proved to be essential for child's nutrition and therefore improved nutrition security. Services like Iron Folic acid tablet distribution, ante natal care of pregnant mothers though in the area were available but still low birth weight rate (18.7%) was quite high indicating the scope of improvement.

In the present study, road condition and drinking water access were assessed to understand food accessibility. All Indian residences are expected to be connected by all-weather roads by early 2019 (Figure 4.1.25). In the present study, all the rural households were not connected by proper roads and in monsoon, the road condition got even worse indicating the scope of improvement.

Facing the world's lowest per capita renewable freshwater resources, rural South Asians have benefited from the growing use of groundwater. But water table is falling, particularly in India and water quality is deteriorating throughout the region due to nutrient overloads and industrial pollution, raising concerns about food safety and drinking water quality (IFPRI, 2019). In the present study, drinking water access was poor in one cluster and needed immediate initiative and also there was chance of ground

water quality deterioration due to the presence of industry nearby and needed more investigation in this area.

Figure 4.1.25: Road density in south Asia



Source: Land Portal, accessed December 10, 2018, https://landportal.org/book/indicator/fao-21017-6124.

Note: Road density for South Asia is calculated as the average of road density of South Asian countries, weighted by their respective geographical areas. Data for Afghanistan are for 2004 and 2010; Bangladesh, 1990 and 2003; Bhutan, 2001 and 2011; India, 1990 and 2011; Maldives, 2005; Nepal, 1999 and 2008; Pakistan, 1990 and 2011; Sri Lanka, 1990 and 2010.

In the present study, socio-economic status was assessed to understand food affordability. Among 160 households, 55% had family income less than 5000 rupees and family income of non-agricultural households were more than agricultural households. Being agricultural labor, 8.75% mothers had individual income which were negligible. Previous study stated that economic access to food or food affordability by about a fourth of the population living below the poverty line is problematic, despite impressive economic growth in recent years. Macroeconomic stability, economic growth and its distribution, public expenditure, and governance as well as quality of institutions are crucial factors affecting food and nutrition security (Ecker & Breisinger, 2012). Rural areas continued to operate in crisis mode as globally, 80 percent of the extreme poor (living on less than $1.90 per day) and 75 percent of the moderately poor (living on $1.90 to $3.20 per day) live in rural areas (Castañeda, 2018). In the present study also its seen that the per capita income was extremely low and the rural people continued to suffer from a lack of economic opportunities and basic services.

Food is important for optimizing human health and environmental sustainability on Earth, but providing a growing world population with healthy diets from sustainable food systems becoming a major concern day by day. While global food production of

calories has generally kept pace with population growth, more than 820 million people still lack sufficient food, and many more consume either low-quality diets or too much food (Lancet, 2019). Dietary diversity, which is defined here as the number of different food groups consumed over a given reference period, has been identified as a potentially useful indicator (Moursi et al., 2008). Therefore, household dietary diversity and dietary pattern were considered major indicators of food utilization in the present study and assessed thoroughly.

Household Dietary Diversity Score (HDDS) was calculated for each mother-child pair using FAO guidelines (FAO, 2010) wherein the households which consumed at least 8 food groups daily (based on 50^{th} percentile) scored as positive and rest scored as negative indicating poor dietary diversity. Result revealed that only 43.1% households scored positive in HDDS and only 45.6% women scored positive in WDDS. Only 23% families dine together resulted in poor intra-household food distribution. Daily consumption of pearl millet or bajra (90%), rice (89%), wheat (46%), red gram dahl or tuver dahl (68%), potato (85%), onion (53%), tomato (43%), milk (56%), oil (85%), sugar (77%) was higher than other foods. Cereals (100%), pulses (95%) and vegetable (90%) consumption was higher among young children compared to milk and milk products (51%). Packaged food consumption (55%) was frequent among young children.

Dietary diversity has been shown to be associated with increased nutrient adequacy of children and adults in developed countries. (Kant AK, 2004). Dietary diversity for cereals, mixed dishes, beverages, sweets and fat consumption as well as fruits and vegetables is associated with increasing body mass index (Hooshmand & Udipi, 2013). Positive associations between dietary diversity and child nutritional status were documented previously in Kenya (Onyango et al, 1998), Mali (Hatloy et al,, 2000). And Haiti (Ruel et al., 2003). In our study also significant positive association observed between dietary diversity and child' weight for age, as among the 43% households who scored positive in HDD scale, among them 49% were underweight whereas who scored negative among them 67% were underweight. In addition, in the present study significant positive association was observed between dietary diversity and mother's nutritional status as well.

Several studies have highlighted the negative associations between food inflation and poor growth and mortality among neonates and young children (Fledderjohann et al., 2016), and positive associations between dietary diversity and child nutrition (Hatloy et al.,2000). However, additional research is required to confirm and clarify relations between various dietary diversity indicators and nutrient intake, adequacy, and density, for children with differing dietary patterns (Arimond & Ruel, 2004).

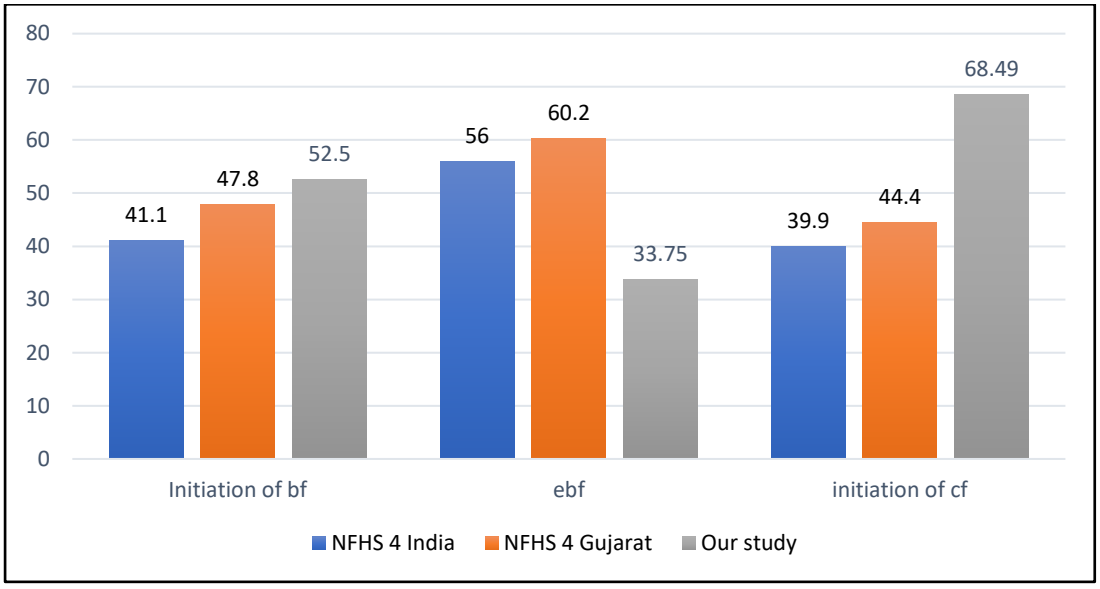
A study in Mali found that even with lower market prices for millet and sorghum than for rice, there was less than expected substitution of these coarse grains for rice because of their increased cooking time, and hence, fuel needs (Hatloy et al., 2000).

At the household level, the dietary intake of specific individuals involves two major issues: what food is being served on the table (household food demand) and who is to eat it (intra-household food distribution) (Weingärtner, 2010). A previous study stated about intra household food distribution which was major indicators in our study also to cause food insecurity. Even when women produce food, the intra-household allocation of food may well disfavor them due to beliefs about the value of females as compared to males. In many regions of south Asia women tend to eat the least or to eat leftovers after other family members have eaten-often the result of gender role internalization (Mukherjee, 2009). The ability to access food depends on power -power to produce, power to purchase and power to access food in intra-household allocation mechanisms. When women have less power than men, this translates directly into weaker access to food (Patel, 2012). Improvements in the status of women, both within and outside the household are thus of vital importance to ensure better nutritional outcomes in general and to reduce child malnutrition in particular (Meinzen-Dick et al., 2011).

In addition to having access to foods that are nutritionally adequate and safe, people must have a healthy environment to ensure effective biological utilization of the foods consumed and to provide adequate family/household care and feeding practices (FAO, 2000). Importance of caring practices such as child feeding need to be emphasized to understand food utilization (Quisumbing et al., 1995; Smith and Haddad, 2000). Therefore, infant and young child nutrition practices were assessed in the present study which revealed that, only 48.8% scored positive in infant and young child nutrition score based on 10 ideal practices defined by UNICEF. Among 160 mothers, only 52% initiated breastfeeding within 1 hour, 65% fed colostrum, 33% practiced exclusive

breastfeeding for 1st 6 months and 68% initiated complementary feeding after 6 months which was much lower than the national and state data as explained in figure 4.1.26.

Figure 4.1.26: Child comparison with national and state data



Previous study indicated that Exclusive Breast Feeding (EBF) for 6 months (Léon-Carvaet et al., 2002), and continued for more than 1y was associated with a greater height-for-age z score. In our study, though there was no significant association between exclusive breastfeeding and height for age of the children observed, but weight for age showed a positive association with EBF. Our previous study suggested that it is necessary to make the community mothers and other family members of a child to understand the direct correlation of wrong IYCF practices with occurrence of infectious diseases and rapid growth faltering of their children (Desai & Nambiar, 2015). An investigation was done regarding the association between breastfeeding duration and teacher-assessed educational achievement in 5-year old children in England. Their findings suggested that longer duration of breastfeeding, at all or exclusively, is associated with better educational achievement during the first year at school (Heikkilä et al., 2014). Previous studies had observed an association between food insecurity and mother's perceived capacity to produce sufficient breast milk (Gewa et al., 2011; Kimani-Murage et al., 2011; Nor et al., 2011; Webb Girard et al., 2012). Education in this context should focus on striking a balance between promoting milk as a good source of nutrition for young children and emphasizing the potential adverse health

consequences of introducing milk and other foods and liquids to infants before 6 months of age (Wyatt et al., 2015). Young children 12–23 months of age seemed to be meeting the recommended needs and nutrient densities for complementary foods better than the younger age groups (6–11 months) as they are given more and a wider variety of foods (Roche et al., 2011).

Hygiene and sanitation practices was another significant indicator in the present study to assess food utilization. Practice of hand**-**wash with soap was not satisfactory (41.25**%).** Only 21**%** filtered or strained drinking water for purification and open defecation was practiced by 37**.**5**%** households. Whereas RSOC reported only 29.9% rural people use improved sanitation facility and 61.6% households practice open defecation (RSOC, 2013-14). A direct relationship exists between sanitation and human wellbeing. Consumption of contaminated drinking water, improper disposal of human excreta, lack of personal and food hygiene have been the major causes of many diseases in India (MSSRF, 2007-08).

Strauss pointed out that the quality of health services might be more important in explaining nutritional status than the availability of or distance to health care services (Strauss, 1990). Diarrheal diseases are among the nutrition-health problems which are mostly associated with water and sanitation condition (von Braun et al., 1992). Water and sanitation improvements, in line with the changes in hygiene behavior and public health programs, have been shown to have significant effects on the population and its health (Smith & Haddad 2000).

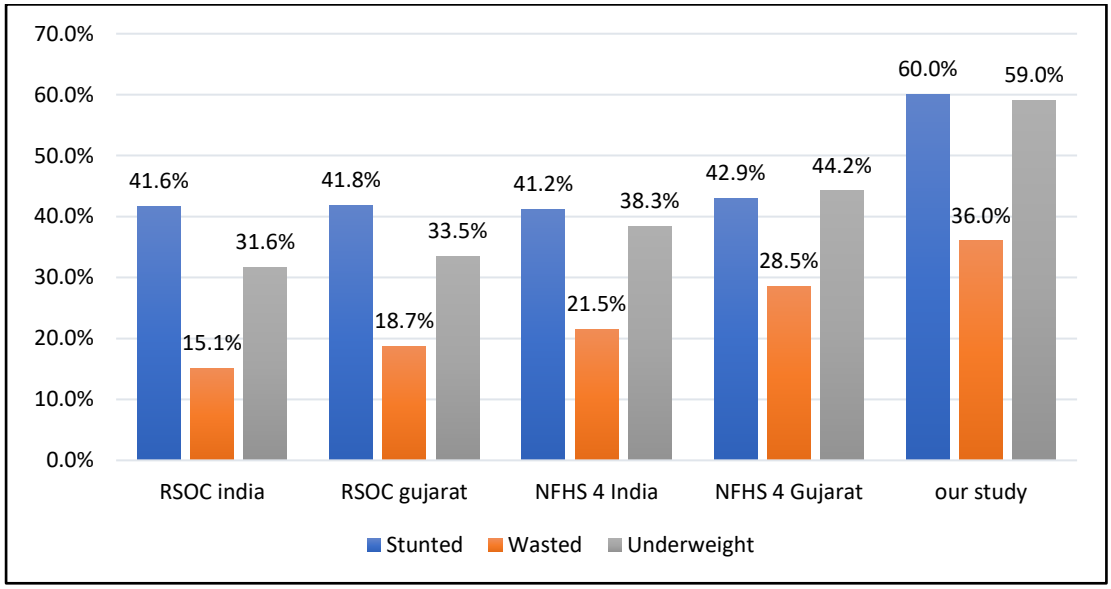
A previous study calculated that even a doubling of household calorie consumption, would reduce nutritional stunting of young children by about one-quarter of a standard deviation (or 17 percent of the z-score mean), whereas deworming would have the same effect, and a clean latrine would have twice this impact on nutritional status (Sungkar et al., 2017).

Undernutrition status of 160 mother-child pairs recorded in the study area was alarming as 36**%** were wasted, 60**%** were stunted and 59**%** were underweight **(**as per WHO new child growth standards, 2006 with z score <**-**2SD**).** Undernutrition rate was higher (54%) among older children (>2yrs). Almost 54% mothers were underweight (BMI<18.5) among 160 mothers. Undernutrition was higher (64%) in the younger age

group (18-21yrs) and 1st time mothers indicating (59%) urgent need to focus on pre-conceptual and adolescence nutrition.

Comparison with RSOC 2015 Gujarat report revealed that there were 2 times more wasted children and almost 1.5 times more stunted children present in the study area in respect to overall Gujarat. Among the undernourished children, 28% were severely wasted and 39.6% were severely stunted in the area. Figure 4.1.27 indicated higher wasting, stunting and undernutrition incidence in the study as compared to RSOC and NFHS 4 (2015-16) national and State data.

Figure 4.1.27: Child undernutrition comparison with national and state data



The prevalence of rural stunting is 26.8 percent, as compared with 19.2 percent in urban areas (Global Nutrition report, 2018). In the present study, weight for age was significantly associated with family income($p<0.05$*), birth weight of child($p<0.05$*), exclusive breastfeeding ($p<0.05$*), intra household food distribution($p<0.05$*), cleanliness of clothes($p<0.05$*), household dietary diversity($p<0.05$*). Our findings regarding association between child undernutrition and food and nutrition insecurity seem to contradict results from previous studies (McDonald et al., 2015). Contrary to our findings this study reported that the risk of maternal thinness, but not child undernutrition, increased as the severity of household food insecurity increased. Our study indicated contribution of both maternal thinness and child undernutrition in occurrence of food and nutrition insecurity.

In the present study, maternal anemia was also assessed to understand food utilization. Biochemical assessment of the mothers under study area revealed that 80**%** were anemic **(**Hb <12g/dL, WHO standard**)** and among the anemic mothers, 12**%** were severely anemic, 48**%** were moderately anemic and 39**%** were mildly anemic**.**

The prevalence of anemia among women of reproductive age rose from 30.3 percent in 2012 to 32.8 percent in 2016; no region in the world exhibited a decline, posing lifelong and generations-long problems for health and development (IFPRI, 2019). The prevalence of anemia was highest in south Asia and central and west Africa. (WHO, 2018). Around 55% of Indian women aged between 15 and 49 have anemia or low blood cell count and around 69.5% of Indian children aged between 6-35 months are suffering from anemia (India Health Report, 2015). More than 60% of pregnant women (15-49 years) in Gujarat are suffering from anemia in the rural area and Only 29% Mothers in rural Gujarat consume IFA for 90 days (RSOC, 2015).

Therefore, nutrition-specific and nutrition sensitive interventions, using integrated strategies targeting immediate causes of food insecurity in the study area such as poor agricultural practices, poor utilization of supplementary nutrition through food aid, poor dietary diversity and diet pattern, poor IYCN and hygiene sanitation practices need to be improved. Introducing several locally available foods such as moringa (Nambiar et al., 2003) along with nutrition communication (NC) is also beneficial (Imran et al., 2014).

RESULTS PHASE II: IDENTIFICATION AND PROMOTION OF POSITIVE DEVIANT BEHAVIORS (PDBS) AMONG MOTHER-CHILD PAIRS OF RURAL HOUSEHOLDS AND ASSESSING ITS IMPACT FOR IMRPOVING FOOD AND NUTRITION SECURITY- A COMMUNITY TRIAL USING PUBLIC PRIVATE PARTNERSHIP

The aim of the study was to improve food and nutrition security in rural households using public-private partnership. The status of food and nutrition security among mother child pairs and predictors of undernutrition in the rural community have been discussed in the previous section (Phase I results). The current section (Phase II) deals with identification of positive deviant behaviors among mother child pairs in rural households and presents the impact of capacity building and infrastructure development through interventions as a part of public-private partnership.

Phase II section A deals with identification of positive deviant behaviors (PDBs) among mother child pairs in all 4 clusters (n=160) using four attributes namely 1) Household dietary diversity score (HDDS) 2) Infant and Young Child Nutrition (IYCN) score 3) Hygiene and sanitation score and 4) weight for age z score of children.

Phase II Section B presents the results of the impact of capacity building and infrastructure development through interventions as a part of public-private partnership.

Section A: Identification of the positive deviant behaviors among mother-child pairs enrolled under the study

"It is often seen that in communities there are a few 'deviant' individuals whose uncommon behaviors or practices enable them to outperform their neighbors with whom they share the same resources. Identification of these "positive deviants" can be crucial to bring sustainable change as their behaviors are likely to be affordable and acceptable and sustainable by the wider community because their peers are already practicing them" (Sethi et al, 2003). The approach involves referring to Positive Deviants, in counselling parents of undernourished children for promoting positive behavior amongst the families of under nourished children. There was no such study to

improve overall food and nutrition security considering all the indicators in rural households using positive deviance approach.

This section highlights several positive deviant behaviors that were existent in the study area. Even it was a poorly resourced community, there were mothers with positive deviant behaviors. In this section mothers with PDB could be identified having positive behaviors in any of the following.

Positive deviant behaviors (PDB) were identified on the basis of four different indicators.

1. **Household dietary diversity score:** Among 12 food groups (Cereals; pulses; GLVs; Roots and tubers; vegetables; fruits; nuts and oilseeds; milk and milk products; non-veg; fats and oil; sugar; spices, condiments and beverages) households who daily consume at least 8 food groups (based on the 50^{th} percentile of the scores this cut off was decided) were categorized as positively deviant and others as negatively deviant (FAO, 2010 guidelines).
2. **IYCN score of mothers:** Among 10 ideal IYCN practices, mothers who scored more than or equals to 6 (more than 50%) categorized as positively deviant and who scored less than 6 were categorized as negatively deviant (UNICEF, 2013 guidelines).
3. **Hygiene and sanitation score of mother-child pairs:** Among 8 practices, who scored more than or equals to 5 (more than 50%) categorized as PDB and others as NDB (UNICEF, 2013 guidelines).
4. **Weight for age z scores of the children:** Children whose weight for age z score was more than -2 SD were categorized as Positively deviant and the children whose weight for age z score was less than or equals to -2SD were categorized as negatively deviant (WHO, 2006 guidelines).

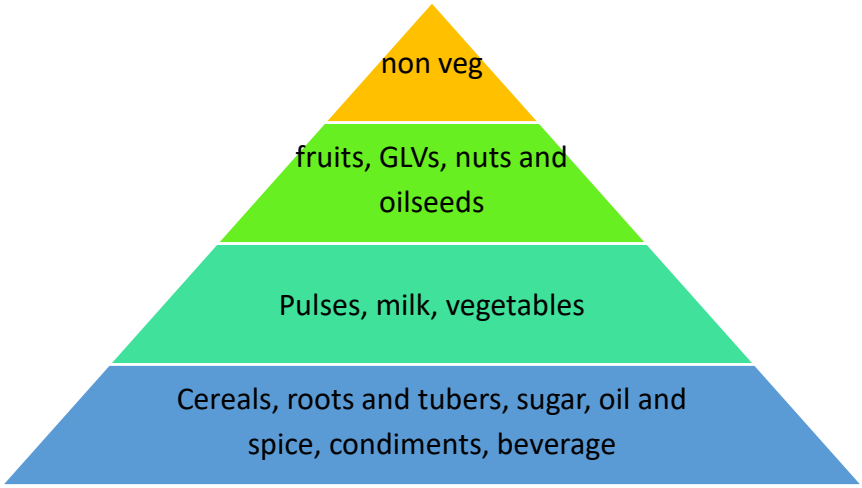
All the cut offs were selected on the basis of prior assessment of the data. Some practices were common among all the households and mother child pairs and some practices were not at all present. Therefore, the cut offs were decided keeping in mind the practices which were only available among few mother-child pairs and differentiate them from others.

Results of the Positive Deviant Behaviors (PDB) identification using four attributes

1. Household Dietary Diversity Score (HDDS)

Using the HDDS, 43.1% mothers had PDBs (HDDS>7), with lowest was non-vegetarian food consumption and highest was pulses and legumes consumption with the ranking as follows pulses>milk>vegetables>fruits>green leafy vegetables>nuts and oilseeds>Non-veg food consumption as per the OR values. Cereals, roots and tubers, sugar, oil and spice, condiments, beverage consumption was 100% in both the groups hence no OR values were determined (Table 4.2.1).

Figure 4.2.1: Consumption pattern of various food groups by the PD households



The blue section of the pyramid (Figure 4.2.1) demonstrated the food groups which were consumed by all of the PD mothers identified, even among the ND mothers, consumption of these food groups was common. The next section demonstrated the food groups which were widely consumed by the PD mothers and which differentiated them from ND mothers. Therefore, consumption of these positive behaviors of milk, pulse and vegetable consumption were already existed in the community among the positively deviant mothers and can be promoted by them to ND mothers. The next section demonstrated the food groups which were not commonly consumed even by PD mothers; therefore, PD mothers need to be empowered regarding the importance of the consumption of these foods and then

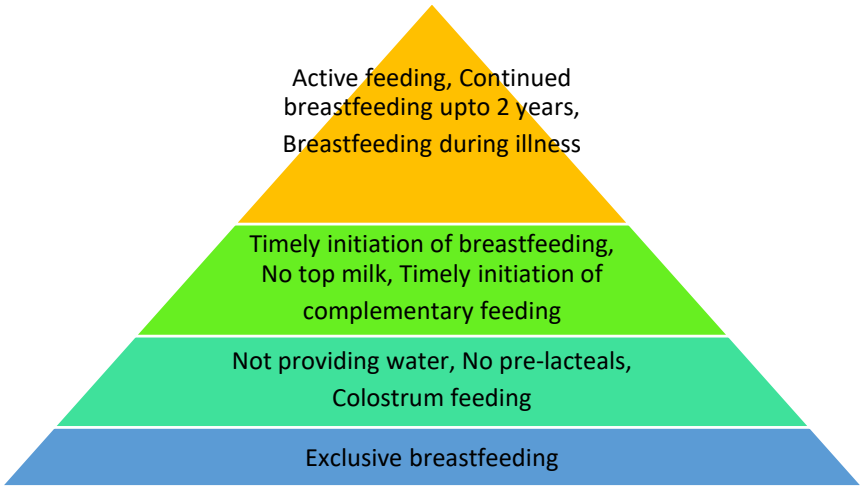
that can be promoted to ND mothers by the PD mothers. The last and top most section demonstrated non veg food which were not at all consumed in the study area, except few households, as the community was mostly vegetarian.

2. Infant and Young Child Nutrition (IYCN) score

Based on the IYCN PDB, only 48.8% (78) mothers could be categorized (IYCN score>5), with lowest behaviors for breastfeeding during illness and highest was not providing water within 1st 6 months to child with the ranking as follows:

Not providing water>no pre-lacteals>colostrum feeding>timely initiation of breastfeeding>no top milk>timely initiation of complementary feeding>active feeding>continued breastfeeding up to 2 years> breastfeeding during illness as per the OR values (Table 4.2.1). Exclusive breastfeeding practice was 100% in PDB mothers hence no OR value was determined. But this is one of the major practice available mostly among the PDB mothers and can be promoted to ND mothers.

Figure 4.2.2: IYCN practices among PD mothers



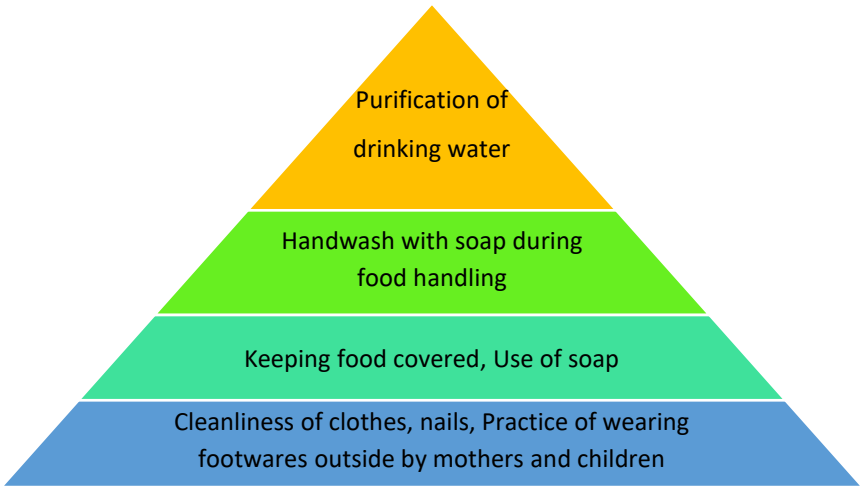
The blue section of the pyramid (Figure 4.2.2) demonstrated the practice, i.e. exclusive breastfeeding which was practiced by all the PD mothers identified. But phase 1 result showed that exclusive breastfeeding practice was very uncommon in the study area, and identified as a major cause of undernutrition. But there are positive deviant mothers who being in the same socio-economic background practiced this positive behavior, therefore this practice must be promoted through

them to improve the nutritional status of the children. The nest section of the pyramid demonstrated the IYCN practices (no pre-lacteals, no water in 1st 6 months, colostrum feeding after birth) which were existent among PD mothers with highest OR values, that means these were the practices which differentiated PD mothers from ND, and not common among the ND mothers, therefore need to be promoted by PD mothers. Giving pre-lacteals and water to young children was still a social taboo and cultural custom in the community, in most of the households and also discarding colostrum thinking its impure, was common. Promoting the mothers who staying in the same community did not stick to the taboo and understanding the importance practicing the Positive behaviors can give more effective results rather than empowering them by any outsiders, researchers or experts. The next section of the pyramid demonstrated the practices which were more or less common among both PD and ND mothers therefore with less OR values. Much awareness program regarding breastfeeding importance, initiatives of ICDS workers regarding timely initiation of breastfeeding and cultural custom regarding initiation of complementary feeding after completion of 6th month through *annaprashan* made these practices more common. The last section demonstrated the practices with lowest OR values, as breastfeeding during illness, active feeding and continued breastfeeding up to 2 years were common among all the mothers irrespective of PD and ND, and therefore can be given less focus while intervention and most focus need to be given on exclusive breastfeeding.

3. Hygiene and Sanitation Score (HSS)

Based on the hygiene and sanitation score, 31.9% (51) mother had PDB (HSS>4), with the lowest was purification of drinking water and highest was cleanliness of clothes and the ranking was as follows cleanliness of clothes of the children>practice of wearing footwears outside home by mothers>cleanliness of nails of child>practice of wearing footwear outside home by child>keeping food covered>use of soap>practice of handwash during food handling>purification of drinking water as per the OR values (Table 4.2.1).

Figure 4.2.3: Hygiene and sanitation practices among PD mothers



The blue section of the pyramid (Fig) demonstrated the practices with highest OR values which were common among PD mothers and not ND mothers, and created the difference in the score. These practices need to be promoted by PD mothers. The next section demonstrated practices with comparatively lower OR values as these were practiced by both PD and ND mothers. The next section demonstrated handwash with soap during food handling which was uncommon among all the mothers hence scored lower OR values. WASH project need to be carried out in the study area to overcome the problem. Purification of drinking water was the rarest hygiene practice among all PD and ND mothers with lowest OR values, hence need to be intervened at macro level.

4. Weight for age z score

Using weight/age as the criteria, 40.6% (65) were identified with PDB (WAZ=>-2SD) among 160 mothers.

Thus overall, only 15 mothers (5 in cluster 1, 8 in cluster 2, 1 in cluster 3 and 1 in cluster 4) were identified with PDBs using all 4 criteria.

Table 4.2.1: Positive deviant behaviors (PDB) identification using 4 Criteria

Criteria 1 HDD	**%(n) OR**	**Criteria 2 IYCN**	**%(n) OR**	**Criteria 3 HS**	**%(n) OR**	**Criteria 4 WAZ**	**%(n)**
Cereals	100 (69) OR-NA	Timely bf initiation	76.9(60) OR-8.06	Use of soap	94.12(48) OR-7.89	Weight for age z score >-2SD	40.6 (65) OR-NA
Pulses and legumes	98.55(68) OR-33.44	Colostrum Feeding	85.9(67) OR15.25	Handwash with soap	64.71(33) OR-4.22		
GLVs	49.28(34) OR-10.08	No Pre-lacteals feeding	85.9(67) OR-35.53	Drinking water straining	37.25(19) OR-3.72		
Roots and tubers	100(69) OR-NA	No water at 1st 6 months	76.92(60) OR133.33	Clean nails of child	86.27(44) OR-36.54		
Other vegetables	94.2(65) OR-21.67	No top milk at 1st 6 months	93.59(73) OR-5.69	Clean clothes of child	94.12(48) OR-86.59		
Fruits	26.09(18) OR-15.7	Exclusive bf	69.23(54) OR-NA	Use of shoes (child)	74.51(38) OR-26.04		
Nuts and oilseeds	11.59(8) OR-2.26	Continued bf up to 2y	64.1(50) OR-3.85	Use of shoes (mother)	82.35(42) OR-41.58		
Milk and milk products	88.41(61) OR-21.29	bf during illness	91.03(71) OR-2.46	Practice of keeping cooked food covered	96.08(49) OR-24.05		
Fats and oil	100(69) OR-NA	Timely initiation of cf	85.9(67) OR-5.52				
Sugar	100(69) OR-NA	Active feeding	73.08 (57) OR-4.03				
Non-veg	5.79(4) OR-1.06						
Spices, condiments & beverage	100(69) OR-NA						

Criteria 1 PD: HDDS>7 (FAO, 2010); Criteria 2 PD: IYCN score>5 (UNICEF, 2013); Criteria 3 PD: Hygiene and sanitation score>4 (UNICEF, 2013); Criteria 4 PD: WAZ>-2SD (WHO, 2006)

Highlight of the Phase II section A

- Using the HDDS as criteria, 43.1% mothers were identified with PDB. Apart from basic staples (cereals, sugar, oil, condiments) consumed by all, pulses, milk and vegetables were the food groups which especially consumed by the PD mothers and need to be promoted to ND mothers. Fruit and GLV consumption were lowest among all the mothers and need to be promoted at macro level.
- Using IYCN score as criteria, only 48.8% (78) mothers were identified with PDB. Exclusive breastfeeding for 1st 6 months to child was the highest followed behavior by PD mothers in these criteria which differentiate them from ND mothers and must be promoted by them.
- Based on the hygiene and sanitation score, 31.9% (51) mothers had PDB. Cleanliness of clothes was the highest followed positive behavior by PD mothers which differentiated them from ND mothers and need to be promoted. Purification of drinking water an handwash with soap during food handling were the least followed behavior both by PD and ND mothers and need to be promoted at macro level through WASH project and various other large scale initiatives.
- Using weight for age z score as the criteria, 40.6% (65) were identified with PDB among 160 mothers.
- Thus, overall in 4 clusters, only 15 mothers were identified with PDB using all 4 criteria

Section B: Results of the impact of capacity building and infrastructure development to improve food and nutrition security through interventions as a part of public-private partnership in rural households

Improving Food and Nutrition Security (FNS) calls for changes in Availability, Accessibility, Affordability, Utilization and Stability of food. In the phase I results it's been understood that food utilization was a major problem in the study area, especially household dietary pattern and diet diversity, infant and young child nutrition practices, hygiene and sanitation practices were not satisfactory in the poorly resourced and unaware community in this study. To improve utilization of food, these practices need to be improved and for that some mindsets and behaviors has to be changed. Among various behavior change communication strategies, positive deviance approach can be used as it has been a proven strategy in many settings. This approach is based on the notion that even in poorest communities there are children with better nutritional status because their mothers are practicing some uncommon positive behaviors which enable them to outperform their neighbors with whom they share the same resources. There was no such study earlier which used this approach in identifying positive deviant mothers on the basis of their positive behaviors (only nutritional status was considered in previous studies) and promoting them to improve food and nutrition security in rural households. But then there were problems in food availability, affordability and accessibility also in the study area. Roads, infrastructure, income can't be improved only through capacity building of the people by teaching positive behaviors at micro or meso level. Some initiatives need to be taken regarding agriculture development, income generation, large scale infrastructure development, therefore public-private partnership investments at macro level need to be done. Socio-ecology model is one approach which can be applied where interventions through PPP investments at micro, meso and macro level can be carried out.

The results of the same were discussed in this section of Phase II, where in the 1st part of this section, positively deviant (PD) mothers, identified in earlier section were our change agents. They were promoted to improve household dietary pattern, IYCN practices and hygiene and sanitation practices of ND mothers at micro and meso level through community mobilization using methods like individual and group counselling,

discussion, demonstration etc. In second part of this section, results of macro level intervention using public-private partnership has been discussed which improved the infrastructure, income, agriculture at large scale benefiting the whole community.

It was a case-control community trial where two clusters (Cluster 1 and Cluster 2) were selected as case (provided all the existing government services along with PD intervention) and other two (Cluster 3 and Cluster 4) were selected as control (provided all the existing government services only). Intervention for 1 year carried out in the case or experimental group promoting PD mothers (n=13, 5 in cluster 1 and 8 in cluster 2) as change agents to ND mothers (n=83, 43 in cluster 1 and 40 in cluster 2) to improve diet, IYCN, hygiene and sanitation and nutritional status at micro and meso level of SEM and large scale infrastructure, agriculture, food aid development at macro level of SEM as a part of public-private partnership.

Section B part I: Capacity building to improve food utilization at micro and meso level promoting positive deviant mothers as change agents

The details of intervention program were discussed below where in micro and meso level, positive deviance approach applied to improve food and nutrition security. In this phase mainly at individual and household level interventions were carried out to improve food utilization as part of public-private partnership. As the mothers were categorized as PD and ND, depending on four aspects (Diet, IYCN, Hygiene and sanitation, nutritional status of children), these four aspects which were indicators of food utilization, were also focused on intervention and impact was assessed.

Intervention activities at micro and meso level to improve dietary pattern

To improve household dietary diversity and dietary pattern of the community following (Table 4.2.2) attempts were made to organize activities. Consumption of fruits, green leafy vegetables along with pulses, milk and other vegetables were very low among the Negatively deviant households. PD mothers were empowered and promoted to improve the dietary diversity and diet pattern through group discussion, experience sharing, demonstration of recipes using drumstick leaves, cauliflower leaves, fenugreek leaves, spinach, lemon etc, individual and group counselling regarding importance of iron rich food like rice flakes, drumstick leaves, beetroot and protein rich pulses like mug dahl showing videos of PD mothers were carried out.

Table 4.2.2: Participant details and receptiveness of the intervention activities to improve household dietary pattern and diet diversity

Activities	Type of session	No of session	No of Participants	On-site support and assessment of learning
Promotion of PD mothers (group discussion, lecture, experience sharing) using NHE to sensitize regarding healthy diet and low cost GLV consumption.	Group	6	15-20	Mothers were more interested in these sessions as they were receiving the knowledge from persons who were familiar to them and came from same social background.
Group counselling and recipe demonstration on healthy diet and dietary pattern using NHE and videos of PDG	Group	10	10-12	These sessions were also well received by mothers but were little difficult to arrange and gather mothers at one place.
Extempore competition on healthy diet promoting PD mothers	Group	2	25-30	There sessions were participated with enthusiasm by the mothers as they were participatory and attractive rewards were ensured after the session.
House to house counselling on healthy diet using Video of PD mothers	Individual	96	1 mother in each session	This individual session was though time consuming but easy to conduct and mothers paid utmost attention when they were showed videos of PD mothers sharing their knowledge and experience.

Intervention activities at micro and meso level to improve IYCN practices

To improve IYCN practices of mothers following (Table 4.2.3) attempts were made to organize activities. Promotion of exclusive breastfeeding practices, restriction on using pre-lacteals, water, top milk on 1st 6 months, colostrum feeding and timely initiation of breastfeeding and complementary feeding were major points which were focused during the group discussion promoting PD mothers, individual and group counselling using videos of PD mothers, experience sharing of mothers using NHE materials.

Table 4.2.3: Participant details and receptiveness of the intervention activities to improve Infant and Young Child Nutrition (IYCN)

Activities	**Type of session**	**No of session**	**No of Participants**	**On-site support and assessment of learning**
Community mobilization (experience sharing, lecture, group discussion)	Group	6	15-20	Mothers were more interested in these sessions as they were receiving the knowledge from persons who were familiar to them and came from same socio-economic background.
House to house individual counselling on IYCN using video of Positive deviant mothers	Individual	96	1 mother in each session	This individual session was though time consuming but easy to conduct and mothers paid utmost attention when they were showed videos of PD mothers sharing their knowledge and experience
Group counselling on IYCN using NHE and videos of PDG	Group	10	10-12	These sessions were also well received by mothers but were little difficult to arrange and gather mothers at one place.
Quiz competition on breastfeeding and complementary feeding promoting PD mothers	Group	2	25-30	There sessions were participated with enthusiasm by the mothers as they were participatory and attractive rewards were ensured after the session.

Intervention activities at micro and meso level to improve Hygiene and sanitation practices

To improve hygiene and sanitation practices following (Table 4.2.4) attempts were made to organize activities. Handwash during food handling, use of soap, use of footwears, cleanliness of clothes and shoes were major points which were focused during the group discussion promoting PD mothers, individual and group counselling using videos of PD mothers, experience sharing of mothers using NHE materials. How to wash hands with soap before and after dealing with food were also demonstrated using PD mothers as change agents.

Table 4.2.4: Participant details and receptiveness of the intervention activities to improve Hygiene and sanitation practices

Activities	Type of session	No of session	No of Participants	On-site support and assessment of learning
Community mobilization (experience sharing, lecture, group discussion)	Group	6	15-20	Mothers were more interested in these sessions as they were receiving the knowledge from persons who were familiar to them and came from same social background.
House to house individual counselling on Hygiene and sanitation using NHE and video of Positive deviant mothers	Individual	96	1 mother in each session	This individual session was though time consuming but easy to conduct and mothers paid utmost attention when they were showed videos of PD mothers sharing their knowledge and experience
Group counselling on Hygiene and sanitation using NHE and videos of PDG	Group	6	10-12	These sessions were also well received by mothers but were little difficult to arrange and gather mothers at one place.
Extempore competition on Hygiene and sanitation practices promoting PD mothers	Group	2	25-30	There sessions were participated with enthusiasm by the mothers as they were participatory and attractive rewards were ensured after the session.

Results of intervention programs using positive deviance approach on Diet, IYCN, hygiene and sanitation practices and nutritional status of mothers and children

Impact of intervention on household dietary pattern

Practice of regular equal distribution of foods for all members increased by 38% in ND group. Regular breakfast consumption increased by 21.7% after intervention. Among all the foods, slight increase in consumption of rice flakes (13.3%), fenugreek (14.4%), spinach (14.4%), beetroot (16.9%), banana (3.7%) and lemon (3.6%) were recorded. Significant increase was recorded in case of consumption of drumstick leaves (76%). Table 4.2.5 shows the paired t test result.

Table 4.2.5: Impact of intervention on household dietary pattern

Serial No	Criteria		Mean	SD	t	Df	Sig. (2 tailed)
1	**Intra-household food distribution**	**Pre**	2.98	1.369	9.649	95	0.000***
		Post	4.41	0.776			
2	**Consumption of breakfast**	**Pre**	3.00	1.026	6.781	95	0.000***
		Post	3.74	0.965			
3	**Consumption of rice flakes**	**Pre**	1.25	0.437	3.539	95	0.001**
		Post	1.12	0.328			
4	**Consumption of Mug dahl**	**Pre**	1.06	0.239	3.723	95	0.000***
		Post	1.06	0.239			
5	**Consumption of methi**	**Pre**	1.83	0.377	3.723	95	0.000***
		Post	1.69	0.467			
6	**Consumption of spinach**	**Pre**	1.77	0.423	3.723	95	0.000***
		Post	1.63	0.487			
7	**Consumption of drumstick leaves**	**Pre**	1.96	0.188	16.072	95	0.000***
		Post	1.20	0.406			
8	**Consumption of beetroot**	**Pre**	1.98	0.154	4.079	95	0.000***
		Post	1.81	0.397			
9	**Consumption of banana**	**Pre**	1.14	0.354	1.754	95	0.083 NS
		Post	1,11	0.313			
10	**Consumption of lemon**	**Pre**	1.24	0.430	1.754	95	0.083 NS
		Post	1.20	0.406			

NS Non significant(p>0.05). * indicates p<0.05 (significant); ** indicates p<0.01 (highly significant); *** indicates p<0.001 (very highly significant)

Impact assessment on Infant and Young Child Nutrition (IYCN) practices

After applying positive deviance approach among mothers in the experimental group knowledge and practice regarding IYCN improved significantly. Knowledge and practice regarding initiation of breastfeeding within one hour increased by 43.4% (Figure 4.2.4), colostrum feeding increased by 14.3% (Figure 4.2.5), not providing pre-lacteals increased by 32.5% (Figure 4.2.6), not providing water (62.7%) (Figure 4.2.7) and top milk (21.7%) within 1st 6 months ((Figure 4.2.8) also increased significantly in ND group. Knowledge and practice regarding exclusive breastfeeding for 1st 6 months increased by 56.6% (Figure 4.2.9), continuation of breastfeeding up to two years or more increased from 34% to 76% (Figure 4.2.10), breastfeeding during illness increased by 9.6% (Figure 4.2.11), timely initiation of complementary feeding increased from 61% to 89% (Figure 4.2.12) and active feeding increased from 29% to 82% (Figure 4.2.13) in ND group. Table 4.2.6 shows the result of paired t-test showing significant improvement in knowledge and practice of child care and feeding nutrition.

Figure 4.2.4: Impact of intervention on knowledge and practice regarding Initiation of BF among PD and ND groups

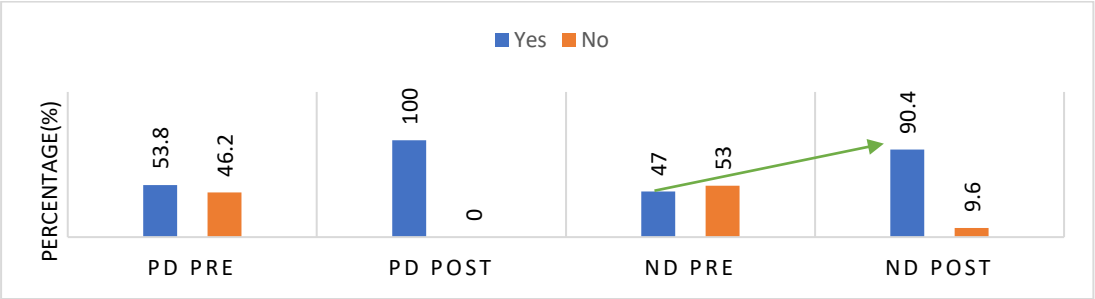


Figure 4.2.5: Impact of intervention on knowledge and Practice regarding colostrum feeding among PD and ND groups

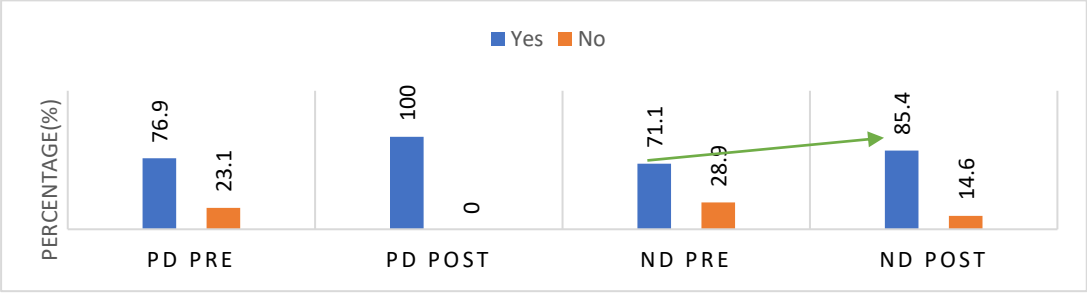


Figure 4.2.6: Impact of intervention on knowledge and practice regarding not providing pre-lacteals among PD and ND groups

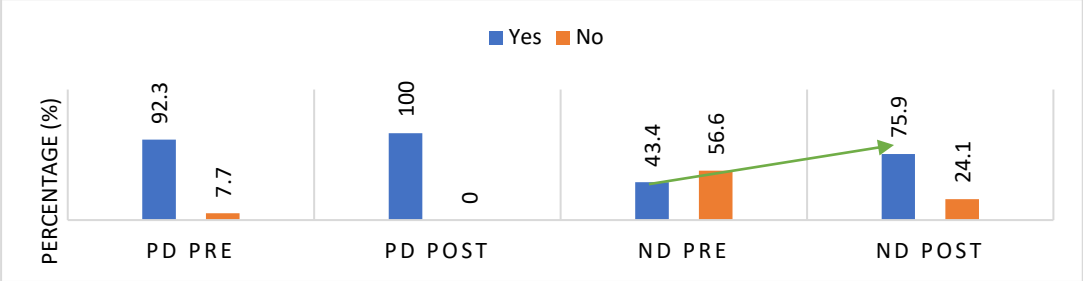


Figure 4.2.7: Impact of intervention on knowledge and practice regarding not providing water within 1st 6 months among PD and ND groups

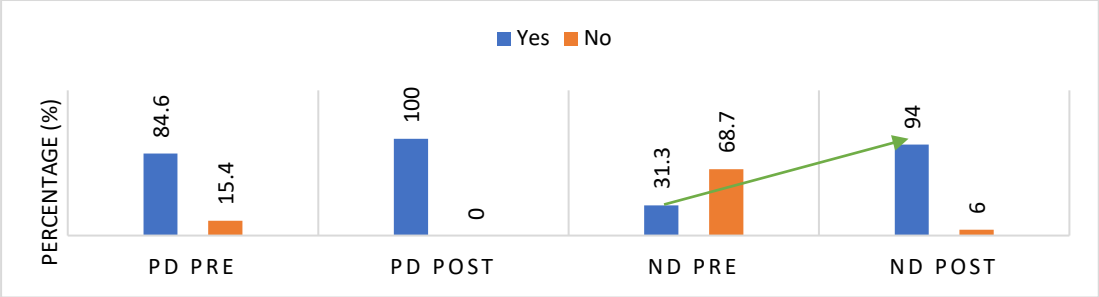


Figure 4.2.8: Impact of intervention on knowledge and practice regarding not providing top milk within 1st 6 months among PD and ND group

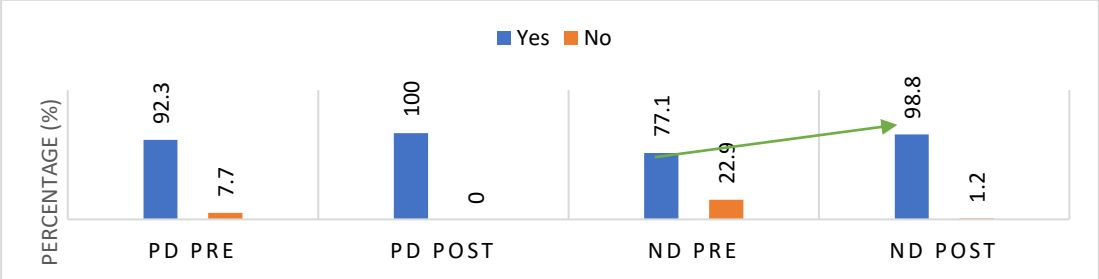


Figure 4.2.9: Impact of intervention on exclusive breastfeeding practices in 1st 6 months among PD and ND groups

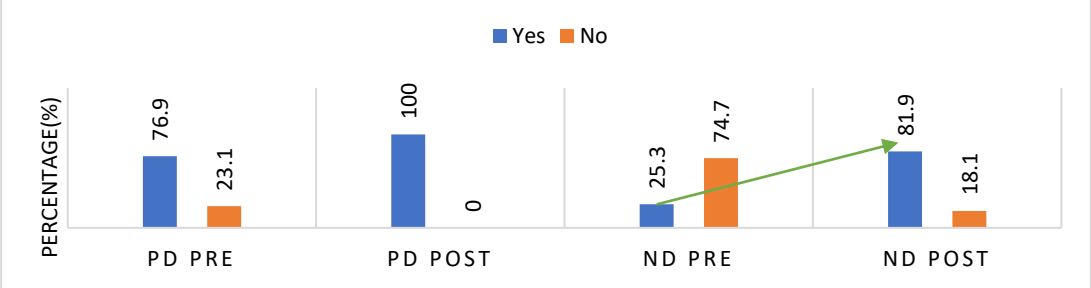


Figure 4.2.10: Impact of intervention on continued breastfeeding upto 2 years among PD and ND groups

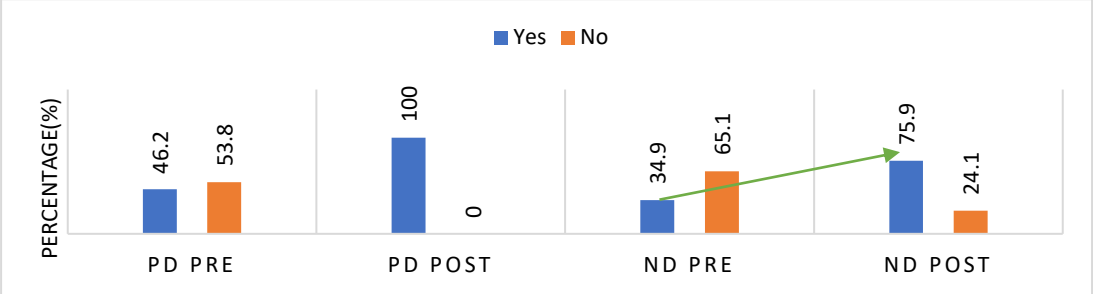


Figure 4.2.11: Impact of intervention on knowledge and practice regarding breastfeeding during illness among PD and ND groups

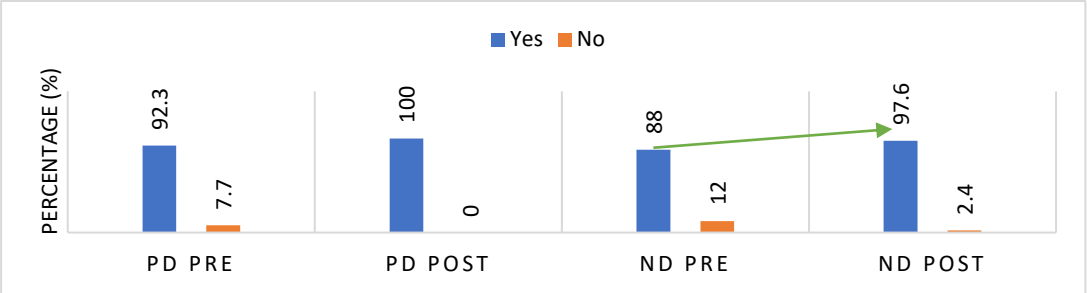


Figure 4.2.12: Impact of intervention on initiation of complementary feeding among PD and ND groups

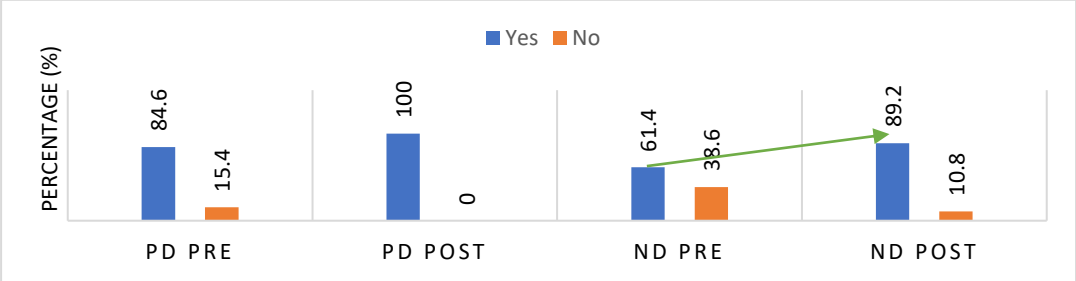


Figure 4.2.13: Impact of intervention on active feeding/feeding monitoring among PD and ND groups

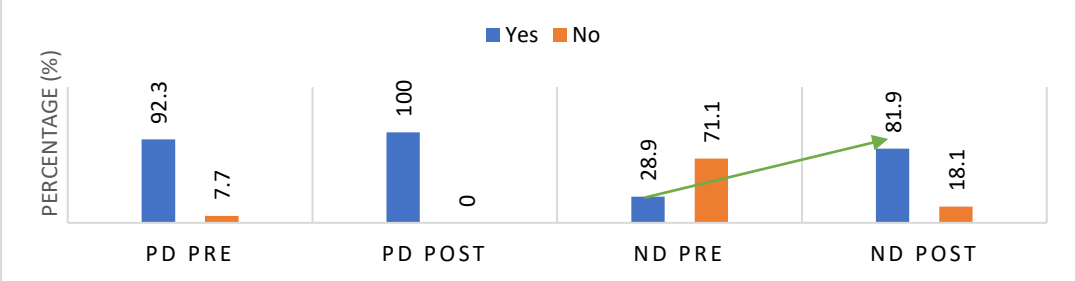


Table 4.2.6: Impact of intervention on IYCN practices

Serial No	Criteria		Mean	SD	t	Df	Sig. (2 tailed)
1	**Initiation of breastfeeding**	**Pre**	1.53	0.502	7.925	82	0.000***
		Post	1.10	0.297			
2	**Colostrum feeding**	**Pre**	1.28	0.452	3.542	81	0.001**
		Post	1.15	0.356			
3	**Pre-lacteals feeding**	**Pre**	1.57	0.499	6.288	82	0.000***
		Post	1.24	0.430			
4	**Providing water within 1st 6 months after birth**	**Pre**	1.69	0.467	11.728	82	0.000***
		Post	1.06	0.239			
5	**Providing top milk within 1st 6 months after birth**	**Pre**	1.23	0.423	4.765	82	0.000***
		Post	1.01	0.110			
6	**Exclusive breastfeeding**	**Pre**	1.75	0.437	10.347	82	0.000***
		Post	1.18	0.387			
7	**Continued breastfeeding upto 2 years**	**Pre**	1.65	0.480	7.543	82	0.000***
		Post	1.24	0.430			
8	**Breastfeeding during illness**	**Pre**	1.12	0.328	2.957	82	0.004**
		Post	1.02	0.154			
9	**Initiation of complementary feeding**	**Pre**	1.39	0.490	5.607	82	0.000***
		Post	1.11	0.313			
10	**Active feeding**	**Pre**	1.71	0.456	9.618	82	0.000***
		Post	1.18	0.387			

NS Non significant($p>0.05$). * indicates $p<0.05$ (significant); ** indicates $p<0.01$ (highly significant); *** indicates $p<0.001$ (very highly significant)

Impact assessment on hygiene and sanitation practices

After applying positive deviance approach among mothers in the experimental group knowledge and practice regarding hygiene and sanitation improved significantly. Practice of using soap increased from 64% to 82% and hand-wash with soap during food handling increased from 23% to 82% after intervention in ND group. Practice of purification of drinking water increased from 12% to 80% after intervention. Practice of covering cooked food increased from 55% to 90% after intervention. Cleanliness of clothes increased from 34% to 82% and cleanliness of nails increased from 31% to 74% after intervention. Practice of wearing shoes outside by children increased from 17% to 72% and by mothers increased from 27% to 67% after intervention. Table 4.2.7 explained the impact of intervention on hygiene and sanitation practices showing the paired t test results.

Table 4.2.7: Impact of intervention on Hygiene and sanitation practices

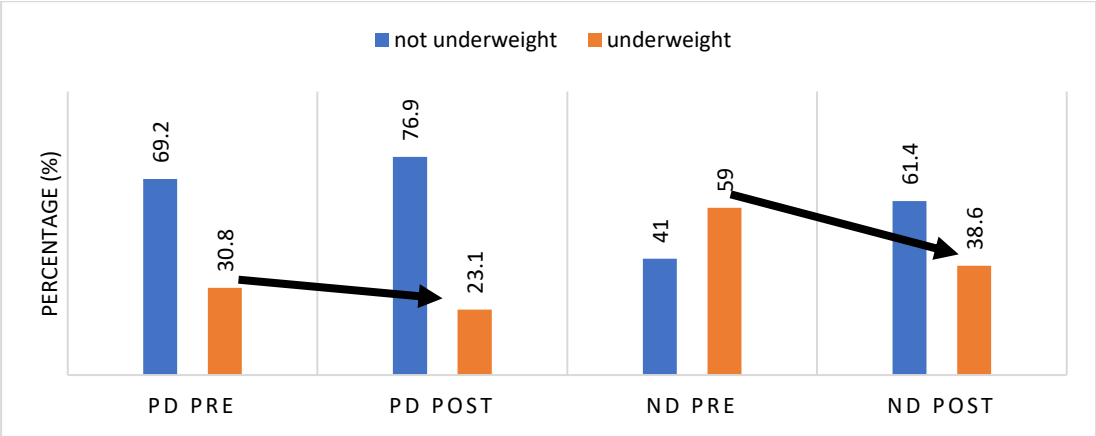
Serial No	Criteria		Mean	SD	t	Df	Sig. (2 tailed)
1	**Use of soap**	**Pre**	1.36	0.483	4.253	82	0.000***
		Post	1.18	0.387			
2	**Handwash during food handling**	**Pre**	1.77	0.423	10.871	82	0.000***
		Post	1.18	0.387			
3	**Purification of water by straining**	**Pre**	1.88	0.328	13.041	82	0.000***
		Post	1.20	0.406			
4	**Practice of covering cooked food**	**Pre**	1.45	0.500	6.636	82	0.000***
		Post	1.10	0.297			
5	**Cleanliness of clothes**	**Pre**	1.66	0.476	8.734	82	0.000***
		Post	1.18	0.387			
6	**Cleanliness of nails**	**Pre**	1.69	0.467	7.925	82	0.000***
		Post	1.25	0.437			
7	**Use of shoes (child)**	**Pre**	1.83	0.377	10.097	82	0.000***
		Post	1.28	0.450			
8	**Use of shoes (mother)**	**Pre**	1.72	0.450	7.357	82	0.000***
		Post	1.33	0.471			

NS Non significant($p>0.05$). * indicates $p<0.05$ (significant); ** indicates $p<0.01$ (highly significant); *** indicates $p<0.001$ (very highly significant)

Impact assessment on nutritional status of mothers

After 1year intervention regarding household dietary pattern and hygiene and sanitation practices, mothers' nutritional status was expected to be improved. Therefore, the weight of the mothers was measured post intervention and BMI was calculated. It was observed that before intervention 30.8% mothers were underweight in PD group which reduced by 7.7% and 59% mothers were underweight in ND group which reduced by 20.4% ($p<0.01^{**}$) after intervention (Figure 4.2.14)**.**

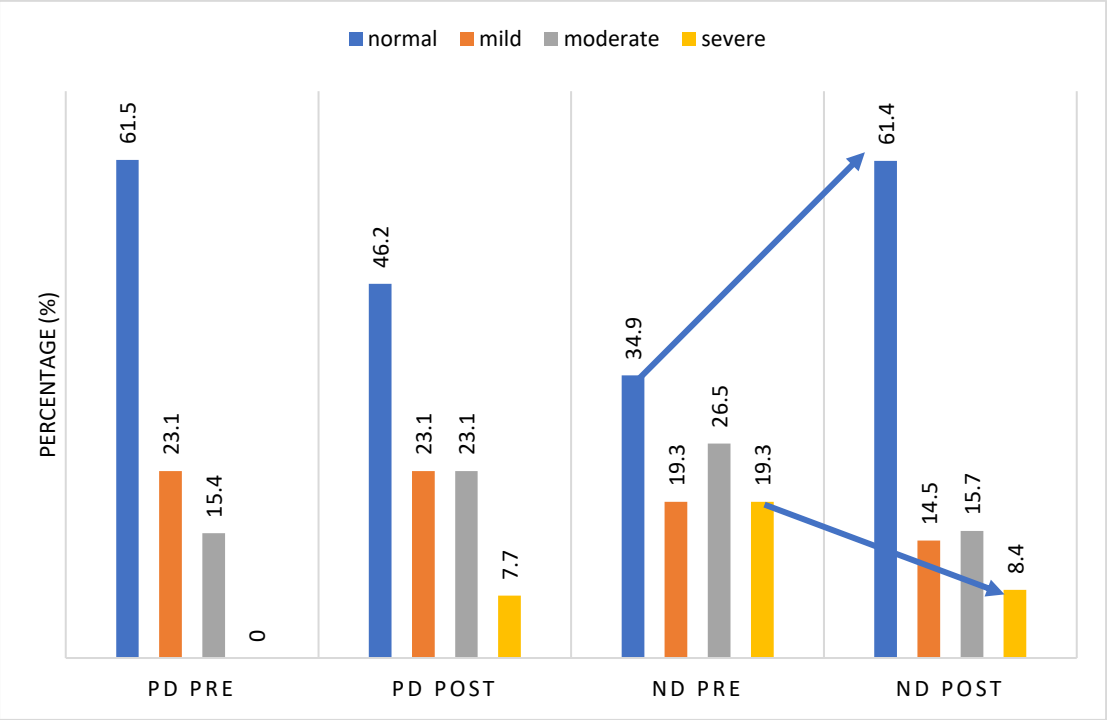
Figure 4.2.14: Impact assessment on Nutritional status of PD and ND mothers



Impact assessment on nutritional status of children

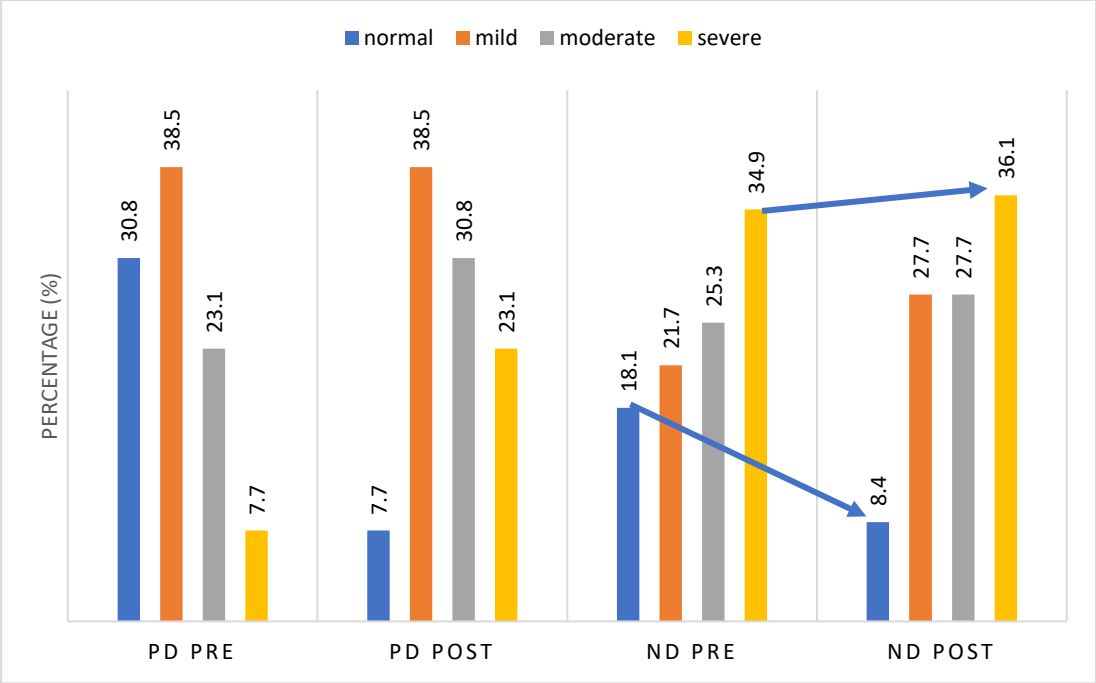
After 1year intervention regarding household dietary pattern, IYCN and hygiene and sanitation practices, child's nutritional status was expected to be improved. Therefore, the weight and height of the children were measured post intervention and then weight for age, height for age and weight for height z scores were calculated to determine underweight stunting and wasting status respectively. Figure 4.2.15 indicated that severe wasting or SAM reduced by 10.9%, moderate wasting or MAM reduced by 10.8%, therefore, GAM reduced by 21.7%, mild wasting reduced by 4.8% after intervention in ND group as well as severe underweight reduced by 18% (Figure 4.2.17). But stunting increased even after intervention (Figure 4.2.16).

Figure 4.2.15: Wasting status of PD & ND children before and after intervention



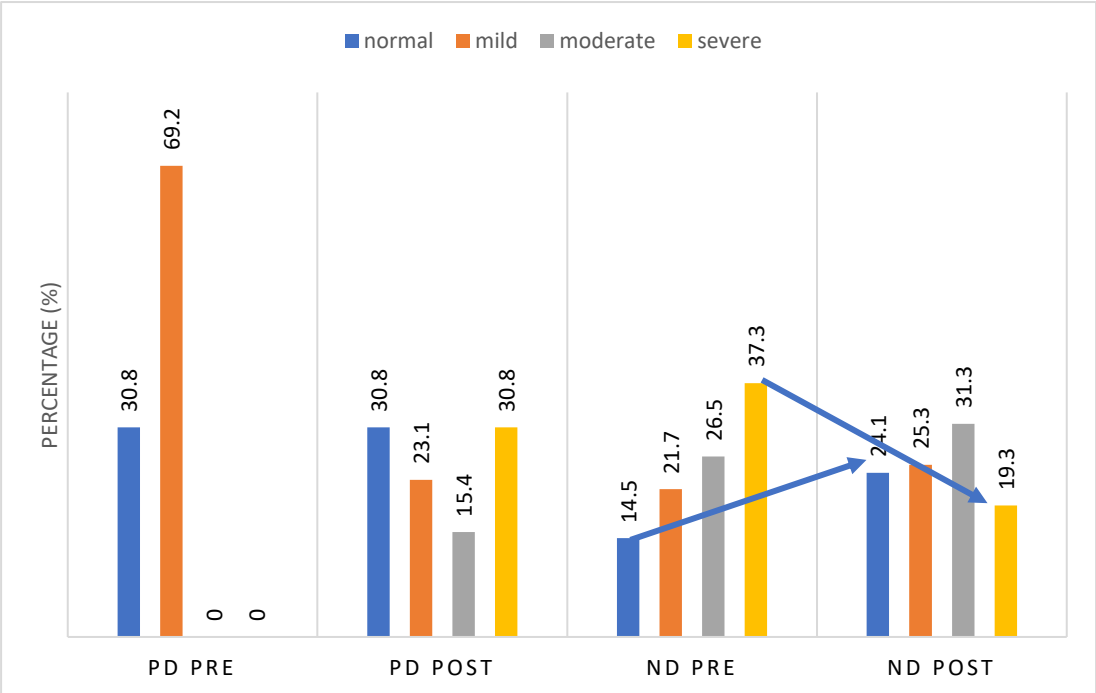
Severe wasting or SAM: weight for height z score ≤-3SD; Moderate wasting or MAM: weight for height z score ≤-2SD & >-3SD; Mild wasting: weight for height z score ≤-1SD & >-2SD; Normal: weight for height z score >-1SD Reference: WHO, 2006

Figure 4.2.16: Stunting status of PD & ND children before and after intervention



Severe stunting: height for age z score ≤-3SD; Moderate stunting: height for age z score ≤-2SD & >-3SD; Mild stunting: height for age z score ≤-1SD & >-2SD; Normal: height for age z score >-1SD Reference: WHO, 2006

Figure 4.2.17: Underweight status of PD and ND children before and after intervention

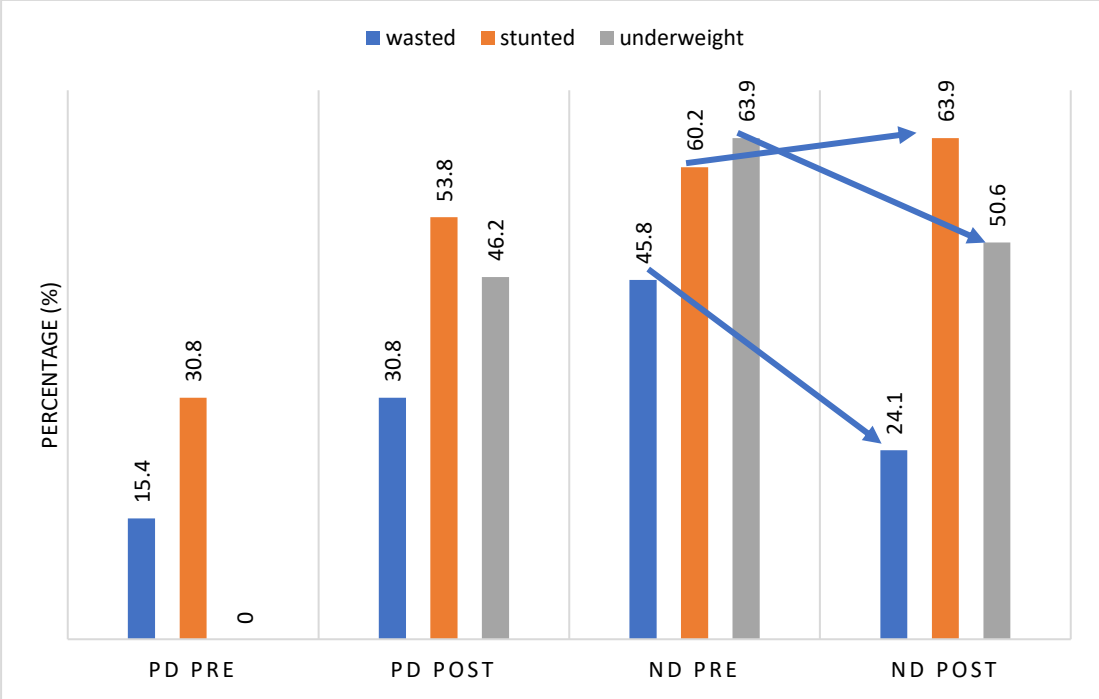


Severe underweight: weight for age z score ≤-3SD; Moderate underweight: weight for age z score ≤-2SD & >-3SD; Mild underweight: weight for age z score ≤-1SD & >-2SD; Normal: weight for age z score >-1SD Reference: WHO, 2006

After intervention overall wasting reduced by 21.7% ($p<0.01$**), underweight reduced by 13.3% ($p<0.01$**) and Stunting increased by 3.7% ($p<0.05$*), after completion of the study (Figure 4.2.18). Figure 4.2.19-4.2.21 shows individual nutritional status of each children under the study before and after application of positive deviance approach using public-private partnership.

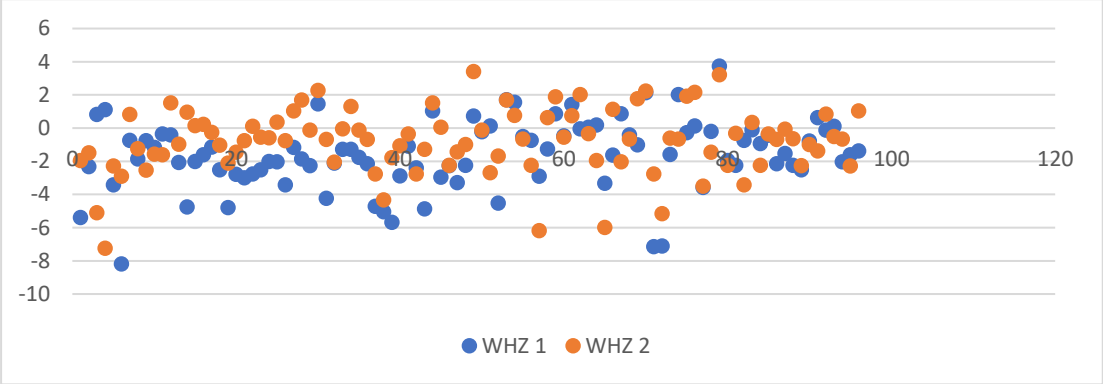
Nutritional status of PD children could not be maintained and incidence of undernutrition took place mainly due to child morbidity, poor dietary diversity and dietary pattern which as result explained could not be improved much as its not possible to change dietary pattern of a rural set up in such short period. Therefore, longitudinal study is needed to understand the impact of positive deviance approach on nutritional status of children especially on stunting.

Figure 4.2.18: Nutritional status of PD and ND children before and after intervention



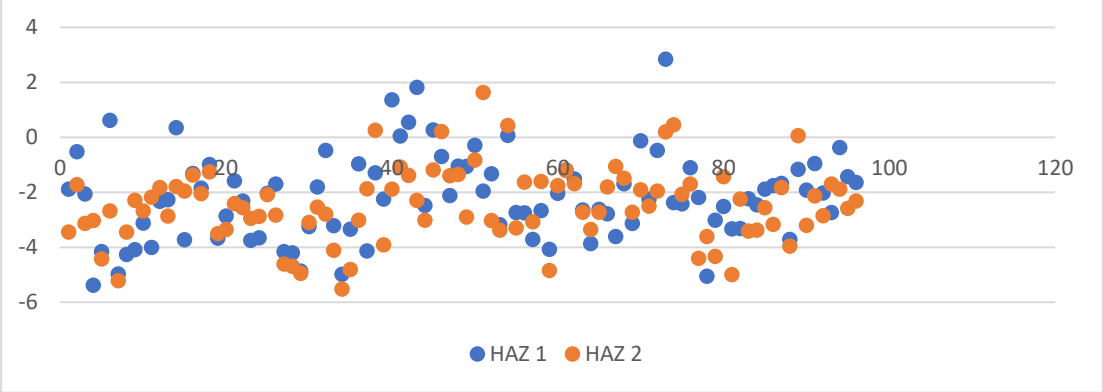
Wasted: weight for height ≤-2SD Stunted: height for age ≤-2SD Underweight: weight for age ≤-2SD
Reference: WHO, 2006

Figure 4.2.19: Shifts in status of wasting or weigh for height z score (WHZ) post 1year intervention



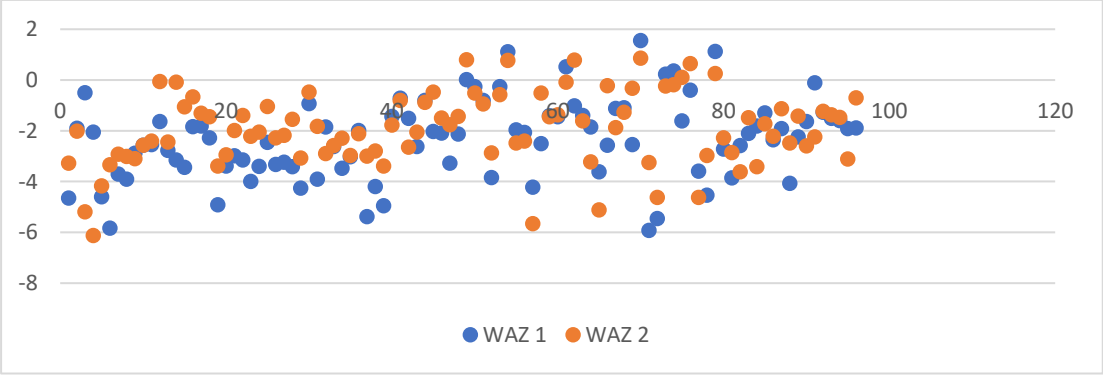
WHZ1: before intervention z scores WHZ2: After intervention z scores

Figure 4.2.20: Shifts in status of stunting or height for age z score (HAZ) post 1year intervention



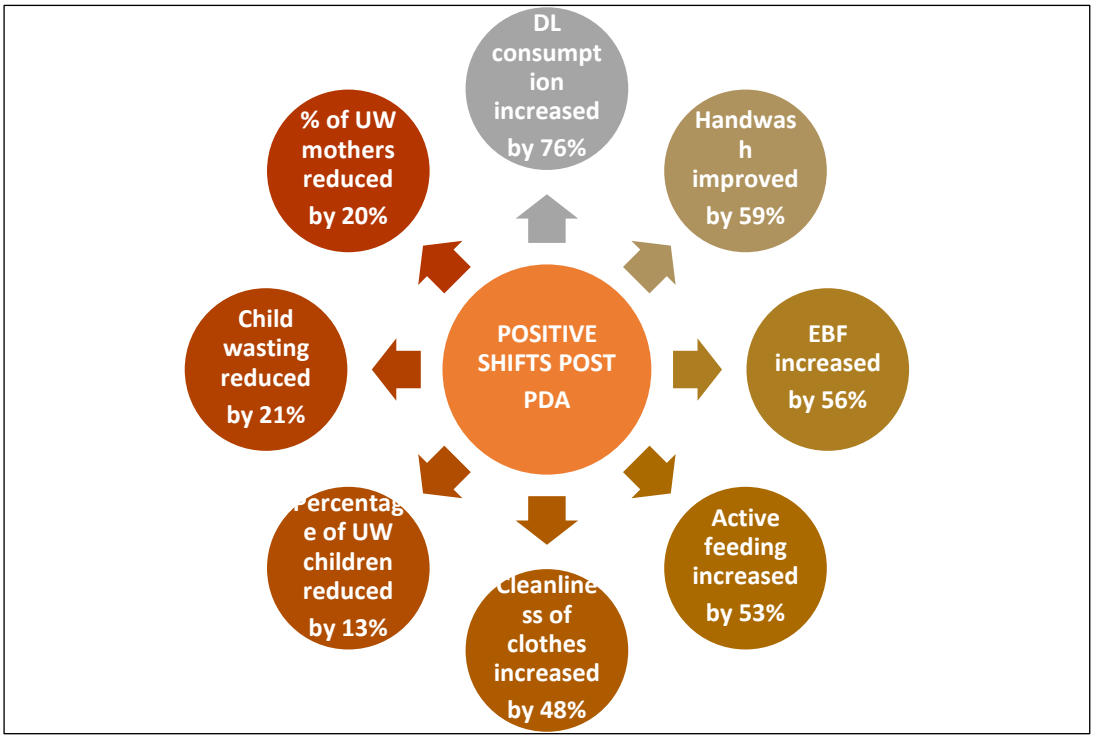
HAZ1: Before intervention z score HAZ2: After intervention z score

Figure 4.2.21: Shifts in status of underweight or weight for age z score (WAZ) post 1year intervention



WAZ1: Before intervention z score WAZ2: After intervention z score

Summary of Capacity building of ND mothers using PD mothers at micro and meso level



Section B part II: Capacity building and Infrastructure development to improve food availability, accessibility and affordability at macro level through interventions as a part of public-private partnership

The details of intervention program were discussed below where in macro level, interventions applied to improve food and nutrition security. In this phase mainly at community or village level interventions were carried out to improve food availability, accessibility and affordability as part of public-private partnership and impact was assessed.

Intervention activities at macro level to improve food and nutrition security

To improve food availability, accessibility and affordability of the community following (Table 4.2.8) attempts were made to organize activities at macro level. Food availability can be improved through infrastructure development of ICDS and empowerment of ICDS workers in the study area as well as creating awareness among the beneficiaries regarding importance of ICDS, which was the existing food aid in the community. ICDS workers were empowered and trained regarding weight monitoring, inclusion of more GLVs in the supplementary foods, regular home visits and providing knowledge regarding foods and nutrition. Beneficiaries were counselled regarding utilization of the food aid and supplementary nutrition provided by ICDS which was not satisfactory initially. New ICDS centres were also made to recover the gaps and improve food availability. Drumstick seed distribution and drumstick plantation program were also carried out to improve the Green leafy vegetable production in the village as GLV consumption was very low among the households. Kitchen garden was also promoted for the same purpose. Roads were improved, solar lights were installed in the roads to improve food accessibility. Training was given to make solar cookers and smokeless chulhas were also distributed to reduce fuel cost, morbidity cost, improve the quality of life, easy access to cooking, so that more money can be spent on food and food accessibility can be improved. In one village there was no drinking water access in every households and only one handpump was the main source of drinking water for the entire village cluster. Pipelines were provided to each households and drinking water accessibility was improved through intervention at macro level with the help of public-private partnership. Capacity building of women were done with various

skill development program to generate income and improve food affordability as low income was a major cause of undernutrition in the village.

Table 4.2.8: Participant details and receptiveness of the intervention activities to improve food and Nutrition Security in rural community using public-private partnership at the macro level

Activities	Type of session	No of session	No of participants	On-site support and assessment of learning
Empowerment of ICDS workers to improve food aid and food availability	Group	4	3 ICDS workers in each session and on in ICDS centre Padra with 40 AWWs	ICDS workers were all very attentive and enthusiastic and participated willingly.
Infrastructure development of ICDS centres to improve food availability and accessibility	-	-	-	It was done by initiative of CSR of local private company in partnership with government setor
Empowerment of the beneficiaries of ICDS regarding the utilization of the existing food aid	Group	10	8-12	Mothers and beneficiaries initially unaware of the importance of food aid utilization gradually changed their attitude towards it and responded positively in these sessions.
Drumstick plantation program to improve food availability	Group	10	8-10	Mothers were interested especially who were involved in farming and readily planted seeds distributed for the program.
Promotion of kitchen garden and distribution of neem and drumstick plants	Groups	10	8-10	Mothers were interested and made the efforts to plant the saplings and also happily received the trees.
Distribution of bananas and biscuits through ICDS centres	-	-	-	CSR of local private company took this initiative to improve food availability especially energy dense and micronutrient rich foods

Improvement of roads and solar light installation	-	-	-	Solar lights were installed using private sector investments
Training to make solar cooker and solar bulbs	Group	2	20-25	Mothers participated and observed the procedure but was not enthusiastic enough to use the solar cookers as they thought its time consuming to cook in it.
Smokeless chulha distribution program	Group	2	48 mothers with pther villagers	All the mothers were happy to receive the chulhas and expressed their interest to utilize them
Initiatives to improve drinking water access	-	-	-	Sarpanch and local government leaders in the study area took the initiative to provide pipelines in every households which were not present in one cluster initially.
Women empowerment by skill development to generate income	Group	10	15-20	Mothers were interested and participation rate was higher in various trainings and skill development program especially the sewing sessions.

Results of intervention programs using public-private partnership at exo and macro level

Impact of Drumstick plantation program

Some of the households took initiative to make kitchen garden and started cultivating the drumstick plants in their field and household premises. drumstick plantation in the households increased significantly from 17% to 40% after intervention. Table 4.2.22 shows the paired t test result and significance level of the intervention outcome regarding drumstick plantation.

Figure 4.2.22: Impact of intervention on drumstick plantation

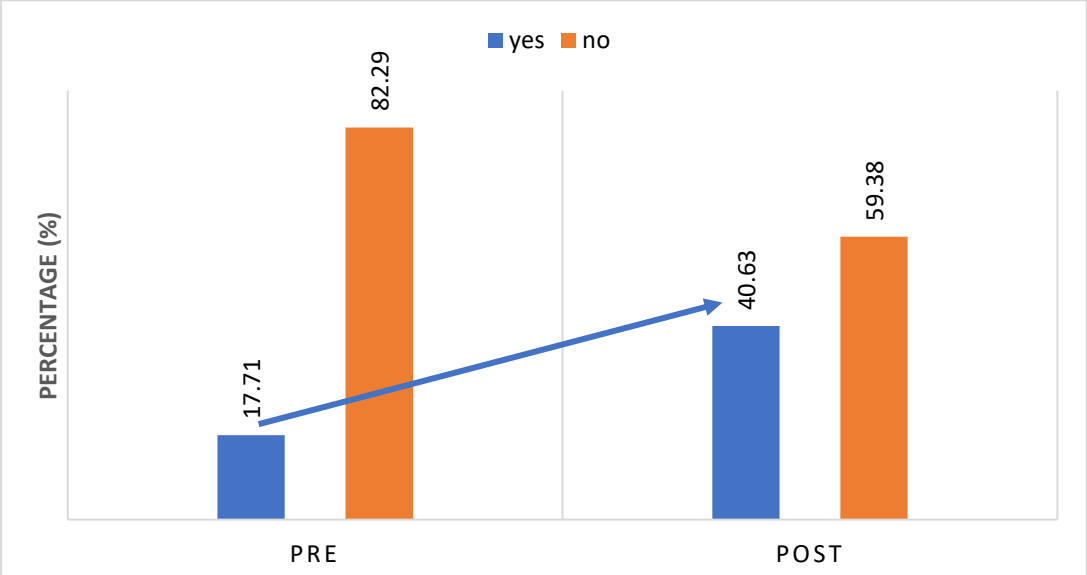


Table 4.2.9: Result of paired t-test on drumstick plantation

Criteria		Mean	SD	T	Df	Sig. (2 tailed)
Successful drumstick plantation	Pre	1.82	0.384	5.314	95	0.000**
	Post	1.59	0.494			

** indicates p<0.01 (highly significant)

Impact of Women empowerment and skill development program

Women empowerment was done with the help of various resource persons with the help of public-private partnership. Livelihood practices of women tried to be improved by generating income.Two women started their business of jewellery making in small scale.

Impact of Smokeless chulha distribution program

Chulhas were distributed among all the enrolled mothers by CSR of local private company under public-private partnership project which will reduce the fuel cost and increase their affordability of food. All the enrolled households started using smokeless chulha

Impact of Drinking water access installation program

After meeting with sarpanch drinking water was easily accessible in one experimental cluster after the study through water pipes in every households where previously they need to fetch water from handpump situation in the corner of the village.

Impact of Solar lights installation program

Solar lights were installed in the villages using public-private partnership which will improve the physical access and road condition to certain extent.

Impact of ICDS empowerment program

In one experimental cluster (cluster 2) another anganwadi centre was made by CSR team of local corporate company under public-private partnership to resolve the distance issue. Hence, services of ICDS became more accessible by all the beneficiaries of the village cluster easily. Infrastructures were developed in all the AWCs and more reading materials, games, cooking utensils were provided. Biscuits, fruits were provided through CSR on regular basis as well as medical camp also organized. After intervention home visit by AWWs (Figure 4.2.23) increased from77% to 85% ($p<0.01$**) and knowledge gain of mothers regarding foods and nutrition from ICDS (Figure 4.2.24) increased from 42% to 68% ($p<0.001$***).

Figure 4.2.23: Impact of intervention on home visits by AWWs

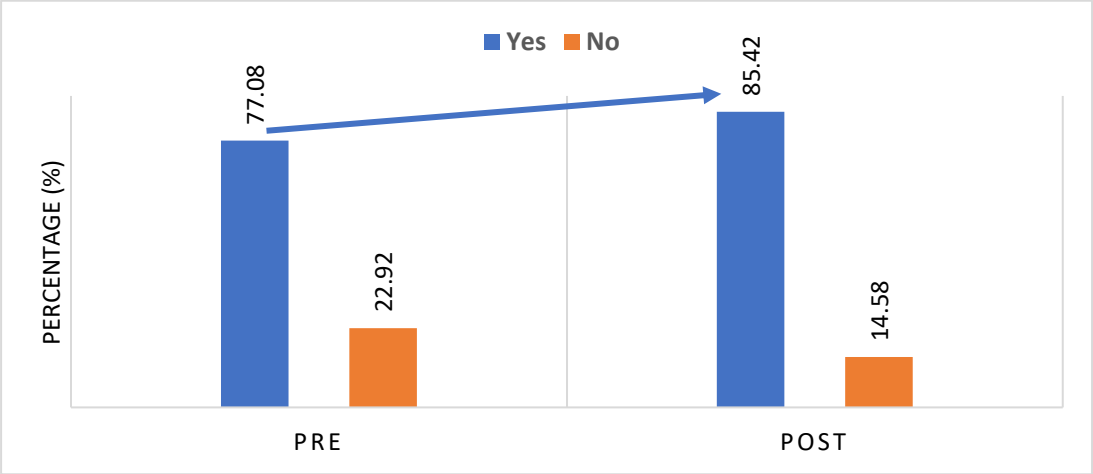
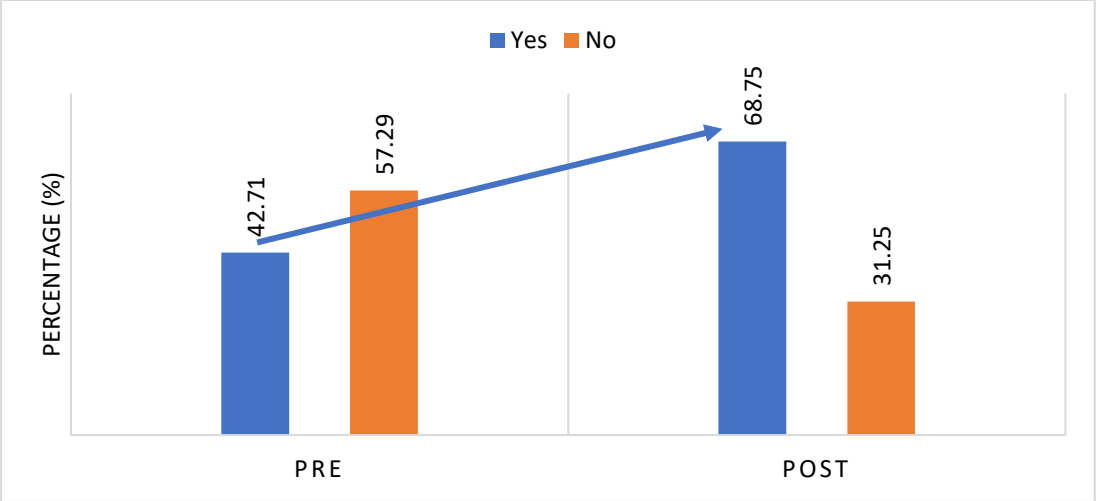


Figure 4.2.24: Impact of intervention on knowledge regarding FN from ICDS



Impact of empowerment program of ICDS beneficiaries

After several session of intervention regarding ICDS utilization, 59% children started to access AWC regularly (Figure 4.2.25), before intervention it was only 25% children who accessed AWC regularly ($p<0.001$***). After intervention 100% enrolment in ICDS was achieved. Balbhog was received by 96% children post intervention (Figure 4.2.26), which was 83% previously ($p<0.001$***). Balbhog consumption by children increased (Figure 4.2.27) from 57% to 92% after intervention ($p<0.001$***).

Figure 4.2.25: Impact of intervention on accessing AWC (child)

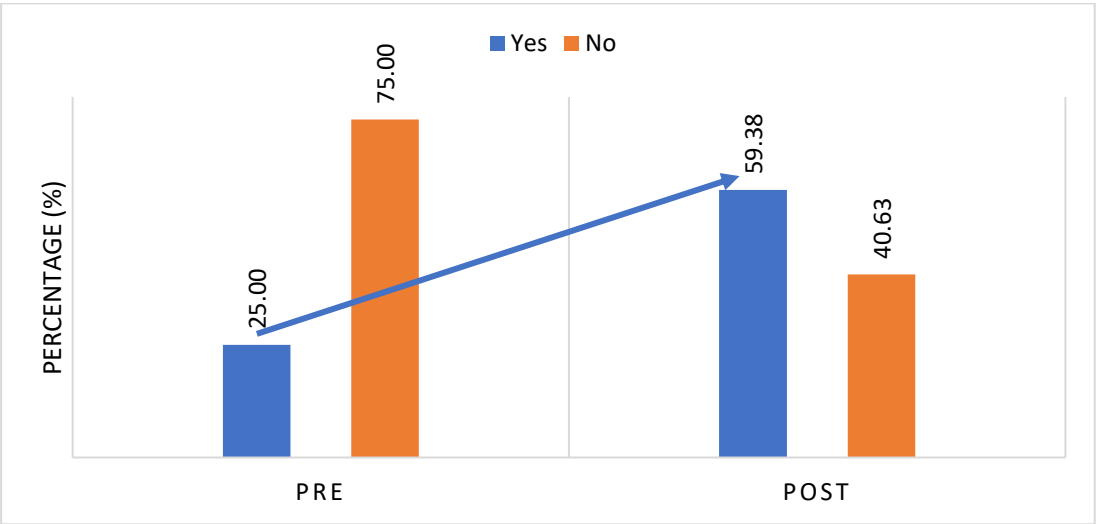


Figure 4.2.26: Impact of intervention on balbhog received from AWC

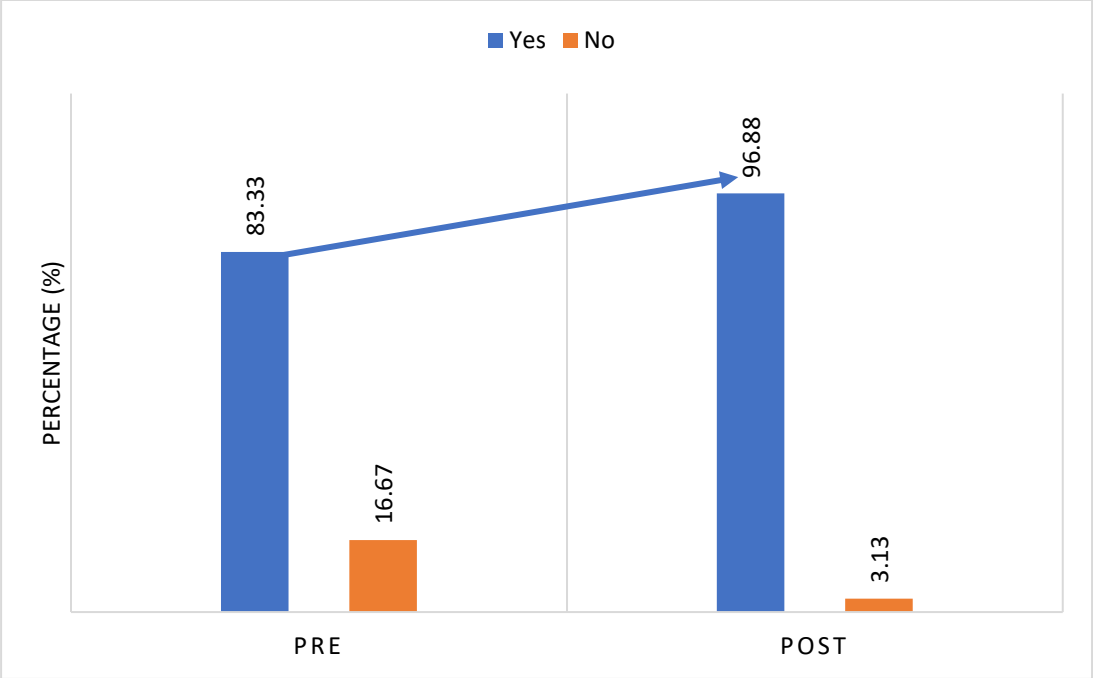
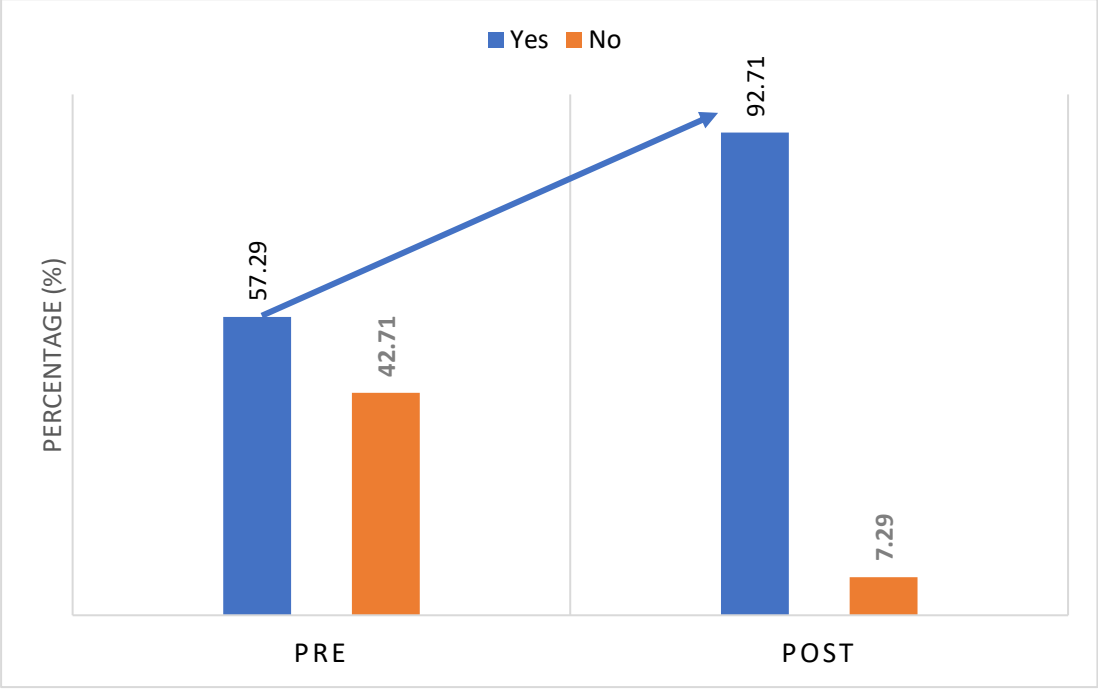


Figure 4.2.27: Impact of intervention on consumption of balbhog



Summary of PPP intervention impact at exo and macro level

Highlight of the Phase II section B

- Food utilization in the study area improved by capacity building using PD mothers as change agents at micro and meso level. Consumption of foods like drumstick leaves, methi, spinach, beetroots improved, IYCN and hygiene and sanitation practices improved.
- Food availability, accessibility and affordability of the selected study area at community level was improved by strengthening its indicators through public private partnership.
- Food aid was improved by increasing the no of ICDS centers, empowering the ICDS workers and sensitizing mothers regarding importance of ICDS which increased the participation of children and utilization of supplementary nutrition provided by ICDS
- Agricultural practices were improved by promoting kitchen garden and encouraging drumstick cultivation (seeds and plant distribution).
- Road and drinking water access improved through PPP by both government and CSR initiative. Skill development program for women started to generate income and empower women

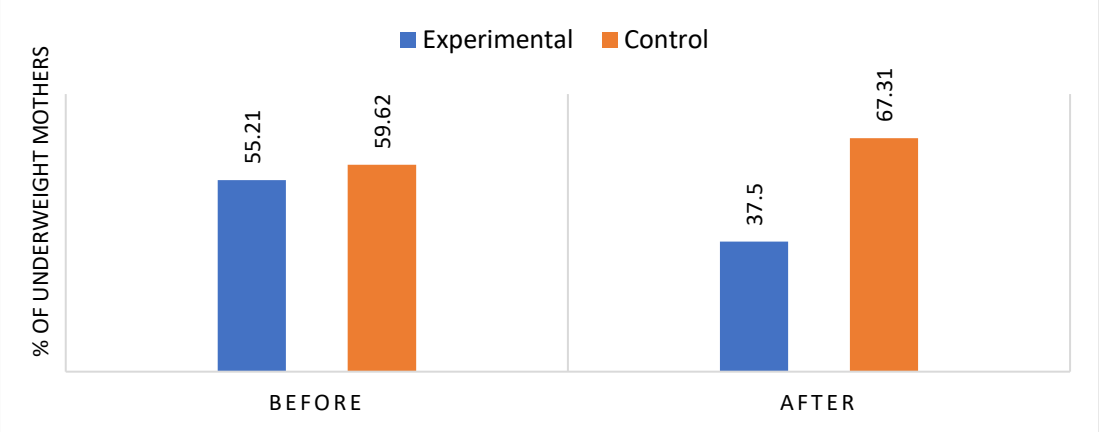
Results of overall impact of socio-ecology model on nutritional status of mother-child pairs: A comparison between case and control group

In control group (cluster 3 and cluster 4) there were total 52 mother-child pairs after dropout whereas in experimental group (cluster 1 and cluster 2) there were total 96 mother child pairs. Socio ecology model was applied in the experimental group, where in micro and meso level of SEM, positive deviance approach was used, and in macro level of SEM, public private partnership was applied. In control group no intervention was carried out apart from existing government programs.

Impact of SEM on mothers' nutritional status

Before intervention in the experimental group 55% mothers were underweight which reduced significantly ($p<0.01$**) by 17.7% after intervention whereas in control group 59% mothers were underweight which increased by 7.6% after the completion of the study (Figure 4.2.28)**.**

Figure 4.2.28: Percentage of underweight mothers in Experimental and Control group before and after intervention

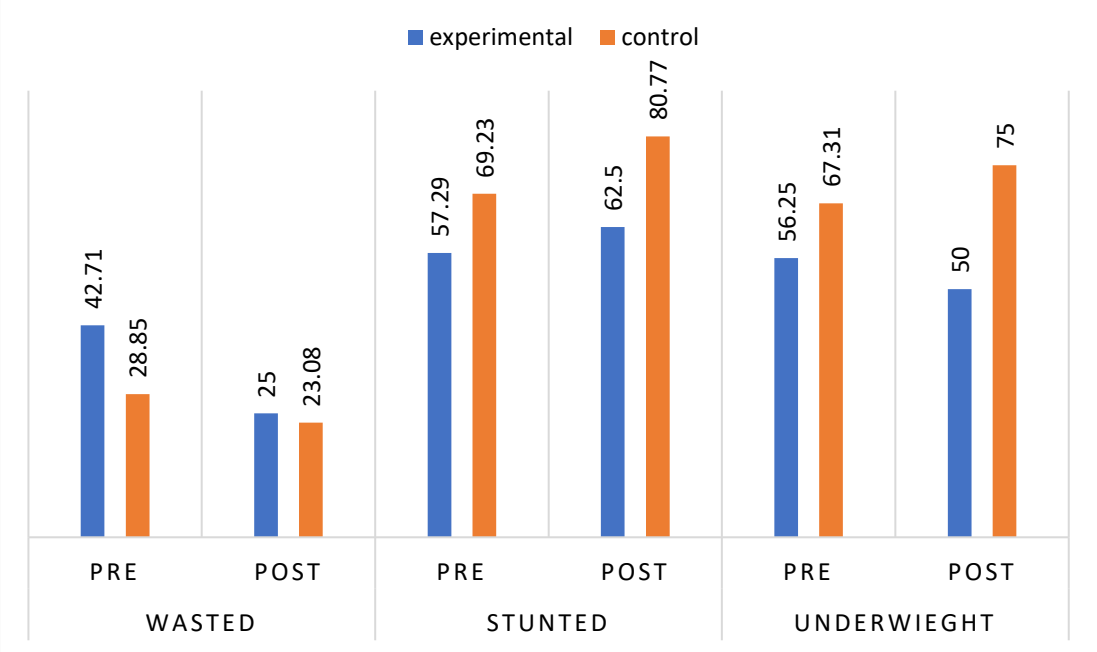


Underweight: BMI<18.9 (WHO, 2006)

Impact of SEM on nutritional status of children

After intervention in the experimental group wasting reduced by 17.7% as compared to only 5.8% reduction in control group, underweight reduced by 6.25% in experimental group whereas in control group it increased by 7.69%. Stunting though increased by 5.21% in the experimental group, the increase rate in much higher in the control group (11.54%) after completion of the study (Figure 4.2.29). Statistical analysis (Paired t test) reveals that reduction in wasting was more significant in experimental ($p<0.01^{**}$) than control($p<0.05^{*}$), increase in stunting was more significant in control($p<0.01^{**}$) than experimental ($p<0.05^{*}$) as well as significant ($p<0.01^{**}$) reduction in underweight status of children was recorded in experimental group.

Figure 4.2.29: Nutritional status of children before and after intervention



Wasted: weight for height z score ≤-2SD Stunted: height for age z score ≤-2SD Underweight: weight for age z score ≤-2SD Reference: WHO, 2006

Glimpses of intervention program using PDA (Image 4.17-4.24)


4.17


4.18


4.19


4.20


4.21


4.22


4.23


4.24

Glimpses of intervention program using PPP (Image 4.25-4.40)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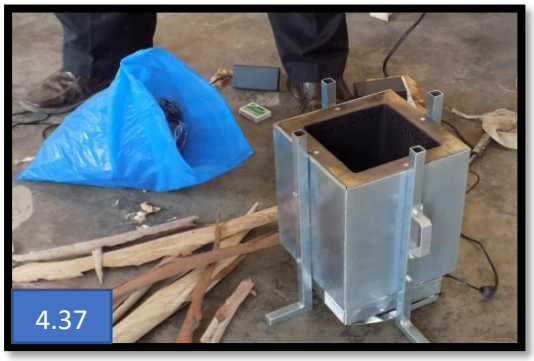
4.37


4.38


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4.40

DISCUSSION PHASE II

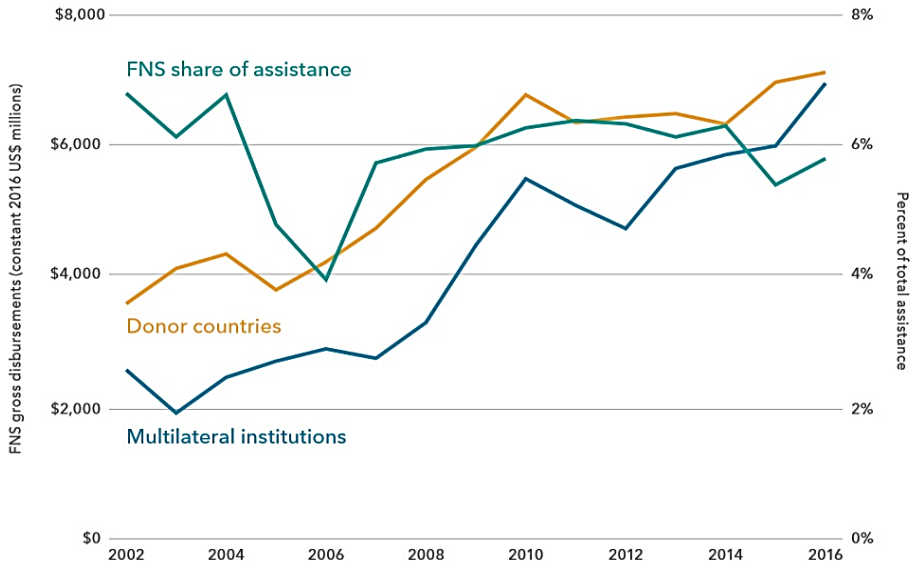
The results of phase 2 indicate that there are positive shifts in the nutritional status and practice of healthy food consumption, infant and young child nutrition, hygiene and sanitation as well as agriculture and food aid utilization over 1 year of intervention programs to improve food and nutrition security in rural communities where positive deviant behaviors were promoted by the mothers to their own neighbors and community members along with various other study partners.

Food and nutrition security were discussed in many significant events and meetings in last few years with the purpose to transform the whole food system in order to achieve the Sustainable development goals (IFPRI, 2019).

An estimated three-quarters of the world's poor live in rural areas (World bank, 2014). Ending poverty and hunger for these rural residents will depend on well-functioning agri-food systems which will help them to lift themselves out of poverty and provide access to sufficient nutritious food (Kharas et al., 2015). IFPRI recommended public–private investment in rural development that could reduce rural poverty and malnutrition, can foster structural transformation, and improve food security and nutrition (IFPRI, 2019).

Critical investments for rural transformation are done by official food and nutrition security funding where 59% supports agriculture, 16% supports rural development, 17% food aid excluding emergency aid and 5% supports nutrition (Kharas et al., 2015). But in last few years after 2010, official finance for food and nutrition security plateaued as explained in Figure 4.2.30 (Food Security Initiative Pledge, 2015).

Figure 4.2.30: Funding for food and nutrition security, 2002-2016



Source: Authors' calculations, based on OECD QWIDS (https://stats.oecd.org/qwids/) and OECD Creditor Reporting System (CRS) (https://stats.oecd.org/index.aspx?DataSetCode=CRS1), accessed November 2018.

Note: FNS = food and nutrition security. Donor countries = participants in OECD's Development Assistance Committee (DAC). FNS gross disbursements and total assistance include official development assistance (ODA) and other official flows (OOF). FNS gross disbursements comprise OECD DAC categories: basic nutrition, agriculture, fishing, agro-industries, rural development, and food aid/food security programs.

One of our previous study in this area, suggested efforts to coordinate between several nutrition specific interventions to enhance domestic production, dietary diversity, frequency of healthy food consumption, road condition, family income, and unawareness regarding proper food utilization which were majorly responsible for the poor undernutrition status (Saha & Nambiar, 2017). Improved socio-economic condition and accessibility alone does not necessarily improve the health dimensions, especially among children (Singh et al., 2007). Instead tailor-made health education imparted with social support brings visible behavior changes (Bushy et al., 2004).

A positive deviant approach can be used too, as these are workable in limited resources within similar setups in a community (Marsh & Schroeder, 2002; Sethi et al., 2003; Nambiar & Desai, 2012). Positive deviance (PD) refers to a phenomenon that exists in many resource-poor communities (Lapping et al., 2002). "It is often seen that in communities there are a few 'deviant' individuals whose uncommon behaviors or practices enable them to outperform their neighbors with whom they share the same resources" (Sethi et al., 2003). Identification of these positive behaviors and enrollment of these individuals who are practicing those behaviors staying in the same community can be effective against food and nutrition insecurity. Therefore, the present study deals with identification of positive deviant behaviors (PDBs) among mother child pairs

depending on their household dietary diversity, Infant and Young Child Nutrition (IYCN) practices, hygiene and sanitation practices and undernutrition status (weight for age) of their children. There was no such study earlier which used this approach in identifying positive deviant mothers on the basis of all these parameters (only nutritional status was considered in previous studies) and promoting them to improve food and nutrition security in rural households. Pulses, milk and vegetable consumption, proper intra household food distribution, household dietary diversity, exclusive breastfeeding practices, no practice of pre-lacteals, no practice of giving water in 1st 6 months, clean clothing were few positive behaviors which were found to be present among the study population in the present study. Family and community work out to be the main change mediator in behavior related interventions (Golan & Crow, 2004). Involvement of parents and community is crucial for sustaining a healthy environment, modeling of healthy eating and activity patterns, and improvement in the child's practices (Lissau, 1994). Therefore, in the present study, mothers were used as change agents to promote the positive behaviors regarding healthy diet pattern and dietary diversity, infant and young child nutrition and hygiene and sanitation practices, already practicing by them at micro and meso level using techniques like individual and group counselling, discussion, demonstration etc. under public-private partnership to improve food utilization, an important indicator of food and nutrition security.

Saaka & Osman (2013), recorded that the challenge to enhance dietary diversity can be met by improving nutritional security. Mishra & Raveendran (2011), stated that the most important challenge is to increase the energy intake of the bottom 30% of the population and at the same time facilitate diet diversification to meet micronutrient deficiency. The results of another study highlighted the need for nutrition interventions to improve dietary quality and feeding practices. Because there were substantial variations on food resources and culture in different geographical regions, it is hard to compare the consumption of specific foods among different intervention studies (Zhang et al., 2013).

Previous studies in rural India, In villages of UP (Sethi, 2003), West Bengal (Mustaphi, 2005), and Tamil Nadu (Shekhar, 1992), *positive deviance* and normal growth of children was enhanced under conditions of small family size (<5), parity below 3, family support to mother, timely initiation of breast feeding, higher frequency of breastfeeding. Studies in urban slums have indicated positive behaviors in household

factors such as smaller family size, higher maternal literacy, lower parity of child, better environmental hygiene, fewer morbidity episodes (mainly diarrhea), and desirable IYCN practices such as frequent breast feeding, timely initiation of Complementary Food (CF), active feeding and giving foods of thicker consistency (Kanani & Popat, 2012). Thus, whether rural or urban, several 'deviant' behaviors exist (Black et al., 2008).

In the present study promotion of positive deviant behaviors using mothers as change agents resulted in increased drumstick leaves consumption (76%), increased knowledge and practice of exclusive breastfeeding (56%), increased active feeding (53%), increased practice of handwash with soap during food handling (59%), increased cleanliness of clothes of children (48%), improved mothers' nutritional status (20%), reduction in child's wasting (21%) and underweight (13%) status. But stunting could not be reduced and need further intervention for longer duration. Therefore, food utilization in micro and meso level had improved using positive deviance approach in the present study.

Another study done in Indonesia stated that nutritional surveys are needed to identify most significant malnutrition determinants to see adoption of new behaviors and sustainability of outcomes and PDA could be a community-based solution to improve child's nutritional status (Hidayat, 2009). Study done in rural Uttar Pradesh, India stated using PD helps in promoting indigenous positive correlates of child growth by using community wisdom through people who promote positive practices in concern with technical interventions (Sethi et al., 2007). Nutrition education based on positive deviance approach and supplementary nutrition helped to improve the nutritional status of the *anganwadi* children in a previous study (Imran et al., 2014).

Apart from food utilization at micro and meso level, food availability, affordability and accessibility at exo and macro level, also needed to be improved in the present study. Roads, infrastructure, income can't be improved only through capacity building of the people by teaching positive behaviors at micro or meso level. Some initiatives needed to be taken regarding agriculture development, income generation, large scale infrastructure development. Therefore, public-private partnership investments at macro level needed to be done.

In the present study it was observed that as it was an industrial area, even if the area was surrounded by agricultural land, mainly women were engaged in agriculture and main source of income was industry and not agriculture. Therefore, there was enough opportunities to involve women in agricultural intervention which may improve the dietary intake of the household as well. Numerous studies have shown that when women control resources, their families, especially their children, enjoy better health and nutrition. Other studies have demonstrated that women's empowerment can improve agricultural productivity, dietary quality, and maternal and child nutrition (Seymour, 2017). Previous study also suggested that Agricultural interventions that involve women (who often are more concerned than men with family health and food consumption) are more likely to lead to an improved translation of household income increases into improved household food security. Indirect support for this was found in a study carried out in Egypt, which found that female-headed households consumed more calories than male-headed households at the same income level (El-Hamidi & Said, 2008).

In the present study, promotion of kitchen garden and distribution of seeds and saplings were carried out. Drumstick seeds were distributed among mothers and promotion regarding drumstick leaves consumption were carried out, as it is easy to cultivate even in less developed agricultural field and its consumption will reduce micronutrient malnutrition and iron deficiency. Post intervention, drumstick plantation increased by 23% in the study area.

Previous study stated that when home garden production increases and led to the sale of some portion of this production, resulted in purchase of additional rice and the caloric intake of children increased, leading to improvements in anthropometry (Galhena et al., 2013). In addition to kitchen garden, agricultural projects that utilize micronutrient-rich plant varieties like drumstick have major potential for improving nutritional well-being and food and nutrition security. efforts should also be made to improve the variety of staple food production and use of locally available indigenous foods or their bio fortification (Nambiar et al., 2015) along with nutrition communication (Nambiar et al., 2003).

To address food insecurity, the government of Ethiopia is taking a strong leadership role making significant investments particularly through its Productive Safety Net

Program (PSNP) which is one of the largest safety net programs in the world works with vulnerable households through cash or food for work programs to prevent families from having to deplete household assets in times of shortage (Care learning tour, 2014).

In our study through the safety net program ICDS using public-private partnership investment, intervention was carried out. Creation of more ICDS centers, empowerment of ICDS workers through training and demonstration, improving the infrastructure of the ICDS centers and sensitization of the mothers regarding its services and benefit of this food aid or supplementary nutrition program tried to improve. As a result, 2 new AWCs were being made in the study area, consumption of *balbhog* (Take home ration) increased by 35%, home visit by AWWs increased by 8.3% and accessing AWC by children increased by 34%.

Also, Road and drinking water access improved through public-private partnership at macro level by both government and CSR initiative. Skill development program for women started to generate income and empower women. Smokeless chulha were distributed which will reduce fuel cost and food affordability. Solar lights were also installed with the PPP investment in the present study area.

In setups with meagre resources, a public private partnership (PPP) can be a choice as it contributes to ownership along with development. There were many successful PPP interventions carried out all over the world to improve food and nutrition security. In Ghana, Northern Rural Growth Program helped to set up contract farming arrangements between private partners and smallholder farmers (IFAD & PPP, 2013). In Malawi, Rural Livelihoods and Economic Enhancement Program created to ensure that more farmers are able to produce groundnuts that meet required market standards and that there are buyers for their product. In Uganda, Vegetable Oil Development Project was designed to alleviate Uganda's dependence on imported vegetable oils by supporting the domestic production and processing of palm oil. In Indonesia, Smallholder Livelihood Development Project in Eastern Indonesia (SOLID) focuses on establishing links between farmers and the market and supports the development of smallholder farmers. Another project READ (Rural Empowerment and Agricultural Development) supports a public-private partnership whereby smallholder farmers are linked to a private company, in this case Mars in Indonesia, for cocoa production in Central Sulawesi (IFAD & PPP, 2013).

In India also there were various PPP models were developed such as Convergence of Agricultural Interventions in Maharashtra (CAIM) where FieldFresh Foods Pvt. Ltd, an agribusiness company exporting fresh vegetables, linked a significant number of smallholder farmers to the global market for high-value produce (IFAD & PPP, 2013).

In the previous study It was assumed that collaboration with the private sector in the form of Public-Private Partnership would improve equity, efficiency, accountability, quality and accessibility of the entire health system. Advocates argue that the public and private sectors can potentially gain from one another in the form of resources, technology, knowledge and skills, management practices, cost efficiency and even a make-over of their respective images (ADBI, 2000).

One of our tribal study highlighted though several government schemes and programs exist for the population, they need to be monitored and executed well so as to have a significant impact on the health and nutrition of the population (Nambiar et al., 2015). Co-ordinating various health components under one umbrella can be effective, discussed in one of our previous school-based study (Desai & Nambiar, 2015).

Food can fix many problems, but to do so food systems must be reshaped for nutrition, health, inclusion, and environmental sustainability. New opportunities, in and outside of the agriculture sector and new global forums for fostering multisectoral collaboration, public-private partnership must be leveraged through appropriate actions to maximize benefits for all and integrate strategies such as positive deviance approach which in turn can improve nutritional status and food and nutrition security (IFPRI, 2018).