CHAPTER: 10

SUSTAINABLE LIVELIHOOD AND NUTRITION SECURITY FOR TRIBAL FARMERS: CASE STUDY OF WADI PROJECTS IN DUNGARPUR

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ABSTRACT

Dungarpur is a tribal-dominated district of Rajasthan. The district is exemplified by low agriculture productivity, poor irrigation sources, drought, and low infrastructural and market support to the farmers. The majority of farmers in this tribal part of the state are small and marginalized and have experienced age-old deprivation. The Dharampal Satyapal Ltd. (DS Group), as a Corporate Social Responsibility (CSR) has built a model of a three-tier system of wadi cultivation (small orchard to grow fruits and vegetables) to reduce climatic, biological, and market risks and secure livelihoods and nutrition for deprived tribal farmers' families. The study attempted to assess the PAHAL (Promotion of Agriculture and Horticulture for Advancement of Livelihood) project implemented by DS Group in Dungarpur. The exploratory study was conducted using quantitative and qualitative methods for data collection. The 24 dietary recall method and food frequency were used to understand micronutrient intake. An anthropometric data was taken to explore BMI for women and MUAC for children under five years. The study covered 100 samples from the intervention area and 100 from the non-intervention area (control group) to obtain findings based on a case-control strategy. The findings of the study indicate that wadi cultivation has dramatically increased family income through improved production of diversified crops. The family income ranges from 5000-10000 per month exclusively from the sale of wadi produce throughout the year. The availability of varied fruits and vegetables and nutrition awareness resulted in adding diversity of nutritious food to the farmers' food basket and improved nutritional

outcomes among women and children. The anthropometric data indicate the significant contribution of the project in improving nutritional outcomes among women and children of farmers' families.

***Keywords**: Nutrition, Farmers, Income, Wadi, Food Security, Dietary Diversity, Rajasthan*

INTRODUCTION

Despite substantial economic progress in the last few years, 189.2 million people in India are malnourished (FAO, 2020). The country has a high number of children under five with stunting and wasting and the reasonable cause is declining livelihoods, poverty and worsening food and nutrition security in the country (Chatterjee, 2021). The blight of maternal and child malnutrition contributes to 15 per cent of the total disease burden of India (Saha, 2021). Ironically, the majority of India's malnourished women and children reside in the most backward districts. Among the backward districts of the country, the Dungarpur district of Rajasthan is one of the districts having the highest number of malnourished women and children population in remote rural areas. The tribes of the area practice traditional agriculture and rely much on rainfall. The frequent drought, crop failure and limited livelihood opportunities often lead to seasonal migration. The area has a long history of seasonal migration to the nearby urban areas and the Gujarat district for wage earnings. The majority of the migrant workers from Dungarpur work in factories, hotels, and homes as domestic help (Aajeevika Bureau, n.d.). The status of maternal and child health remains critical in Dungarpur and is often viewed as a stumbling parameter for development. The latest report of NFHS -5 figured out a high percentage of anaemic children aged six to fifty nine years (79.8 per cent). The percentage of women aged fifteen to forty nine years who suffer from anaemia is also highest in the district i.e. 72.6 per cent (MoHFW, 2021). The lack of availability of nutritional food, particularly at a time of economic crisis in the family, along with the poor health-seeking behaviour, lack of nutrition awareness, and normalization of malnutrition perception has led to the grim situation of malnutrition among the tribal community of the area (Mohan et al., 2016).

Nutrition Sensitive Agriculture is a key to addressing the issue of malnutrition through dual pathways to increase the production of diverse and nutritious food and at the same time offer livelihood opportunities for marginalized farmers. Evidence shows that nutrition-sensitive agriculture can improve food consumption patterns and dietary diversity among women and children in families (Ruel et al., 2018). Therefore, the agriculture interventions coupled with a focus on improving crop diversification and nutrient-rich food production increase farmers' income, dietary diversity, and high-quality diets as the precursor for better nutrition outcomes.

The PAHAL intervention (Promotion of Agriculture and Horticulture for Advancement of Livelihood) started in 2017 as a Corporate Social Responsibility (CSR) initiative of Dharampal Satyapal Ltd. in the Dungarpur district. The purpose of the initiative was to promote water-efficient agri-production, marketing, and income generation for marginalized farmers. The intervention also aimed to improve the overall health outcomes of the farmers' families, particularly women and children.

In terms of the horticulture and vegetable sector, the district of Dungarpur has suitable agro-climatic conditions and the availability of markets. These factors act as strength for the area and act as an opportunity for the farmers to grow a variety of semitropical, rainfed fruit and a variety of semitropical, rainfed fruits and a variety of seasonal vegetables. Despite all these present aspects, the small farmers of the district were inclined towards migrating to Gujarat as daily wage workers, and the district was also dependent on Gujarat for food needs. The attitude changes of the farmers and their mindset towards crop diversification needed a must change. Through the PAHAL project, numerous small farmers were supported for *wadi* development. *Wadi* is a *Gujarati* word meaning an Orchard. This structure promotes water efficiency for farming to improve agriculture and food security for marginalized farmers. The intervention covered 500 farmers' families having agricultural land for *wadi*.

OBJECTIVES OF THE STUDY

The purpose of the study was to understand the impact of the *wadi* intervention on income generation and nutritional outcomes for the farmers' families in the remote tribal region of Dungarpur. The specific objectives of the study were (a) to assess the impact of PAHAL intervention on the livelihoods and income generation of farmers' families, (b) to assess the nutrition status of mothers (15-49 years) and children (under five years) using anthropometric data, and (c) to assess the PAHAL intervention's impact on dietary diversity and micronutrient intake.

METHODOLOGY

The study was conducted in six intervention and six control villages of Dungarpur district of Rajasthan. The two-staged random sampling was applied to select the sample size. In stage one, villages were selected, and in stage two, farmers families were selected from the villages on a random basis. The sample size consists of 200 farmers' families and the primary respondents were women from the Households. Out of 200, 100 farmers' families were from the project villages and 100 from the control villages. The study findings were drawn based on the case-control strategy. The control group of villages were selected based on criteria such as similar topography, district and socio-economic characteristics.

The study employed both quantitative and qualitative techniques in generating necessary information and data based on the study objectives. The quantitative data was captured at the farmers' households through face-to-face interviews using a structured questionnaire. Qualitative information was collected through focused group discussions, case studies, and observation. The data analysis was done using SPSS, Excel and Diet software.

FINDINGS

1. Economic activity

a. Main economic activity of the households

The main economic activity of the household was explored in the study to identify the overall economic status of the marginalised farmers in the region. It was found that 69% of the households in the intervention villages were engaged in agricultural activities as their main economic activity to sustain their

families' livelihood. While in the control group, 23% of the families were engaged in agricultural activities and 55% in daily wages. A larger number of families engaged in daily wages indicates a lack of availability of appropriate livelihood opportunities through agriculture and allied activities in the control villages. The *wadi* cultivation has provided ample scope for livelihood within villages hence, people rarely choose to migrate or daily wages outside the village (Table 10.1).

Table 10.1: Main economic activity of households

Activities	Percentage of Households		Total
	Intervention villages	Control villages	
Agriculture	69	23	92
Private service	8	2	10
Daily labourers	7	55	62
Non-working	7	16	23
Others	9	4	13
Total	**100**	**100**	**200**

b. Annual household income from agriculture and allied activities

The farmers' annual income at the family level was taken into account to explore and gain deeper insights into the purchasing capacity of the farmers. The data in the Fig 10.1 showed that almost 49% of the respondents' families in the intervention site have an annual income of more than 56000 per annum as derived from agriculture and allied activities. However, 48% of the total respondents' families in the control villages have an annual income of less than 25,000. The huge variation between the income levels of both sites suggests that *wadi* intervention activities being the primary source of income for the farmers in intervention areas have significantly contributed to their increased annual income level. On the contrary, farmers in the control villages find it difficult to sustain their livelihood by having a very low annual income. Moreover, lower-income groups are also insufficient to meet the daily food demands of their family members. Therefore, the positive impact on the income level of the marginalized farmers in the intervention areas has illustrated the increased capacity of people to fulfil the food and nutrition requirements of their families.

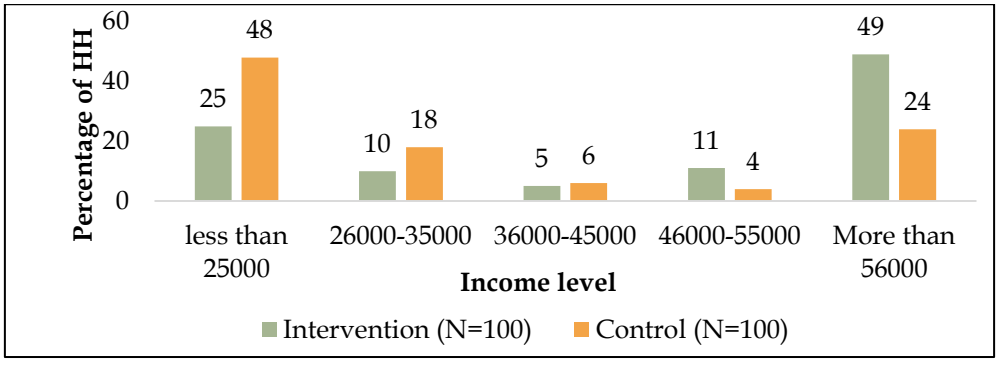

Figure 10.1: Annual income of households from agriculture and allied activities (in percentage)

c. Annual Income of Households from Livestock

The *wadi* cultivation has also enhanced the availability of adequate fodder for the animals. This has created an indirect and significant impact on livestock and related income Resultantly, the livestock rearing and the income from the livestock has increased in the intervention area. The data reveals that the number of families gaining higher income from the livestock is more in intervention area as compared to the control area. Out of total, 19% have annual income up to 24,000 and 5% have an annual income of up to 60,000 (Table 10.2).

Table 10.2: Annual income of households from livestock (in percentage of household)

Activities	Percentage of Households (HH)	
	Intervention villages	Control villages
up to 2000	49	57
Up to 8000	23	20
up to 24000	19	5
up to 60,000	5	0

d. Secondary sources of income

Livelihood and income diversification provide more social security to rural households. Besides agriculture being a primary source of income, the families also have secondary income sources as the study provided insights into the varied income sources of the families.

The data (Figure 10.2) depict that most of the respondents in the intervention sites have responded to allied agricultural activities such as horticulture and livestock as their secondary sources of income. On the other hand, the control villages have 89% of the farmers' households are dependent on daily wages as their secondary source of income.

Despite having agricultural land available to the households in the control region, agricultural activities are performed very nominal due to varied challenges in farming such as the wrath of wild animals, and lack of water availability. As Dungarpur is a region where the overall land productivity is rated to be low. The climate of the district is dry. While performing agricultural activities or horticulture on the land available to the marginalized farmers in the region, the wrath of wild animals and limited availability of water occurs as the major challenges that compel the farmers to reduce agricultural activities as their main source of income and to shift towards other sources for sustaining their livelihood.

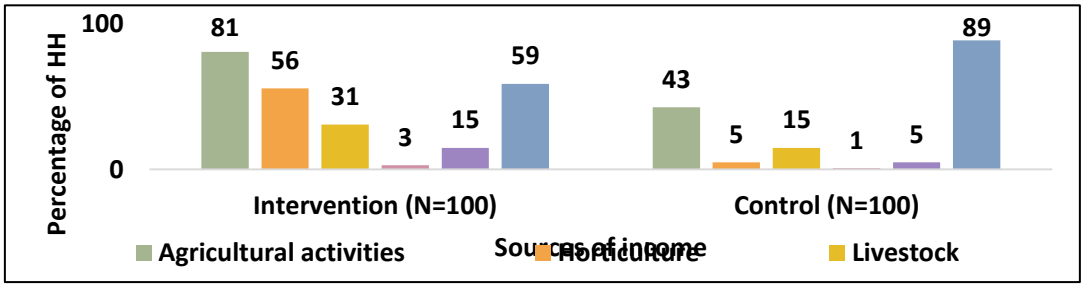

Figure 10.2: Percentage of households with sources of income

Under the study, it was observed that the intervention of the DS group had assisted the farmers in setting up the *wadi* on their land and using several irrigation methods that have helped grow large agricultural produce in short and limited availability of water. Intervention performed by the DS group has positively increased the income level of the marginalized farmers in the intervention areas, and it has increased their household consumption of agricultural produce from the *wadi*. The *wadi* development in the intervention area has been proven to be an effective measure to help the farmers meet their nutritional demands and maintain the food security of their family members. It further benefitted the farmers by in-house producing quality agricultural produce such as vegetables, fruits, certain crops, etc.

e. Trend analysis of main income sources in the intervention area

It has significantly emerged from the data (Fig 10.3) that the main source of income for the families in the intervention area has shifted from daily wages to agriculture and horticulture after the PAHAL project intervention. The trend suggests the huge scope and economic benefit of *Wadi* cultivation to the farmers within their villages.

Table 10.3: Household income analysis

Income sources	Before Project (2017) Intervention	Present (2022) Intervention
Agricultural	46.0	53.0
Horticulture	10.0	15.0
Livestock	1.0	2.0
Small enterprise	2.0	2.0
Service	5.0	7.0
Daily wage	32.0	19.0

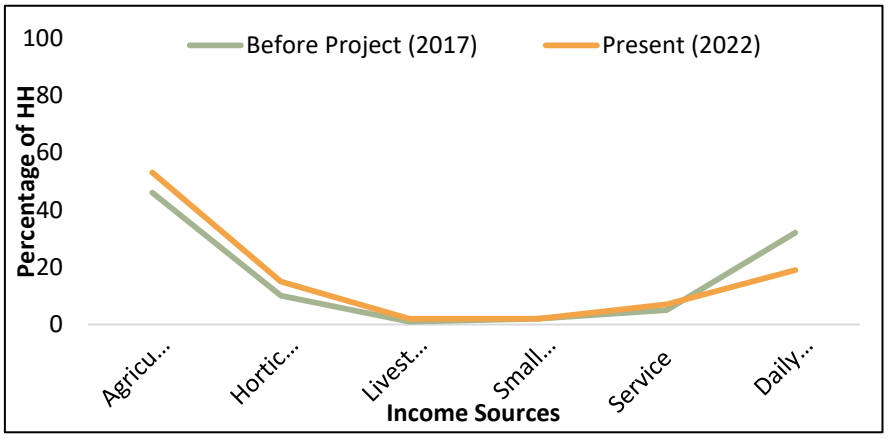

Figure 10.3: Trend analysis of main income sources

2. Migration

a. Migrating households

Migration in the Dungarpur region has traditionally been practised for livelihood due to low agricultural productivity. The information relevant to migration was recorded in the study to understand the livelihood diversification and factors.

Table 10.4: Percentage of households migrating to other places

	Intervention (N=100)	Control (N=100)	Total
Yes	25	68	52.5
No	75	32	47.5
Total	100	100	100

The data (Table 10.4) reveals that over 25% of households from the intervention villages have recorded migration by any of their family members and in the control group, the percentage is very high almost 68% of the families have migrated to the other places.

b. Causes of migration

There are several reasons for the household members to migrate to urban spheres. The marginalized farmers often due to a lack of income sources available in their area are compelled to move to urban areas for earning their livelihood. The data for control villages determined that at least one family member from the family is migrating to Ahmedabad for livelihood and is involved in construction, carpentry, private sector services, fishery, hotel work, daily wages, etc.

Table 10.5: Causes of migration wise percentage of households

Causes	Intervention (N=100)	Control (N=100)	Total
Daily wage	18	55	70
Private sector jobs	7	3	25
Fishery	0	5	5
Hotel jobs	0	5	5
Total	25	68	105

In the study, it has been found that the daily wage is the livelihood of 55% of the migrated population in the control villages. This percentage is relatively lower in intervention sites with 18%, respectively. However, the percentage of the migrated population is lower in the intervention area compared to the control region (table 10.5).

3. Wadi intervention

As the intervention focuses on evaluating the impact that has been created due to the intervention performed by the DS group in the intervention area, the study team asked *wadi* related information from the respondents. It helped in gaining in-depth insights into the perception of farmers on *wadi* development in the intervention villages. *Wadi* is a Gujarati word meaning an Orchard. This structure promotes water efficiency for farming to improve agriculture and food security for marginalized farmers. In terms of the horticulture and vegetable sector, the district of Dungarpur has suitable agro-climatic conditions and the availability of markets. These factors act as strength for the area and act as an opportunity for the farmers to grow a variety of semitropical, rainfed fruit and a variety of semitropical, rainfed fruits and various seasonal vegetables. The small farmers of the district were inclined towards migrating to Gujarat as daily

wage workers, and the district was also dependent on Gujarat for food needs. The transformation in the thought process of the farmers and their mindset towards crop diversification needed a must change. Under this umbrella of PAHAL intervention, numerous small farmers were supported, helped, and trained for *wadi* development. Therefore, it is necessary to measure the impact of the intervention on the advancement of the socio-economic and livelihood status of the small and marginalized farmers of the area.

a. Three tier model of *Wadi*

Under the intervention, farmers were encouraged to maximize the use of small land dwellings to produce seasonal vegetables and fruits in three tier model:

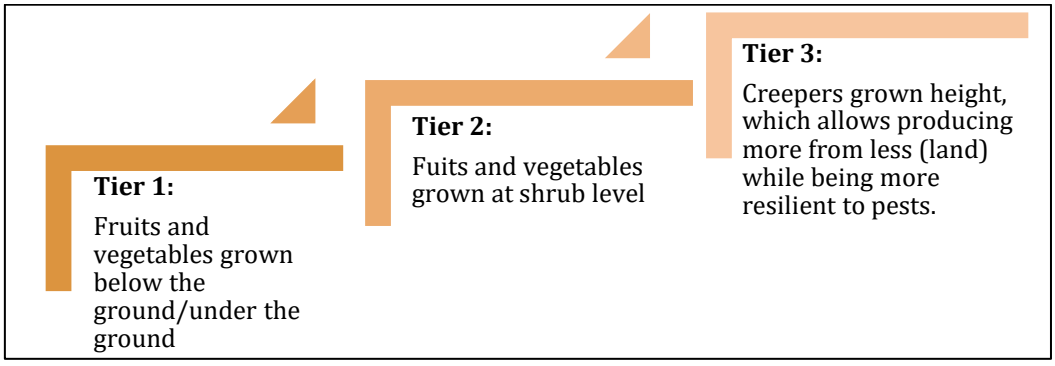

Figure 10.4: Three tier model of *Wadi*

b. Establishment of *Wadi*

The study covered the farmers' households who had installed *wadi* on their land at different points in time during intervention. The intervention was initiated with coverage of 24 farmers' families in the year 2017. Subsequently, the number of households increased in the year 2017-2018. It depicts that the population involved in the sample size are the farmers that have established *wadi* between 2017 and 2018. The study also covered 27% of households who have started *wadi* 2019 onwards.

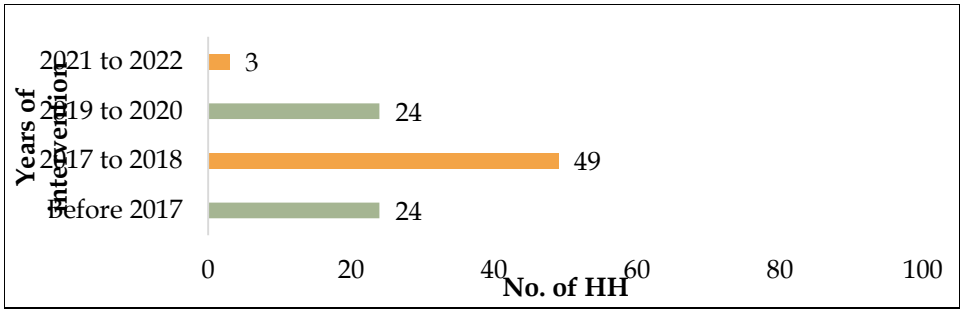

Figure 10.5: Number of samples covered under intervention

c. Expansion of *Wadi*

As per the data (Table 10.6), over 36% of the total sample population from the intervention sites have expanded their area or agricultural land covered under their *Wadi*. This depicts a significant impact on

the willingness of farmers towards crop diversity and generate family income as a result of increased production from the *Wadi*. The respondents shared that the increased income leads to increased savings which they have used to expand their agricultural area under *Wadi*. This will significantly contribute to increasing further income for the family. Looking at the water scarcity for irrigation, drip irrigation is the most suitable method to be followed as it allows water to drip slowly to the roots onto the soil surface. In this regard, the farmers associated with the intervention were also encouraged and offered their participation in setting up a drip irrigation facility at their *Wadi* under the intervention.

Table 10.6: Percentage of households under expanded *Wadi* and irrigation facility

Type of expansion	Households (%age)
Expansion of *Wadi* after installation in the household	36
Use of drip irrigation in *Wadi*	3
Households provided with training/exposure for *Wadi* production and maintenance	100

However, only 3 % of the total study population from the intervention sites used drip irrigation in their agricultural land. This depicts that there is still a huge scope for using drip irrigation among the beneficiaries of the intervention area. As has also been reported during FGDs, there are certain months when the availability of enough water for irrigation and drinking purposes is not sufficient. In this situation, drip irrigation is the most appropriate way for irrigation. It is significant to note that all the respondents in the intervention villages were provided with constant handholding and capacity-building support by DS Group staff to produce the *Wadi*.

d. Types of fruits and vegetables grown annually

Under the intervention, proper training and field sessions were provided to the farmers by DS group staff. They measured the impact of training and field sessions provided by intervention staff on the agricultural pattern of farmers. Among seasonal fruits, the beneficiaries largely grow bananas, papaya, guava, and mango. The root vegetables grown in higher quantities include *Adarak* (Ginger), *Arvi* (Taro), *Rataloo* (Indian purple yum), *Gajar* (Carrot), *Aloo* (Potato) and *Mooli* (Radish). Ground vegetables largely consist of Began (Brinjal), Tamatar (Tomatoes), *Kharbooz* (Musk Melon) and *Mirchi* (Chilli). The climbers grown include Karela (Bitter Guard), Semfali (Borad Beans), *Loki* (Bottle Guard), and Matar (Peas).

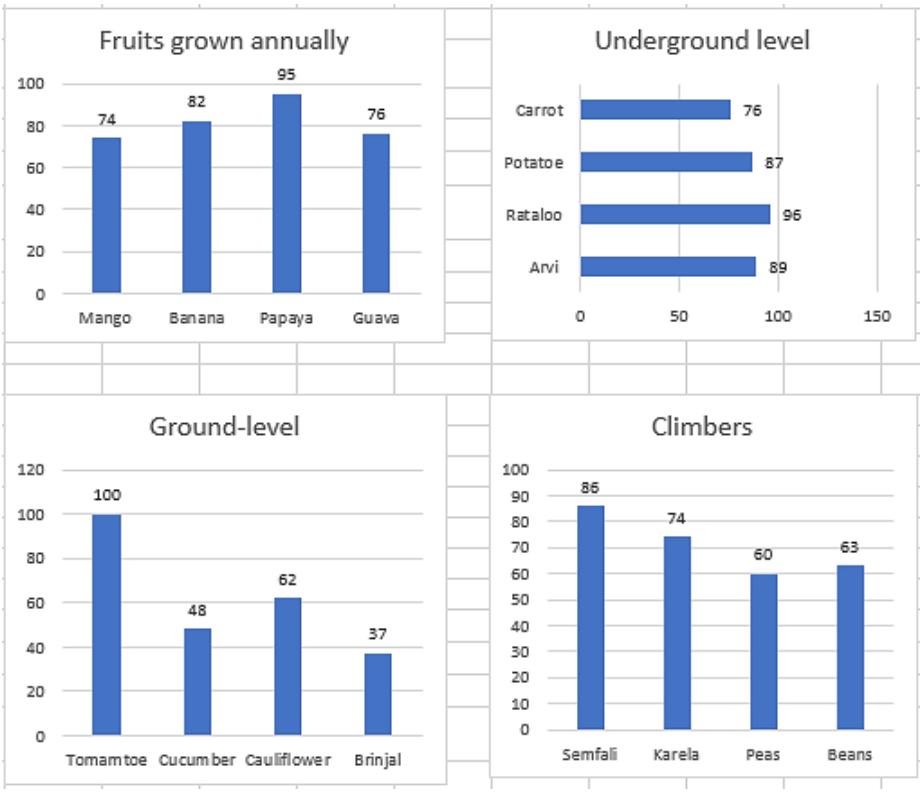

Figure 10.6: Types of fruits and vegetables grown annually

The production of diverse crops at *Wadi* depicts that the 3-tier model proved profitable for the farmers as it has assisted them in yielding more quantity from the small landholdings. The 3-tier model helped achieve intervention objectives to a large extent by increasing family income and, at the same time, meeting local demands.

e. Total sale out of *Wadi* produce

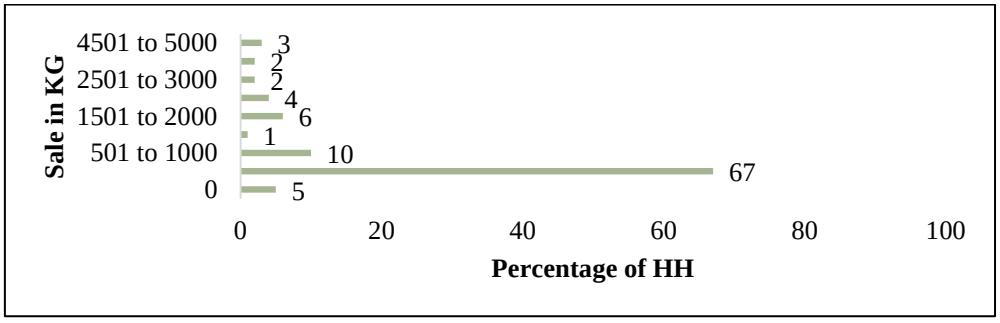

Figure10.7: Total sale per month

To understand the proportion of the *wadi* production being sold out for income generation, the data (Fig 10.7) on total production sale was captured. Almost 67% of households among the respondents'

families used to sell up to 500 kg of produce in the market. The households selling more than 500 kg and up to 1000 are 10%. The qualitative information also showed that the extension of *Wadi* by some of the farmers aided more production which resulted in more income.

f. Household monthly income from *Wadi*

Income generated from the Wadi cultivation is considered to evaluate the impact of the intervention on the farmers' household income in the intervention area.

Majority of respondents' households i.e. 47% generate monthly income up to rupees 2000 per month from the *Wadi* produce. The farmers' expenditure on buying vegetables and fruits from markets substantially declined after establishing *Wadi* on the agricultural land. It is significant to note that 3% of the farmers also generated highest income up to 50,000 per month. The increase in the income level through *Wadi* reduced dependence of farmers on non-farm livelihood diversification and migration.

Table 10.7: Monthly income of farmers from *Wadi*

Income in Rupees	Households (in %age)
up to 2000	47
up to 3000	37
up to 5000	6
up to 20,000	7
up to 50,000	3
Total	**100**

g. Market Options for Farmers

Most of the *Wadi* produce is sold through different marketplaces such as home shops, street vending, city markets, and the *mandis*. The quantity of production decides the marketplace for the sale of *Wadi* produce. Higher production provides the opportunity for the farmers to diversify the marketplaces. The home shops are used by 69% of the respondents, 31% in market shops of urban areas, and 29% use *mandis*.

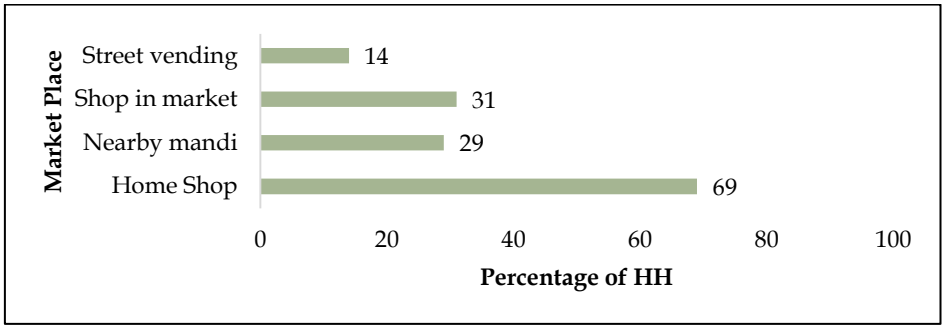

Figure 10.8: Marketplaces used for sale produce from *Wadi*

4. Women's participation in Wadi project

a. Women's participation in decision making

For the study purpose, the operational definition of empowerment was conceived as a multifaceted process, which involves four parallel aspects viz; 1) women's participation in making decisions for installing *Wadi* 2) decision about the choice of vegetables to be cultivated seasonally, 3) decision on selling vegetables and keeping income and 4) decision on seeking technical support for vegetable cultivation.

The study observed that women play a significant role in *Wadi*-related activities such as seed sowing, plantation, irrigation, harvesting, and selling the *Wadi* produce. When it comes to decision-making for the installation of *Wadi*, 43% of women respondents shared that they decide jointly with their husbands. While 38% make decisions jointly with the family members and 7 % make decisions alone. While observing the decision-making trends on the choice of vegetables to be cultivated seasonally, the data showed that in 42% of cases, the women decided jointly with their husbands. Similarly, 34% of women decided jointly with family members. The decision regarding the selling of vegetables had also been taken by most women jointly with their husbands and family members. It represents that women play a major role in selling *Wadi* produce, yet they make the joint decision about the place, price and quantity of products for selling in the market. It is significant to note that in 11% of cases, women take the decision alone.

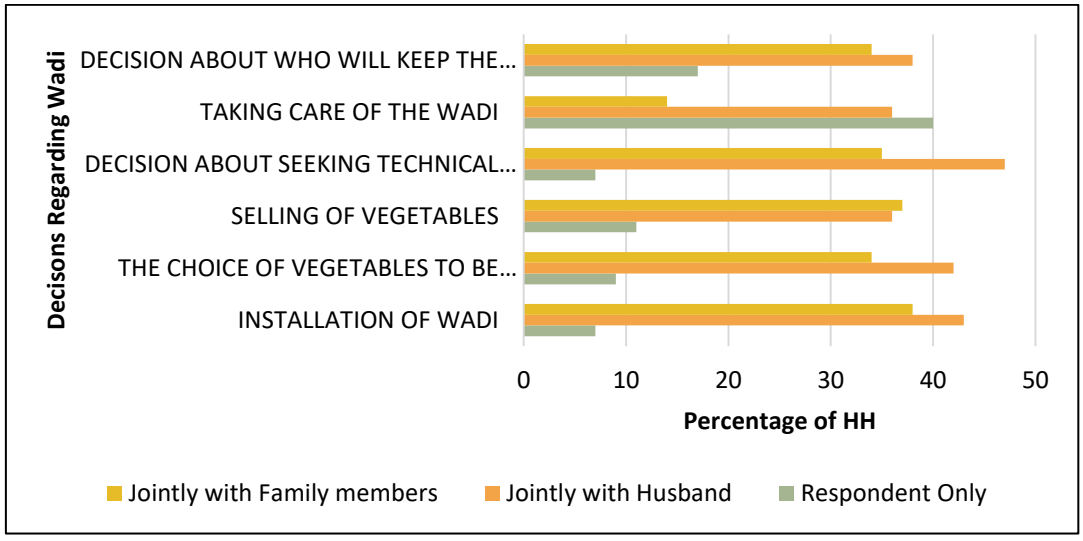

Figure 10.9: Percentage of women participating in decision making

As shown in the graph, taking care of the *Wadi* is the sole responsibility of almost 40% of the women respondents at the household level. In the study, questions were also asked the respondents to understand women's autonomy or freedom to make decisions in the family for the advancement of their livelihood. It shows that the responsibility of women in terms of labour inputs is higher compared to the decision-making. However, the women also revealed that their participation in decision-making improved from production to revenue since they were involved in *wadi*.

5. Nutrition status of women and children: An anthropometric analysis

A 24-hour dietary recall (24HR) method was applied to capture detailed information about the food consumed by the respondent in the past 24 hours.

The average intake or RDA as per the ICMR is as follows:

1. Kcal is 2730-2230 for persons carrying out moderate work.
2. Proteins are 60-55 gm/day
3. Fats 30-25 gm/day
4. Carbohydrates 100-130 gm/day

As observed from the dietary recall data in the project area, though the calorie intake of the family is very low, consumption of carbohydrates and fats is better, i.e., within the standard range of ICMR. The critical factor is that the Indian diet consists mainly of macronutrients or carbohydrates, and the consumption of wheat/ maize and rice contributes to a large intake of carbohydrates. Another intake is Fats; the intake of fats is also sufficient. As per the dietary recall is concerned both the groups i.e., the families residing in the intervention area and control area do not have any significant food habits and are having complete meals. Certainly, the intake of fruits was more in intervention villages. However, the diet mainly had more carbohydrate-rich foods in both areas, in both areas only 10 to 12 families were not taking enough grains (Wheat, rice, maize, Bajra).

a. Body Mass Index (BMI)

Body mass index (BMI) is a measure that relates body weight to height. BMI is used to measure total body fat and whether a person is a healthy weight.

Table 10.8: BMI results of women as per BMI

Sites	BMI (kg/m²)				
	Underweight (>18)	Normal weight (18–23)	Overweight (23 –25)	Obesity (≥25)	Total
Intervention (N=100)	27	52	7	14	100
Control (N=100)	35	55	5	5	100

The data indicates that most women in both the intervention and control villages come within a range of normal weight. However, control villages have 35% women who are underweight. As compared to NFHS 5 data of the Dungarpur, 26.8 per cent of women are below normal and 4.4 per cent are overweight, which is very close to the finding i.e., 27 per cent whereas overweight women in the control site are closer to NFHS 5 figure i.e., 4.4 per cent in NFHS 5. According to the district nutrition profile, the women in Dungarpur with body mass index less than 18.5kg/m2 are 38.1 % which is again close to the percentage of women in control villages i.e. 35% (DNP, POSHAN IFPRI) (Table 10.8).

b. Mid-upper arm circumference (MUAC)

Mid-Upper Arm Circumference (MUAC) is the circumference of the left upper arm, measured at the mid-point between the tip of the shoulder and the tip of the elbow. MUAC is used for the assessment of nutritional status. The MUAC results for children under five given in Table 10.10. It is significant to note that the number of under-five children who fall under the Severe Acute Malnutrition (SAM) category is higher in the control villages having no intervention. Likewise, the number of children under Moderate

Acute Malnutrition (MAM) is higher in control villages than in intervention villages. The MUAC results in the intervention areas are better in the intervention area with a higher percentage of children who are healthy as per the indicators. It indicates that the increased nutrition awareness and dietary diversity due to project intervention led to improved health outcomes in the areas (Table 10.9).

Table 10.9: Percentage of children as per MUAC results

Sites	**Percentage children as per MUAC (cm)**		
	Severe **(>11.5)**	Moderate**(11.5-12.4)**	Healthy **(>12.5 cm)**
Intervention (N=100)	**1**	**4**	**45**
Control (N=100)	**15**	**10**	**25**

c. Results of 24 Hours (Hr) recall method

The ICMR Recommended Dietary Allowance was taken as a benchmark to understand the micronutrient intake of the respondents. The data depicts that 83% of the respondents in the control area consume fewer calories than the calorie intake required by a person per day, as per the RDA standard. Similarly, protein and fat intake among a larger number of respondents was found very less in the control area. The intake of micronutrients was found better in the project area due to the availability of diverse nutritious food in the *wadi* and its increased consumption at the household level. The availability coupled with awareness about nutrition intake has helped people to improve their health outcomes (Table 10.10).

Table 10.10: Percentage of respondents with calorie, protein and fat intake collected through 24 hours (Hr) recall method

Indicator	**Percentage of respondents as per standard intake (SDI)**			
	Intervention sites		**Control sites**	
	Less than SDI	**More than SDI**	**Less than SDI**	**More than SDI**
Calorie intake	60%	40%	83%	17%
Protein intake	39%	61%	57%	43%
Fats intake	54%	46%	79%	21%

Note: Standard intake - Calorie intake @2400 kcal for rural areas; Protein intake @48 gms/day; Fats intake @30 gms/day.

Box 10.1: Prabha Devi- A Self-Reliant Farmer

Prabha Devi is a resident of Surata village. There are six members in her family including her. Her family own a total of 6 acres of agriculture land. The subsistence farming was not enough for fulfilling the

daily consumption needs of the family. A major part of the crops used to destroy by wild animals. The only alternative for Prabha and her family was to migrate to Gujarat and work as daily wage labourers. Cultivating crops on their land did not seem viable. Overall annual income generated by the family before 2017 was less than 25000. In the year 2017, Prabha participated in a community meeting organized by DS Group at the village level. The three-tier model of WADI was explained by the staff for protection of crops, maximize use of small land dwellings to produce seasonal vegetables and fruits.

Prabha Devi told the benefits of wadi cultivation to her husband and they both decided to participate as wadi beneficiaries in the PAHAL project. They started with wadi with 0.5 acre of land. The PAHAL project supports the family by providing seeds, netting, and technical knowledge. The family started to grow diverse and cultivated vegetables and fruits such as guava, papaya, bitter guard, peas, potatoes, etc. The entire patch of the field was well fenced which protected the crops from animals grazing. As a result, the family could get approximately 40,000 in Kharif season and 35,000 in rabi season. Now Prabha Devi is becoming a farmer who takes all the decision about the WADI.

Planting a Wadi has brought a lot of positive changes in our lives. Ranging from the heath of the family members to the education of our children everything has been significantly improved after the installation of the wadi. By saving from the earnings of the Wadi, we have also expanded the area of our wadi from which we expect to earn more in the future.

Box 10.2: Shiv Lal: From A Migrant Worker to A Profit-Making Farmer

Shiv Lal is a resident of village Dolkunjela. His family has five members. He owns eight acres of total agricultural land, out of which 5 acres of land is irrigated land. Lack of irrigation facilities and mechanism to protect crops from wild animals forced him to migrate to distant urban places. Like many others he used to work as daily wage earner in Sarada, Dungarpur and Ahmedabad for almost 6-7 months. The family could hardly generate 2000 rupees per month from the daily wages and migration that too was spent on the food and household expenses. In the year 2017, when he got to understand detailed approach of wadi from the DS group staff, he pursued the idea and started wadi on 0.5 acre of his agriculture land. He sown variety of seeds provided by DG group and produced seasonal vegetables and fruits which gave him good return both in terms of sale of products and household consumption. He also stopped migrating after this and due to which he was easily able to make money from his native land.

Now in my family, we are consuming green vegetables almost every day, but it was barely possible for us to have vegetable once a week and that too from the market.

Through wadi, Shivlal could earn Rs. 7000 per month. Considering the increasing family income within one year, he extended his wadi by 1 acre of land. With this, he has also started drip irrigation with a 50% contribution from DS Group. Looking to the increased capacity for irrigation and the technical knowledge provided by DS staff, he has started growing two new crops Safed Musli (Chlorophytum borivilianum) and Coconut. Now he is earning almost 1 lakh per annum. This has also motivated him to save and invest in his children's education.

"I would like to spend my saving on my children's education so that they could expand our agriculture business in urban areas."

CONCLUSION AND RECOMMENDATIONS

The tribal population in the remote rural villages of the Dungarpur district have faced severe livelihood distress due to shrinking agriculture production on which they were traditionally dependent. The three-tier *wadi* model under the PAHAL intervention provided a sustainable solution for marginalized and poor farmers to secure their livelihood, food security and nutrition. The increased family income turned out to benefit them in terms of their saving, investment in livelihood assets, and reduced migration.

The findings of the study indicate that *wadi* cultivation has dramatically increased family income through improved production of diversified crops. The family income ranges from 5000-10000 per month exclusively from the sale of *wadi* produce throughout the year. The sustainable source of income enabled the beneficiaries to further invest in the *wadi* extension, irrigation facilities, and adding cash crops. The spillover effect of the intervention motivated other women farmers of the intervention villages to take a loan from SHGs and ensure the availability of water for *wadi* installation. The *wadi* as a sustainable means of livelihood for the farmers reduced migration for livelihood to a large extent in the intervention areas.

The *wadi* intervention also addressed the direct and underlying determinants of women and child health among the intervention beneficiaries. The availability of varied fruits and vegetables provided options to the beneficiaries' families to consume diverse food and enhance their food basket, resulting in better nutrition outcomes among women and children in the project areas, as per the Recommended Dietary Allowance of ICMR. On the other hand, 35% of women in control villages were found underweight (BMI less than 18 kg/m^2). The MUAC for children under five also represented the high percentage of children affected by Severe Acute Malnutrition (SAM) in control villages. The highlights of the present study recommend a strong need to scale up the model and improve dietary diversity and intake of nutritious food through nutrition awareness in the non-intervention areas. Also, there is a huge scope of convergence with government schemes such as Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), ICDS, and other social security schemes. The Intervention has also provided a spectrum of diverse food baskets and availability of nutritious food for consumption for families. The better nutrition status, increased family income and reduced migration have emphasized the need for replicating the model in other non-intervention areas. However, the study suggests that the intervention of the PAHAL project needs to be converged with other government schemes such as Pradhan Mantri Krishi Sinchayee Yojana, ICDS and National Nutrition Mission for better livelihood and nutrition outcomes.