



Introducing Sustainable Technology and Industry in Aspirational District, Yadgir to Provide Livelihoods and Strengthen Human Capital

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Abstract | This paper explains a unique, multi-sectoral convergence and development project for women self help groups covering sustainable technology, women's economic empowerment and livelihoods, horticulture, health and nutrition, and education in Yadgir Aspirational District. Yadgir is the most backward district of Karnataka with extremely poor human development indicators, low per-capita income and minimal industrialization. Sustainable technology has been introduced in this district for the first time for setting up a small scale nutritious food production unit run by self help group women, for producing VitaPoshan, a fortified, nutritious multi-grain food, for children, adolescents, adults and family, made from locally available agri-horticulture produce. An accompanying strong multi-layered communication strategy has resulted in progressive behavior change regarding health, nutrition, sanitation practices, already visible in families. This initiative is expected to accelerate improvement of the health/nutritional status of the family/community; economic empowerment of women; higher learning capacity of children; upward social mobility and higher income within families-in short, strengthen Yadgir's human capital.

Keywords: Sustainable technology, Aspiration district, Women's empowerment, Women self help groups, Human capital, Horticulture/Nutrition/Health, Fortified nutritious food

1 Introduction

The Government of India in 2018 initiated the Aspirational Districts Programme¹ with the aim to transform 112 most under-developed districts of the country, quickly and effectively. Aspiration Districts are the most under-developed districts across the country, with the highest levels of poverty, poorest health, nutrition and education status and deficient infrastructure. The broad contours of the programme are convergence of State and Central programmes, collaboration of Central, State and District administrators, and competition among the districts through monthly delta ranking, all driven by a mass movement. The ranking is based on the incremental programs

made across 49 Key Performance Indicators (KPIs) under 5 broad socio-economic themes— Health & Nutrition, Education, Agriculture & Water Resources, Financial Inclusion & Skill Development and Infrastructure.

One such Aspiration District is Yadgir District in the State of Karnataka, which is also the most backward district of the State. Yadgir District has a population of around 12 lakhs, of which 81% live in rural areas and 19% live in urban areas.² As per the Karnataka Economic Survey, 2023–24, the per capita income of Yadgir District is Rs 1,53,247.³ Yadgir District ranks 30th among the 30 districts in the District HDI Index.³ ¹ Auro Centre for Public Nutrition, Public Health and Public Policy, Bangalore, India.
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With the objective of working in the most deprived pockets of India, now constituting the Aspiration Districts, the Karnataka State Council for Science and Technology (KSCST), Centre for Sustainable Technologies (CST), Indian Institute of Science, Bangalore and the Auro Centre for Public Nutrition, Public Health and Public Policy (ACPN), Bangalore, a vertical of Sri Aurobindo Society (SAS) Pondicherry, are implementing a unique project, "Establishing SHG/FPO enterprises to address malnutrition and provide rural livelihood in Yadgir District, Karnataka."4 This project is being supported by the Department of Science and Technology, Govt. of India. BAIF Institute for Sustainable Livelihoods and Development was selected as implementation partner,

The nutritional/health indicators of Yadgir District are extremely worrisome. As per National Family Health Survey, 2019–20, (NFHS 5), the incidence of stunting among children below 5 years is 57.6%, wasting is at 17.7% and underweight at 45.2%. Anemia afflicts 76% children below 5 years and 57.3% women of reproductive age. 26% women have low body mass index < $18.5 \text{ kg/m}^{2.5}$.

Yadgir District has no large or medium scale industry, no food processing industry and no cold chains or primary processing industries for horticulture produce. Several studies establish that India, one of the largest fruit and vegetable producers in the world loses a large percentage of production due to spoilage and post-harvest losses⁶ because of lack of primary processing facilities, fuel-efficient post-harvest technology and hygienic storage facilities. Horticultural loss estimates vary from 15 to 40%. A study, "Mechanisms to Improve Access to Nutritious Horticulture Produce by BPL Communities", conducted by Centre for Sustainable Technology, Indian Institute of Science, in 2014,⁷ in 3 Blocks of Karnataka, viz., Bellary, Gubbi and Shikaripura, has concluded that approximately 30% of horticultural produce is wasted on account of lack of primary processing facilities, cold chains or proper supply chains.

In the absence of primary processing or preservation facilities, it is to be expected that wastage of horticulture produce will continue unless simpler methods using alternative source of energy and more decentralized operations at the grassroots for processing and preserving horticulture produce are introduced. This is what the project attempts to achieve.

1.1 Project Objectives

- Provide livelihoods to Self Help Groups/ Farmers Producers Organizations through sustainable technology, innovative farm-based enterprises, value chains and market linkages.
- Address malnutrition, reduce anaemia and improve the health status of the community and provide fortified nutritious food to the rural poor—to children, adolescents, adults and family.
- Prevent wastage of fruits and vegetables, reduce losses during glut season, arrest distress sales and reduce market risks.
- Provide cash income to the Self Help Groups/ Farmers Producers Organizations and contribute to their economic empowerment.
- Build capacity of Farmers Producers Organizations/Self Help Groups, improve the quality of life of women through value added income generation and marketing of nutritive horticultural products preserved/dehydrated/processed through fuel efficient, green energy.

2 Literature Review

A thorough literature search pertaining to the general subject of socio-economic development of human capital in Yadgir District, and also for specific studies relating to technology and livelihoods for women self help groups was attempted. Search results were extremely limited and did not throw up any studies or research focusing holistically on women self help groups, sustainable technology and livelihoods, health and nutrition. However, some papers relating to varied development sectors are listed below:

- A study on school drop outs conducted by Azim Premji Foundation in 2013, "Who drops out of school? Evidence From an Action Research Study in Yadgir District, Karnataka". This study concludes that poverty and mother's literacy are prominent reasons for the high school dropout rate of children.⁸
- 2. A study regarding the local health traditions that are followed in Yadgir, documented in the article "Documentation of Local Health Traditions of Yadgir District, Karnataka⁹"
- 3. A cross-sectional study done in rural Yadgir to measure undernutrition among children, "Nutritional status assessment of 6–59 months age children in rural Yadgir, Karnataka state, India, by Dhanaraj Chittapur, Shilpa S. Patil, Shruthi Lakshman-

appa".¹⁰ The study reveals that 53.6% of children were stunted, 39.4% were underweight and 15.3% were wasted. Severe forms of underweight, stunting and wasting were observed among 9.4%, 24.2% and 4% children respectively. The frequency of being underweight and stunted has increased with age, which was accelerated after 6 months and about 34% and 52% of children were underweight and stunted by the age 12-23 months. While wasting was higher among children aged 6-11 (24.2%) months than their counterparts. The anthropometric findings of this study are in line with the findings of the baseline survey of the present project, which is quoted as a reference in this study.

4. An article "Problems of The Shg Members in Yadgir District of Karnataka"¹¹ by Prof. Bheemanna Malipatil, 2015, enumerates the personal, administrative and financial problems of self help group women and focuses on micro-credit activities.

3 Methodology

"Establishing SHG/FPO enterprises to address malnutrition and provide rural livelihood in Yadgir District, Karnataka" is a unique, multi-sectoral convergence and development project for women self help groups covering sustainable technology, women's economic empowerment and livelihoods, horticulture, health and nutrition, and education in Yadgir Aspirational District. The project began with a baseline survey to capture the health, nutritional and socio-economic status of the two poorest quintiles of the community. A training programme was conducted for the field team led by implementation field partner, Bharatiya Agro Industries Foundation (BAIF), particularly regarding taking anthropometric measurements of infants, children, adolescent girls and boys, and adult men and women (Figs. 1, 2, 3). An innovative add-on was that along with the baseline survey, the field workers simultaneously started the primary multi-layered communication strategy for behavior change, and the mapping and mobilization of women self help groups. The BAIF field team interacted with the women and community in a very simple manner. While they were taking anthropometric measurements and filling questionnaires, they were also explaining why they were doing so, and what was the significance of the measurements. They used this as an opportunity to provide information about proper nutritional and health care of children, adolescents and adults; balanced diets within family budgets; anemia prevention; the importance of safe drinking water and sanitation; the intergenerational cycle of malnutrition; and community nutritional and health care.¹² Specially created, simple advocacy material was also distributed to the families.

3.1 The Baseline Survey and Primary Information Education Communication (IEC) Programme

The baseline survey and primary Information Education Communication (IEC) programme was conducted from June 2022 to November 2022.¹³ The indicators of the two poorest quintiles of Yadgir District are even more alarming than the district average as brought out in NFHS 5.

A Summary is placed below.

• 20% of mothers of children below 3 years (all migrant labourers) said that their infants did not consume any complementary food until they were about 2 years. The mothers said that whenever the infants were given something



Figure 1: Anthropometric measurements being taken of a child.



Figure 2: Anthropometric measurements being taken of an adolescent girl.

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Figure 3: Anthropometric measurements being taken of an adolescent boy.

from the family food, mostly roti, dal, idli (a soft steamed cake made from rice and lentils) or ganji (soft boiled rice), they were not able to digest it and became ill. All the mothers were migrant workers and did not access any benefits from Integrated Child Development Scheme (ICDS).

- Among children aged 6–35 months, about 64.5% are either stunted, or wasted or underweight. The proportion of children (both boys and girls) under 3 years who are not stunted, not wasted or not underweight decreases as the age increases, implying that their nutritional status/health deteriorates as they grow older.
- Among children aged 3–5 years, about 72.79% are either stunted or wasted or underweight. The proportion of children (both boys and girls) who are not stunted, not wasted and not underweight decreases as age increases, implying that the nutritional status/health

of the children is deteriorating as they grow older.

- About 17.5% of adolescent girls and 7.2% of the adolescent boys (between 11 and 18 years) are illiterate. None of the girls have studied up to class 10, and about 20% of boys are in class 10.
- Overall, about 47.39% adolescent girls and 52.9% adolescent boys are severely underweight and 27.96% girls and 30.77% boys are moderately underweight.
- About 57% of mothers of children under 3 years and 63.5% mothers of children between 3 and 5 years are illiterate.
- Consumption of fruits, vegetables, dairy products constitute a very small part of the daily diet.

The table below shows some Baseline Survey Indicators compared with National Family Health Survey (NFHS 5) Indicators for Karnataka State and Yadgir District (Table 1).

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tors.								
Table 1:	Some baseline	survey indicators	compared w	vith National F	amily Health	Survey (N	FHS 5) indic	

	BLS Yadgir	NFHS 5-Yadgir	NFHS 5-Karnataka
Percentage children under five years [#]	% (N)	%(N)	%(N)
Stunted*	47.9 (698)	57.6(215)	35.4 (6785)
Wasted*	32.5 (695)	17.7 (209)	19.5 (6563)
Underweight*	53.5 (703)	45.2 (219)	32.9 (6991)
Adolescent BMI (% BMI < 18.5 – total thin) ^{\$}	(11–18 Years)		(15–19 years)
Boys	83.3 (221)	-	47.1 (576)
Girls	75.4 (211)	-	42.4 (3993)

*Statistically Significant differences at 95% CI and p<0.05

#—NFHS 5 Karnataka state report Table 72

Pictures of anthropometric measurements being taken of children and an adolescent girl are placed below.

3.2 Product Development

Simultaneously, product development of four inexpensive, but highly nutritive and fortified foods for children, adolescents, adults and general family food started. An expert committee was constituted in February 2022 with representatives from Department of Horticulture, Government of Karnataka, and Indian Institute of Horticultural Research (IIHR) Hessarghatta, and eminent experts to finalize the composition of the foods to be made from locally available agricultural and horticultural produce, mainly, banana, tomato, ragi, wheat, peanut, soya and green gram (Table 2).

It was agreed that the children's food should be an extruded food, so that it did not require additional cooking, and could easily dissolve in hot water or milk, in liquid or paste form, and be fed to the children. This was important because reports from the field have clearly indicated that the main reason why mothers are not able to give their children any complementary food is because they do not have the time to cook anything separately for children in the morning, as they are mostly agricultural or construction workers and cannot be late for work. It was also decided that the adolescent food should be a healthy extruded food which could be eaten as a crisp, healthy snack to replace the junk food which was presently being consumed. The family food was a simple fortified mix of various pulses,

which again could be added to whichever staple was consumed by the community.

Community Sciences Nutrition Lab, Mount Carmel College, Bangalore, was selected for developing the four products, which were successfully finalized in December, 2022. Mandatory nutritional analysis for nutrient, mineral and vitamin content was completed at the Indian Institute of Horticultural Research (IIHR) by March 2023. Shelf-life tests were conducted at Central Food Technological Research Institute (CFTRI), Mysuru during January 2023.

After discussion with all stakeholders, it was unanimously agreed to name the products as VitaPoshan Baalya,(Children) VitaPoshan Yuva (Adolescents) VitaPoshan Vayaska (Adults) and VitaPoshan Kutumbha (Family).

4 Setting up Production Unit and Selection of Technology

A shed belonging to the Agricultural Produce Market Committee (APMC) with water and electrical connection suitable for food industry was identified at Yadgir and was taken on rent and renovated appropriately for establishing the Vita-Poshan production unit. It was decided to select and adopt sustainable and energy efficient technologies which are cost effective, easy to maintain, and which could be easily handled by self help group women, who were mostly engaged in agricultural and household activities.

Most important among the sustainable and energy efficient technologies is the ASTRA agroprocessing dryer which was earlier developed by Centre for Sustainable Technologies to help farmers protect their produce, particularly areca

Table 2:	Composition of the products and the	eir nutritional values.	
SL no	Product	Ingredients	Nutritional content for 100 g
1	Fortified nutritious product for Children (above 6 months)	 Broken wheat flour Banana flour Malted ragi flour (millet) Defatted soya flour Granulated sugar 	Carbohydrate %- 54.13 Protein %- 10.85 Total fat %- 2.01 Crude fibre %- 7.44 Energy Kcal- 318.38
2	Fortified nutritious product for Adults	 Roasted broken wheat flour Banana flour Malted ragi flour (millet) Defatted soya flour Peanut flour Granulated sugar 	Carbohydrate %- 55.56 Pro- tein %- 9.45 Total fat %- 2.02 Crude fibre %- 6.66 Energy Kcal- 330.43
3	Fortified nutritious product for Ado- lescents	 Banana flour Tomato powder Broken wheat flour Defatted soya flour Green gram flour Iodized salt Granulated sugar Pepper powder 	Carbohydrate %- 44.97 Protein %- 20.832 Total fat %- 4.23 Crude fibre %- 4.06 Energy Kcal- 279
4	Fortified nutritious product for Family	 Tomato powder Powdered channa dal (Lentil) Powdered urad dal (Lentil) Iodized salt Red chilli powder Curry leaves powder Asafoetida Garlic powder Sugar 	Carbohydrate %- 32.26 Protein %- 16.058 Total fat %- 3.61 Crude fibre %- 12.5 Energy Kcal- 238.71

and cardamom, which had to be dried after harvest to avoid fungal infection because of excessive humidity, rain or lack of sunshine. Other horticultural produce, fruits, vegetables, herbs with low shelf life can also be dried and stored for future consumption with increased shelf life. The dryers are very widely used by farmers in Uttara Kannada, Dakshina Kannada and Malnad districts of Karnataka, and Kerala. (The name ASTRA was derived from the acronym of the previous name of Centre for Science and Technologies, namely, Application of Science and Technology to Rural Areas).

The ASTRA agro-processing dryer works on the principle of heat and mass transfer through generation of hot air and passing it in orderly flow around the wet material to pick up moisture and throw it out using the natural convection. The dehydration of fruits/ vegetables takes place in the temperature range of 40 to 45°c, and in this process only moisture gets separated keeping other contents like vitamins, minerals, sugar etc. intact, without affecting the flavor, colour and taste of the vegetable or fruit. The dehydrated product becomes soft and fresh upon rehydration through soaking in water.¹⁴ Concepts used in achieving energy efficiency

- Carry out total combustion of the fuel, with little excess air to generate the highest temperature of flue gases.
- Maximize the heat transfer to the job in hand, that is to generate hot air after fresh ambient air comes in contact with the hotter bottom and back ducts, to dehydrate the products.

Heat transfer takes place by conduction, convection and radiation according to the following equations:

Conduction :
$$Q = \frac{kA(Th - Tc)}{L}$$

Convection : Q = hA(Th - Tc),

and

Radiation :
$$Q = e\sigma A(Th4 - Tc4)$$
,

where, (all in consistent units: for radiation the temperatures are in absolute units), Q=heat transferred in unit time, k=thermal conductivity, A=area of heat transfer, Th=temperature of the hot medium, Tc=temperature of the cold medium, L=thickness of the conducting medium, H=convective heat



Figure 4: ASTRA Biomass Dryer - Cabinet type (back to back 3+3 trolley).

Table 3: Temperature in °C, at the lower tray (LT) and upper tray (UT) of the trolleys 1 to 6 with time of dry-

mig.												
Time hrs	Trolle	y-1 ∘C	Trolley	/-2 ∘C	Trolley	y-3 ∘C	Trolle	y-4 ∘C	Trolle	y-5 ∘C	Trolley	-6 ∘C
	LT	UT	LT	UT	LT	UT	LT	UT	LT	UT	LT	UT
1–0	22	22	20	20	20	26	20	22	24	22	24	26
2–0	24	26	20	22	22	28	22	28	24	26	38	32
3–0	26	28	26	28	30	30	26	28	32	28	48	40
4–0	32	34	28	34	40	36	30	32	40	36	62	50
5–0	40	40	32	40	44	40	34	36	44	40	52	50

transfer coefficient, e=emissivity, and $\sigma=Stefan - Boltzman constant$.

These equations indicate that the amount of heat transferred by all the mechanisms increases with the area of heat transfer, temperature difference between the hot (flue gases) and cold media, and the co-efficients (conductivity, convective heat transfer co-efficient, emissivity). By carrying out the combustion in an enclosed firebox and by controlling the primary and secondary air entry with ports of proper size, suitably located, the maximum possible combustion temperature could be generated. Thus, a higher temperature difference is achieved.

There are two types of ASTRA Dryers,

(i) Cabinet Dryers with natural convection where solid fuel is burnt in the masonry combustion chamber below the tray cabinet and is connected to the metallic flue gas ducts at the back of cabinet to vent out through the chimney. The fresh air which enters through the ports below the hot combustion chamber gets heated and the hot air moves naturally over the stacked trays with wet materials to pick-up moisture, and goes out through the separate outlet. During this process the moist air gets reheated as it comes in contact with the hot metallic ducts which are placed spirally at the back of the tray chamber. In the laboratory, this design could evaporate 3 to 4 kgs of moisture from wet gunny bags per kg of fuel wood, with controlled inlet rate of drying air. In the field, the specific fuel consumption varies between one kg to half kg fuel wood for the evaporation of one kg moisture.

(ii) Room Dryers which work on forced convection having a separate chamber for hot air generation and this hot air is pumped into the drying chamber for drying wet material.

Centre for Sustainable Technologies has installed various sizes of Cabinet Dryers in the Yadgir production unit, each with different capacity of drying, with a total capacity of 1200 kgs wet material per batch. The largest dryer has six back-to-back trolleys, and each trolly has 22 stainless steel trays stacked inside, with each tray measuring 0.4 sq.m. It is calculated that the dryers in the production unit can dehydrate an average of 1000 kgs of horticulture produce within 48 h (Fig. 4). The temperature rise is uniform in all the six trolleys and there is not much variation between the bottom trav and top tray temperature (Table 3). This is due to orderly flow of hot air which gets recharged to pick up more moisture, by coming in contact with the hot duct at the back of the trays during the process of flow and thus picks up moisture continuously from wet materials from all the trays before it gets out from the dedicated vent. The flue ducts carrying hot gases are connected to the chimney and these hot gases/smoke do not come in contact with the drying material. The fuel burning rate of this dryer is 12.5 kg/h.

The dehydrated fruit/vegetable products thus obtained are pulverized to bring them to powder form and sieved to be stored for further processing in combination with other ingredients as per product formulation process. Standard machineries used for these have been installed and tested by July 2024, and are listed in Annexure 1.

Training of self help group women for production started by end of July. Trial production of all 4 varieties of VitaPoshan is presently going on.¹⁵

5 Mobilizing Women Self Help Groups, Information Education Communication, (IEC) for Behaviour Change

The baseline survey indicated that while women self help groups existed in all villages under several government programmes, their activities were limited to providing microcredit to the women members. Around one percent of the self help groups were conducting very basic economic activity, such as selling pickles and other popular homemade food items.

The primary Information Education Communication (IEC) campaign for behavior change with the women self help groups had started along with the baseline survey in June 2022. The campaign began with the dissemination of the following basic messages¹⁶:

- 1. Intergenerational Life Cycle of Malnutrition.
- 2. Anemia Prevention.
- 3. Nutritional Care of Pregnant women.
- 4. Nutritional Care of Adolescent Girls.
- 5. Importance of Complementary Feeding for Children above 6 months.
- 6. Proper Dietary Practices within Family Budgets.
- 7. Importance of Sanitation and Safe Drinking Water.

All advocacy material can be viewed on the ACPN website.¹⁶

Tried and tested methods of engaging with women self help group members and village influencers were used through the advocacy material and interactive focused group discussions in the same villages where baseline survey questionnaires were being answered. However, even after six months of running the IEC campaign, there was general agreement among project stakeholders that this strategy was not creating much impact. While the self help group women politely attended the group meetings and answered the baseline survey questions, they did not appear to be convinced by any of the information that was being given to them regarding how they could improve their family health and nutritional status, or how they could make their children stronger and prevent them from falling ill often. There was much discussion and debate as to why this was happening-perhaps the women's indifference was on account of lack of trust for any kind of behaviour change messaging; perhaps their cynicism within the culture of poverty was too strong to allow them to believe the messages. After all, they had lived in this subsistence state for generations and had come to accept it as a norm with a sense of fatalism.

After a series of brainstorming sessions and discussion with field partners, it was finally agreed that the most influential agents of change in this generational subsistence society were



Figure 5: IEC programme in Govt High School, Arkur village.



Figure 6: IEC programme in Govt High School, Devapur village.

perhaps the children, as they were the most aspirational group in the community. It was also informed that children in these subsistence societies hold a very special place in the family for the reason that boys are treated as family assets to take care of their parents once they grow old and are unable to work, and girls are considered as temporary inmates who would move away to their marital homes after some years. As per local culture in this area, parents generally are very indulgent towards their children.

A very innovative decision was therefore taken that in addition to the IEC programmes for women, special IEC programmes focusing on students in senior schools would also be started, for providing them with critical information to engineer behaviour change in the household. Relevant themes that were urgently required to be disseminated in families were selected and age-appropriate advocacy material in the form of posters and films for students was developed...¹⁶

The themes covered were:

- 1. Importance of balanced diet and consumption of locally available fruits and vegetables
- 2. Not coming to school on an empty stomach.
- 3. Avoiding junk food.
- 4. Importance of clean drinking water and sanitation.
- 5. Causes of anemia and how to prevent it.
- 6. Intergeneration lifecycle of malnutrition.

IEC programmes were conducted in 40 government high schools (12-16 year old children) from November, 2022 onwards. On account of their great success and popularity, they were continued in 20 government higher primary schools (9-12 year old children) across the district. Particular care was taken to ensure that the programmes were made engaging through films and interactive through quizzes and games so that children could enjoy them and take home the messages to their parents.¹⁷⁻¹⁹ Schools in the most backward and remote villages of the district were deliberately selected, many of which did not even have motorable roads. Details are available in the Auro Centre for Public Nutrition, Public Health and Public Policy (ACPN) website.⁴ This was a first of its kind programme being conducted in schools, which the teachers and staff also found very informative and useful, both for themselves and for the students. School IEC progarmmes were conducted from November 2022 till February 2023 after which Impact Assessments were conducted as described below.

6 Reaching Mothers Through Schools 6.1 Impact of School Information Education Communication Programme: A Success Story

Impact Assessments were conducted in April 2023 and October 2023, across 40 high schools in 37 villages, and 20 government higher primary schools in 20 villages. The Impact Assessment was based on formal interviews with students, parents and teachers. The observations were extremely encouraging:

- There was positive behaviour change in around 60–65% families
- Many students started eating sprouts and local fruits daily
- All children started eating a meal before coming to school



Figure 7: IEC programme in Govt High School, Shahpur village.



Figure 8: Marketing training of self help group women.



Figure 9: Marketing training of self help group women.



Figure 10: Production training for SHG women and staff.

- Children started asking their parents for a variety of fruits and vegetables
- Students realised the risks of junk food and chose healthier options like chikki (peanut and jaggery toffee) and banana as a snack
- Students were not wasting vegetables served as part of their school mid-day meal
- All students found the IEC materials very informative and students learned new information about intergenerational cycle of malnutrition, anemia, hygiene, affordable nutritious food.
- Teachers reported that the health of students who followed the messages has improved



Figure 11: Production training for SHG women and staff.



Figure 12: Safety and Hygiene training for SHG women and staff.

• Students were more active; they participated in games and had better concentration in the classroom

Detailed Impact Assessment Reports are available at Reference^{20,21} (Figs. 5, 6, 7).

The School IEC Programme is an important learning and success story that emerges from this project, as it became the critical catalyst for triggering behavior change in the family. The faith of the self help group women in the programme, which was a bit skeptical when the programme began, started increasing as they followed the behaviour change advice which came to them through their children and the school IEC programme, and they experienced for themselves the continuous improvement in their well-being and higher energy for work, and the well-being of the family, particularly their children.

To continue the IEC programme with women self help groups with more active participation, the field team discussed the serious findings of the baseline survey with them, particularly the general poor nutritional and health status of children and adolescents, and female illiteracy. To avoid information overload and to promote further participation, it was decided that the field team would request the women to themselves identify the priority areas in their community that required behavior change. After comprehensive engagement, the women agreed that areas requiring urgent attention were:

- (a) preventing the extremely high rates of school drop outs, especially among girl students;
- (b) preventing early marriage among girls, which is very high in the district; and
- (c) ensuring that infants are given adequate complementary feeding after 6 months

These suggestions were taken with due seriousness, and suitable advocacy material focusing on these three issues was created. Two simple, impactful films were produced namely:

- Complementary food for Infants, Foundation for Life²²
- 2. Power of Education, Freedom from Poverty and Education First, Marriage Later²³

Posters on same topics were also created¹⁶

7 Mobilizing Women SHGs- Marketing

It was decided that marketing of Vita Poshan would be done through a hybrid marketing strategy involving marketing by self help groups, traditional retail and wholesale distribution networks, and on-line sales. A marketing training for trainers programme was organized in April 2024 for the Karnataka State Council of Science & Technology and BAIF field teams. A marketing expert trained the field staff regarding several marketing techniques incorporating the AIDA model (Awareness, Interest, Desire and Action) and its ethical application. This was then converted into a simple module in Kannada to train the self help group women.

It was seen that of a total number of 300 women self help groups which were mobilized, only around 40 self help groups were engaged in economic activity, mainly selling pickles, papads, rotis. To begin with, it was these self help groups which were selected for marketing training. So far, 128 self help group women have received marketing training and feedback suggests that the training has been well received



Figure 13: Production training for staff.

and understood. These marketing trainings are an ongoing component of the project.

While ascertaining the interest of self help groups to take ownership of the production unit after termination of the project in June 2025, many self help groups were intimidated by the machinery and opted out. After motivation by the BAIF field team, the self help group "Shree Mailaralingeshwara Sangha, Hattikuni" showed interest in taking over the production unit and producing Vita Poshan. The remaining self help groups will engage in marketing of Vita Poshan (Figs. 8, 9).

8 Setting up of Production Unit, Training Self Help Group Women and Trial Production

Meanwhile, Karnataka State Council for Science & Technology completed installation of the machineries in the Yadgir shed in July 2024, and the production unit became operational. The self help group women who agreed to work in the production unit were given training on safety and hygiene protocols, and on how to operate the machines.

Trial production of all Vita Poshan varieties is presently going on and Food Safety and Standards Authority of India (FSSAI) Certificate for the 4 VitaPoshan Products was issued on September 4, 2024. Sample distribution to the community for feedback is presently going on. The feedback so far, has been most encouraging and the community is waiting for the product to enter the market. This is the first time that they would have



access to a healthy, affordable, fortified, nutritious product in the market and be able to purchase it. What makes it even more compelling for the community is that it is being manufactured by women folk of their own district (Figs. 10, 11, 12, 13).

9 A Unique Project

This is indeed a unique, first-time, inter-sectoral project which focuses on the two poorest quintiles of the community, and integrates the objectives of:

- Introducing sustainable technology for the first time in the Aspiration District Yadgir for establishing a small scale processing unit, run by self help group women, to utilize the locally available agricultural / horticultural produce.
- Production of value added, affordable, nutritional foods for improving the health/nutritional status of the poorest sections of the community and the learning capacity of children and adolescents.
- Women's empowerment and improving the livelihoods and incomes of self help group women by providing them skills and engaging them for production and marketing of Vita Poshan.
- Improving livelihoods and earnings among the poorest sections of the community.
- Strengthening human capital through skill development and training of youth and womens groups for procurement of raw materials, production and marketing of value added nutritious products for local consumption
- Dissemination of knowledge and behavior change regarding health, nutrition, child, adolescent and maternal care, sanitation and safe drinking water (Fig. 14).

10 Discussion

A thorough internet search was done with keywords: small scale energy food production unit run by women self help groups; Aspiration District with food production unit; small scale industries run by self help group women; small scale industries in Aspiration Districts of India. However, no similar or comparable multi-sectoral project was found. As the VitaPoshan production unit is the first small scale food production unit of Yadgir Aspiration District and is being run by self help group women, several new findings have emerged regarding the social dynamics of change in what can be called a pre-industrial, generationally poor society. The most important learning is that in this social background of backwardness, it is the students, both

girls and boys, who became the critical agents of change, as they are the most aspirational. The Impact Assessment Reports dated April 2023 and October 2023^{20,21} clearly indicate that the students were able to influence their families to bring about a marked behaviour change regarding what they had learnt in the School IEC Programme about proper child and adolescent care, dietary diversification, improved hygiene practices, which resulted in improved school performance by school children, and better health in the families. It is also important to note that it is for the first time during free sampling of VitaPoshan for consumer feedback that the poorest section of the Yadgir Aspiration District community-children, adolescents and adults, got an opportunity to consume fortified horti-multigrain nutritious foods, produced in the same district by their own SHG women. Feedback from the community has been excellent- the children like VitaPoshan and are more active; the adolescents enjoy the taste and feel more energetic, and adult women and men feel stronger.

11 Conclusion

After 3 years of implementation of this pioneering and unique inter-sectoral project which combines the objectives of (a) introduction of sustainable food processing technology for the first time in one of the most backward districts of India, (b) IEC and behaviour change through self help group women, students and schools, (c) women's empowerment and livelihoods, (d) better health and nutrition—the positive, transformational impact of the project on the poorest sections of the community is clearly visible.

As stated earlier, the VitaPoshan production unit is the first small scale food production unit of Yadgir Aspiration District. It is expected that this introduction of sustainable technology for improving livelihoods of the most deprived sections of the Yadgir community will trigger a process of further industrialization and technological development in the district, accompanied by higher entrepreneurship, livelihoods and economic development, and progressive behaviour change and knowledge in the community for improved health/nutritional/ educational status resulting in stronger human capital and socio-economic status of the people.

The process of strengthening human capital must necessarily be accompanied by appropriate behaviour change and change in belief systems in families and communities, particularly related to child and adolescent care, maternal care, adopting proper health/nutrition/dietary practices, safe drinking water storage and hygienic sanitation. The new learning regarding the critical role of children for bringing about the much-required behaviour and belief systems change in the community and family, and creating aspirations in the families of this aspirational district, may be useful for other organizations working in the field of human capital. Recent reports from the field confirm that that the behavior change captured in the Impact Assessment Reports cited at,^{20,21} sustains and has come to stay within families and the community.

There is also a sense of pride among the community that a state-of-the-art food production unit has come up in the District, the first of its kind, and is being run by their own self help groups women. The project is at the stage of introducing Vita Poshan into the market, and it was unfortunate that the project milestones were delayed on account of the Covid lockdowns. Discussions are presently going on with the Government of Karnataka regarding the sustainability strategy for the year 2025, and a multi sectoral impact assessment will be done within the next six months.

Lastly, it can be concluded that inter-sectoral human capital development strategies alone can bring the most deprived and poorest communities closer to achieving Sustainable Development Goals 1. No Poverty 2. Zero Hunger 3. Good Health and Wellbeing 4. Quality Education 5. Gender Equality 6. Clean Water and Sanitation 8. Decent work and Economic Growth 9. Industry, Innovation and Infrastructure and 12. Responsible Consumption and Production.

12 Annexure I

List of machines installed at Production Centre, NGRG shed, APMC, Yadgir

Astra Dryers

ASTRA Biomass Dryers (ABD) & Electrical Dryers (ED)

Vegetable Slicers.

- 50–100 kg/hr., for slicing Banana, Tomato, Power 1 HP to 1.5 HP
- Cutting chamber material: SS 304-
- Slicing thickness should be adjustable to cut banana and tomato—preferably 2 mm

Grain destoner.

• 50–100 kg/h for cleaning grains, Power 2 to 2.5 HP

Pulverizer.

- 50–100 kg/h, for grain milling, With blower, cyclone separator, starter, anti-vibration pads
- Pulverize, hammer, sieves, cyclone separator, blower MOC should be SS 304
- Power: > 5HP. Multiple Sieve type: SS 304

Mixer blender.

- 50 kg/batch for mixing flours, Motor: 2 to 2.5 HP
- Type: Ribbon blender
- Blending: Spiral
- Surface Finish: 150 Grit
- Drive: Gear Drive
- MOC of frame and angle: SS 304
- MOC of drum & Ribbon: Stainless steel 304

Vibratory Sifter (Sieve type).

• 50–80 kg/hr. for sieving, Continuous & vibratory type sifter (US standard mesh number 70)

#	Name of the Dryer	KSCST accession no	No. of SS trays	Tray size cm / inch	Total tray area S.M/S.ft
1	ABD-1	KSCST1829	07	58×98/23″×39″	4 / 43
2	ABD-2	KSCST1820	11	58×78/23″×31″	5 / 54
3	ABD-3	KSCST1822	13	50×100/20"×40"	6.5 / 66
4	ABD-4	KSCST1830	05	30×40 12"×16"	0.6 / 6.6
5	ABD-5	KSCST1821	132	59×77 24"×31"	60 / 681
	Total ABD	-	-	-	76.1 / 850.6
6	E-D-6	KSCST1934	48	75×42/30″×17″	15 / 169
7	E-D-7	KSCST1934/1	48	75×42, 30″×17″	15 / 169
	Total ED	-	-	-	30 / 336
	Total ABD + ED*				106.1 / 1188.6

Based on the total tray* area we can dry 1200 kg/batch @ 1 kg/S.ft tray area or 600 kg processed Banana or Tomato / batch (@0.5 kg/S.ft tray area)

• Power: 1 to 1.5 HP

Twin Screw Extruder.

- 50 kg/h-for food processing at high temperature, Product type: Puffed snacks (Corn curls, cheese ball, Corn Ring etc.)
- Raw Material: Millet Flour, Rice Flour, Wheat Flour, Corn Flour, Maize Flour, Sorghum, tomato flour, banana flour, coconut flour etc.

Extruder barrel.

- No of Barrel: 2 number with individual heating arrangement for each barrel; minimum two electrical heating elements shall be provided. Power consumed per heater is 1.5 kW. Temperature: Ambient to 200–250 °C
- Barrel is jacketed with solenoid valve arrangement, which allows flow of water as per requirement to control temperature automatically
- Temperature control limit: 3 to 5 °C
- Auto Self-cleaning function without disassembling the barrels.
- MOC of Barrel: Stainless Steel 420, for high wear and corrosion resistance
- MOC of Screw should SS 420 for high wear and corrosion resistance

Twin screw.

- Screw Length—700 to 860 mm, Screw diameter—36 to 42 mm, Screw speed—80 to 480 RPM
- Co-rotating, fully intermeshing, (Intact model) self-cleaning extruder screws

MOC of Screw should SS 420 for high wear and corrosion resistance.

Flavor coating machine.

- 5–10 kg per batch—for taste and aroma addition Power: minimum 2 HP Single Phase 220 V
- MOC of drum: Stainless Steel 304
- Discharge: Tilting or door
- Rotating Drum Speed: fixed/variable
- Inside drum 6 No's of Baffles, with oil sprayer

Packaging machines.

• for powder and solids packaging Capacity: 25 packet per min (depending of bulk density of product)

- Power: 3 HP
- Packing Range: 20–500 g
- Filling type: Auger filling
- Automatic weighing and fill seal
- Packing style: Three side seal type
- Type of Pouches Pillow Type
- MOC of contact parts: SS304
- Weight Accuracy: ± 1 g
- In Feed Screw conveyor-required for conveying of powders to packing machine hopper
- Batch coding system (min three line required)
- Batch cutting system

Cold storage.

- 10×8×10 feet, Type of refrigeration system— Split Type
- Type of Cooling—DX type
- Ref. system capacity [3 KW]
- Type of Refrigerant—Freon (R 404a)

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Not applicable.

Declarations

Conflict of Interest

The authors declare no conflict of interest with respect to research, authorship and/or publication of this paper.

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