Original Article

Production of fortified food for a public supplementary nutrition program: performance and viability of a decentralised production model for the Integrated Child Development Services Program, India

Clémentine Antier MD, Salil Kumar CA, Sadhana Bhagwat MD, Rajan Sankar MD

Global Alliance for Improved Nutrition (GAIN), New Delhi, India

Integrated Child Development Services in India through its supplementary nutrition programme covers over 100 million children, pregnant and lactating women across the country. Providing a hot cooked meal each day to children aged between 3-6 years and a take-home ration to children aged between 6-36 months, pregnant and lactating women, the Integrated Child Development Services faces a monumental task to deliver this component of services of desired quality and regularity at scale. From intermediaries or contractors who acted as agents for procuring and distributing food to procurement directly from large food manufacturers to using women groups as food producers, different State Governments have adopted a variety of strategies to procure and distribute food, especially the take-home ration. India's Supreme Court, through its directive of 2004, encouraged the Government to engage women's groups for the production of the supplementary food. This study was conducted to determine the operational performance, economic sustainability and social impact of a decentralised production model for India's Supplementary Nutrition Program, in which women groups run small-scale industrialised units. Data were collected through observation, interviews and group discussions with key stakeholders. Operational performance was analysed through standard performance indicators that measured consistency in production, compliance with quality standards and distribution regularity. Assessment of the economic viability included cost structure analysis, five-year projections, and financial ratios. Social impact was assessed using a qualitative approach. The pilot unit has demonstrated its operational performance and cost-efficiency. More data is needed to evaluate the scalability and sustainability of this decentralised model.

Key Words: decentralised complementary food production, viability, women empowerment, India, ICDS

INTRODUCTION

Despite tremendous economic growth and poverty reduction in India over recent years[1,2] the prevalence of undernutrition remains high. According to the NFHS 3, from 2005-2006, 43.5% of children below 5 were underweight (weight-for-age z-score < -2); 47.9% were stunted (height-for-age z-score < -2); and 20% were wasted (weight-for-height z-score < -2).[3] The Integrated Child Development Services (ICDS) scheme is India's primary response to the nutritional and developmental needs of impoverished children and mothers. The ICDS offers an integrated package of six services comprising supplementary nutrition, immunisation, health check-up, referral services, pre-school non-formal education, and nutrition and health education, delivered through a network of more than 1 million local Anganwadi Centers (AWCs[a]).[4] The ICDS supplementary nutrition component comes under the Supplementary Nutrition Programme (SNP), which aims at bridging the caloric and nutritional gap between the national recommended and average intake of children and women in low income and disadvantaged communities. The SNP provides supplementary nutritional support for 300 days per year to children from 6 months to 6 years old, as well as pregnant and lactating women.

The current budget for supplementary nutrition is 4 rupees (8 US cents) per beneficiary per day for children 6-72 months; 6 rupees (12 US cents) for severely malnourished children 6-72 months; and 5 rupees (10 US cents) for pregnant women and nursing mothers.[4]

Guidelines for the SNP are developed by the Ministry of Women and Child Development, Government of India, and each State is then expected to implement the programme within the parameters of the guidelines. Different models have been used to procure foods for take-home rations in different States, ranging from private food

[a] Anganwadi Centers are the last mile infrastructure at the community level used for ICDS services. These centres are present for every habitation with a population of 700-1000.

Corresponding Author: Salil Kumar, Global Alliance for Improved Nutrition, Suite 15 AB, The Lodhi, Lodhi Road, New Delhi 110003, India.
Tel: +91-11-43147575; Fax: +91-11-43147580
Email: skumar@gainhealth.org
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manufacturers to community managed suppliers and government food manufacturers.

In 2004, The Supreme Court of India released an order on decentralisation of production of food for the ICDS' Supplementary Nutrition Program, encouraging using local self-help groups[b] or other community groups for procuring the food[c]. In June 2011, the National Advisory Council reinforced the direction to give mothers and communities a stake in ICDS, for increased flexibility of the program and community ownership.[5,6]

A pilot unit was set up in 2011 by the Global Alliance for Improved Nutrition (GAIN), with the UN World Food Programme (WFP) as an implementation partner, after having obtained expert opinion on the ideal model that would be easy to operate by semi-literate/ illiterate women, capable of producing a quality assured product, allow monitoring of quality and fortification and also be an attractive business model for women to be engaged in on a daily basis. A unit with one metric ton production capacity per day was finalised for operation by 12 women belonging to a self-help group in a village in Banswara, a tribal block of Rajasthan.

This study evaluated the operational performance, the economic viability, and the social impact of the pilot unit. It is important to recognise that the scope of the evaluation was limited to only one pilot unit, in operation for less than a year. A broader assessment should be conducted to draw conclusions on the viability of the model at scale.

METHODS

Data were collected through desk review, project reports, observation, interviews and group discussions with key stakeholders. The plant has been operating since August 2011. Data for this study was gathered for 8 months, between August 2011 and March 2012.

Operational performance

Operational performance was assessed using a set of standard performance indicators covering all aspects of the enterprise's activities: 1) General characteristics of the production unit (products and production lines); 2) Raw materials procurement system (organisation and reliability of the procurement system; raw materials qualitative and quantitative characteristics; premix procurement and stock management); 3) Production (adequacy of production capacity versus actual utilisation; production line characteristics and reliability; fortification process; quality assurance and control; production performance in relation to inputs use); 4) Packaging (quality of packaging material; losses); 5) Finished product characteristics (organoleptic quality and acceptance; product credentials; compliance to quality standards); 6) Delivery system (organisation; regularity; cost; reliability); and 7) Stock management. Indicators relating to these different sections were either filled in directly or calculated, from the information collected through interviews with the project manager and other stakeholders (factory technician, women from the self-help group, and staff from a quality lab) and review of project reports and an independent report on the activities and functioning of the pilot unit[5]. We then selected the most relevant indicators for characterising the unit's operations. To get a sense of the acceptability of the product, AWCs supplied with the product – called "Raj-Nutrimix" – were visited and key stakeholders (Anganwadi workers, the service providers at Anganwadi centres and mothers of beneficiaries) were asked questions about their perception of the quality and taste of the product and ease of handling the product.

The indicator values refer to the 8-month period of data collection. We assume that the operations of the unit are stable and that indicators therefore reflect the regular operations of the unit.

Economic viability of the pilot unit

The aim was to understand the cost structure and the viability of the pilot unit set up in Banswara, Rajasthan. Information on costs and sales was obtained from WFP's reporting costing sheet dated from June 2012, which provides average costs in Rupees and Dollars per month. From this source, we selected cost items directly related to the unit operations (whereas costs related to project management were excluded). Cost items were grouped in 10 categories: Raw materials; Utilities (diesel and electricity); Packaging material; Labour (10 women from the self-help group, 1 factory technician, 2 guards); Freight (for raw materials and finished product); Depreciation (calculated by WFP over 7 years); Industrial site rental; Contingencies; Other costs (insurances for plant and equipment and accident cover, license, disposable material, wastage, repair and maintenance); and Quality control. These cost categories were classified in order of importance, which allowed highlighting cost drivers. The margin was calculated as the difference between selling price and total cost. Consistency of data with information from the independent review of the activities and functioning of the pilot unit was verified[d]. From the cost items, we calculated the proportion of fixed costs and variable costs to enable calculation of break-even points. All along the economic analysis the conversion rate from rupees to dollars was taken as 50:1.

Potential viability as an enterprise model

The objective of this component was to understand the economic and financial viability and sustainability of small-scale industrial units established on a commercial enterprise model. The analysis was conducted on the ba-

[b] In India, women below the poverty line are encouraged to organize and strengthen into Self-Help Groups (SHGs) to access bank credit and government's subsidies and economic opportunities. Development of such women's groups is supported by the Ministry of Women and Child Development and the Rural Development Department.

[c] The Supreme Court order states that "The contractors shall not be used for supply of nutrition in Anganwadis and preferably ICDS funds shall be spent by making use of village communities, self-help groups and Mahila Mandals for buying of grains and preparation of meals".

[d] Independent review of the pilot unit: Thakur M. Production and Distribution of Complementary Food by Women's Groups in Rajasthan - A collaborative initiative of the Government of Rajasthan, WFP & GAIN - Independent Review of Decentralized Production of Raj-Nutrimix by Shitalamata self-help group, Banswara, Rajasthan. May 2012, unpublished.

sis of data collected on the pilot unit and a set of assumptions. The study systematically used conservative assumptions. Various scenarios were developed to test the resiliency of such units in different conditions.

General assumptions

The investment needed for setting up a unit and starting the activity was considered similar to the investment expenditure in the pilot unit (US$ 47,600, which includes plant cost, electrification cost, a diesel generator set, license costs and small material such as trolleys and pallets). We assumed that women self-help groups have access to financial services and can borrow the amount necessary for initial investment and working capital. The working capital requirement was roughly estimated as two months of variable and recurring costs (US$ 33,611). Therefore, we considered that a self-help group would have to borrow US$ 81,211 for starting the activity. In the following scenarios, we considered that self-help groups would not have to bring any financial contribution to the initial capital. The interest rate was fixed at 11% - which is an average commercial loan rate in India in 2012. The duration of the loan was taken as 5 years, in line with the calculation of machines' depreciation with a linear depreciation of 20% over 5 years. It is a conservative assumption as equipment is likely to last longer (7 to 10 years according to manufacturer/WFP).

Cost figures are based on real implementation costs (pilot unit, August 2011 to March 2012 - data from WFP's reporting costing sheet dated from June 2012) and related assumptions. We considered a base monthly cost of US$ 0.60 (30 Rupees) per kg - in accordance with the total cost of operations in the pilot unit - over which we added costs related to the units' financial sustainability: financial costs corresponding to the loan repayment over a period of 5 years add up to US$ 1,831 per month; an additional staff member (manager for finance, administrative, planning aspects) was included-according to the current project manager's recommendations for setting up independent units - which adds a salary of US$ 200 (Rs. 10,000) per month to labour costs. Tax on profit was applied in some of the scenarios. Different monthly production volumes were considered in the scenarios. For the analysis of the long-term sustainability and calculation of future values, a discount rate of 7% was considered as a conservative assumption.

Scenarios

Four scenarios were tested. In scenario 1, the selling rate is US$ 0.69 (Rs. 34.57) per kg and the production volume is fixed at 30 metric tons per month (which are the price and volume currently described in the pilot unit's contract). In this scenario, no tax on profit was taken into account. The annual costs, revenues and profit remain the same over the coming years. The profit is fully kept as financial reserve during the first 5 years. We considered that machines and the plant have to be replaced after 5 years and that the need for investment at the end of the 5th year is equal to the investment in Year 0, converted into future value (US$ 62,394). In scenario 2, conditions are similar to scenario 1 except that we consider a tax on profit up to 30% (it is the most conservative assumption as 30% is the maximum tax rate in the country). In scenario 3, we assumed that a higher preferential pricing (US$ 0.73, Rs. 36.72 per kg) could be obtained from the government to ensure a 10% margin over the production cost. In scenario 4, the selling price is set at US$ 0.69 per kg (Rs. 34.57) but we consider that women groups gain in productivity: in Year 1, they produce on average 30 MT per month whereas in following years they produce 40 MT per month. A tax on profit of 30% is applied. The break-even point values were calculated with the formula: Break-even = Fixed costs/(Selling price-Variable Costs).

Social impact of the pilot unit

Social Impact Assessment includes the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programmes, plans, projects) and any social change processes invoked by those interventions.[7] The purpose of this component of the study was to assess the impact of the unit on the women from the self-help group and their households. We compared their current situation to their situation before the project (based on information from the project manager and the women themselves). For that, the village where the women live was visited twice and interviews were held with 8 of the self-help group members and their relatives. As per the small number of households concerned (10 women from the self-help group, plus 8 women designated as "substitutes" who work in absence of self-help group members), the findings from these interviews are seen as representative of the situation. The village counts about hundred households.

RESULTS

Functioning of the pilot unit

The unit comprises a single production line that produces a fortified blended food from wheat, soya, lentils, sugar and vitamin and mineral premix complying with guidelines from Government of India. Subsidised wheat grains are obtained from the State Food Cooperation of India (FCI)[e] after allocation by the Government of Rajasthan. Soya beans, sugar and lentils are purchased as per predefined procurement protocols. The protocols define quality criteria for raw materials, procurement process through tendering and placement of orders and receipts. Premix is procured through the GAIN Premix Facility[f]. The procurement system was found reliable, as no production disruption because of non-availability of raw material was recorded over the last 6 months. During the period considered only one raw material batch had to be returned because of unsatisfactory quality. Average costs of raw materials are provided in Table 1.

The production process begins with cleaning of the wheat and soya, which is then roasted along with lentils.

[e] FCI is a Government agency undertaking to support farmers by offering a minimum support price for their crops of rice and wheat. Farmers are therefore assured of a market for their product and may supply to the FCI at the pre-decided price. The grains thus procured are used for government-funded programs like the Public Distribution System, the ICDS and the Midday Meal Program.

[f] GAIN Premix Facility has been established by GAIN to increase the access to affordable and high quality premix.

The mix of wheat, soya and lentils is then pulverised into a powder to which sugar and vitamin and mineral premix is mixed. The process ends with packaging, wherein the product is manually packed into consumer packs. The product is named "Raj-Nutrimix" and comes in the form of a packed weekly take-home-ration meant for children 6 months to 3 years and pregnant and lactating women. The self-help group which operates the unit has 10 members, all of which belong to a Scheduled Tribe (Ninama) and belong to Baridaylab village located about 6 Kms from Banswara district HQ.

Table 1. Raw materials costs for the production of Raj-Nutrimix

Raw materials items	US$ / kg
Wheat	0.08
Soya	0.60-0.66
Lentils (Chana dal)	0.84-0.96
Sugar	0.64
Premix	2.34

Operational performance of the unit

Table 2 summarizes selected indicators characterising the unit's operations and performance. The current production volume is 1 to 1.3 MT per day, 30 to 40 MT per month. The self-help group was able to reach this production volume after a short trial period (about a month). The unit operates for 8 hours on all working days except on Sundays.

Standard operating procedures (SOPs) developed by experts are followed for production. Distribution of the product is based on orders received from the government and the product in appropriate packs is delivered to the block level, and is in-turn distributed to the ICDS centres.

Regular maintenance and cleaning of machines are done as per protocols. Losses along the production process are not formally measured; losses were observed at several steps of the production line but remain small.

Table 2. Selected performance indicators of the pilot unit in Banswara, Rajasthan. Period of activity: 8 months (from August 2011 to March 2012)

General characteristics of the unit	
Number of products	1
Number of production lines in the facility	1
Raw materials procurement system	
Number of suppliers for each raw material	3 to 4
Average time between indent and receipt of raw materials	2 days
Days with production disruption because of no raw material available	no disruption
Raw material returns because of inadequate quality, per stock supply	1 in 50 stock supplies
Availability of micronutrient powder	no disruption
Quality control checks on raw materials per batch	1 per batch supplied (15 MT)
Production system	
Production flow (metric tons per month)	30 to 40
Failure rate of the production line	no major failure
Process: automated or manual	partly automated
Quality lab: internal or external facility	external
Cycle time[†]	immediate (planned)
Finished product characteristics	
Frequency of quality control checks on finished product	1 per batch
Conformity of quality checks on final product over the last 8 months	100%
Shelf life of the take-home-rations	6 months
Delivery system	
Number of deliveries per month	1 per month
Average quantity per delivery	30 MT
Average time required to reach the point of delivery from the unit by truck	6 hours
Estimated service rate[‡]	~100%
Logistics	
Existence of a minimum stock level policy	No
Stock coverage[§]	< 1 month
Average delay between production and delivering	< 1 month

[†]Cycle time is defined as the average delay between the order and the delivery of a batch of the product.
[‡]Service rate is defined as the percentage of products delivered on time and complying with definition (in terms of quantity and quality).
[§] Stock coverage is defined as the number of days of delivering in stocks.

Table 3. Investment expenditures for the setting up of the pilot facility. US$ 2011

Cost items	US$
Plant cost	36'000
Electrification cost	1'100
Diesel generator set	9'000
Trolleys and pallets	1'300
License costs	200
Investment total	47'600

Table 4. Detailed breakdown of the costs related to the operations of the pilot unit. Source: WFP costing sheet June 2012

Cost items	US$ cents per kg	% of total cost
Raw materials	36	60%
Utilities[†]	6	10%
Packaging materials	5	8%
Labor[‡]	3	5%
Freight	3	5%
Depreciation[§]	2	3%
Industrial site rental	2	3%
Contingencies	2	3%
Other costs[¶]	1	2%
Quality control	1	2%
Total	60	

[†]Utilities (diesel and electricity)
[‡]Labour (10 women from the self-help group, 1 factory technician, 2 guards)
[§] Depreciation (calculated on 7 years)
[¶] Other costs (insurances for plant and equipment and accident cover, license, disposable material, wastage, repair and maintenance)

Internal quality is ensured through following strict protocols during handling of raw materials and finished products, processing and packing as per SOPs. External quality controls are done on composite samples from every batch of raw material and finished product by an external quality lab; tests are done on microbiological and physico-chemical parameters, and nutritional values. No non-conformity on finished product was found so far. However, there is no policy on how to deal with negative test results and its consequent impact on disrupting supplies as well as the financial impact on revenues due to write off of the product.

Supply to ICDS has been regular and on time. The service rate (percentage of products delivered on time and complying with definition) is close to 100%. However there is no defined stock management policy.

The product is appreciated by consumers. All stakeholders asked were positive about the taste and quality of Raj-Nutrimix.

Economic viability of the pilot unit

Investment expenditures include plant cost, electrification cost, purchase of a diesel generator set, license costs and small material and amounts to US$ 47,600. Detail of the investment expenditures are provided in Table 3. Table 4 presents a detailed breakdown of the unit operations' costs. Main cost drivers are raw materials (60% of the total monthly cost), utilities (10%), packaging (8%) and labour (6%). Total cost is 0.60 US$ per kg of fortified food. 20% of the costs are fixed costs; 80% are variable costs.

The State Government has granted a preferential price of US$ 0.69 (Rs. 34.57) per kg to the unit, in view of the women empowerment component of the model and the need for additional support for ensuring the unit's economic viability. This therefore ensures a margin of US$ 0.09 in the current conditions (13% of the selling price). The contract with the ICDS was dealt at 30 MT per month, ensuring a revenue of 20,700 US$ per month to the unit. The unit has a break-even percentage of 57%.

Social impact of the pilot unit

All self-help group members are from the same tribal group belonging to households who are classified as below the poverty line. All women interviewed considered the production unit as a good opportunity given that outside of the unit, economic opportunities are scarce. As families adopt different livelihood strategies, the impact of having a household member working at the unit is different on each family. However, they all mention or show higher income stability and better ability to meet their needs. Income gained from the unit (120 rupees per day per woman, 25 days a month) appears to be spent on household expenditures (food, health, education, clothes) and also allows some households to take loans for developing additional assets. An increased sense of leadership, self-confidence and ability to take initiative was noticed from the women's part. There was initial hesitation or resistance by the men in the families to allow women to operate this enterprise, which was overcome through discussions and assurances of steady income.

Enterprise model

In the simulation of units set up on loans (by adding financial costs and additional human resources) costs for loan repayment and interest become a major cost item (9% of the total monthly cost), other main cost items being: raw materials (53%); utilities (9%); packaging materials (8%); and labor (6%).

Table 5 shows the cumulated profit after 5 years in each of the 4 scenarios. Economic projections show that, in the 4 sets of conditions, women groups are able to repay a loan taken for setting up a unit within 5 years maintaining the units' viability. The break-even point is reached after 8 months or 248 MT (scenarios 3 and 4) to 10 months or 304 MT (scenarios 1, 2 and 4).

In scenarios 1 and 2, in which the production volume is 30 MT per month, the total cost per kg is US$ 0.66 (33.05 rupees). At the same time, the selling price is set at US$ 0.69 (Rs. 34.57) per kg, leaving a margin of 4%. Fixed costs account for 25% and variable costs account for 75% of the cost per kg; therefore, increasing production volume is highly favourable to viability. If production increases to 40 MT (such as in scenario 4), the cost is reduced to US$ 0.62 (31.01 rupees) per kg and the margin goes up to 10%. In the pilot unit, women rapidly gained

Table 5. Set of conditions in scenarios 1 to 4 for the simulation of economic viability of units set up on loans and cumulated profit after 5 or 8 years. All figures in 2011 US$

	Conditions							Cumulated profit after 5 or 8 yrs	Estimated capital need for replacing equipment after 5 or 8 yrs
	Selling price	Volume (MT per month)	Total cost per kg[†]	Margin[‡]	Break-even (months)	Per Annum profit	Tax on profit		
Scenario 1	0.69	30	0.67	4%	10	10 931	No	*End of Yr 5:* 62,860	62,394
Scenario 2	0.69	30	0.67	4%	10	10 931	30%	*End of Yr 8:* 78,503	76,435
Scenario 3	0.73	30	0.67	10%	8	26 441	30%	*End of Yr 5:* 106,441	62,394
Scenario 4	0.69	30 in yr 1 40 in next ys	0.67 0.62	4% 10%	10 8	10, 931 in yr 1; 34m 205 in next yrs	30%	*End of Yr 5:* 116,338	62,394

[†]Figures are based on data collected in the pilot unit.
[‡]Calculated as the difference between selling price in each scenario and total cost.

in productivity and were able, after 6 months of activity, to produce 40 MT per month within the same amount of working hours instead of 30 MT at the start of the activity, which encourages considering this option to ensure units' viability. With a production volume of 30 MT, the selling price must be increased to US$ 0.73 (Rs. 36.72) to ensure a 10% margin (scenario 3).

As explained in the Methodology section, we considered that the need for investment (in new machines and equipment) in Year 5 is US$ 62,394. Without tax on profit (scenario 1), the cumulative profit after 5 years is enough to cover the need for investing in new equipment. When profit is taxed, maintaining economic viability of the units requires either increasing years of activity before replacing equipment (scenario 2), increasing production volume (scenario 4), or increasing selling price (scenario 3).

The study found that, in the 8-month period since its commissioning, the pilot unit in Banswara has been effective in producing and delivering quality fortified supplementary food to the ICDS. The unit produces about 30 metric tons per month of a supplementary food product that is delivered to the ICDS in a neighbouring block, reaching over 8000 beneficiaries. In the current conditions, the unit is economically viable: total cost (including salaries) build up to US$ 0.60 (Rs 30) per kg whereas the ICDS provides US$ 0.69 (Rs 34.57) per kg. It must be noted that the unit has provided significant economic opportunities to the members of the self-help group and improved their households' livelihoods.

Economic projections tend to show that similar units can be set up on loans, are profitable and able to repay their loan in 5 years. In the scenarios tested, units generate enough profit to build financial reserves covering the estimated capital need for replacing equipment after 5 years (US$ 62,394 in future value) to 8 years (US$ 78,503 in future value). The cumulated profit that is still available for dividends, reserves, cash availability, etc. goes up to more than US$ 50,000 in the more favourable scenario (scenario 4); therefore, if the women entrepreneurs decide to distribute most of the profit as dividends, they would receive ~US$ 5,000 each over the period of 5 years.

In summary, such units are viable at the pricing indicated in the report.

DISCUSSION

Supplementary feeding programs are a common form of intervention for addressing malnutrition, and India's ICDS has one of the largest supplementary nutrition programs in the world, in terms of coverage and funding. However, important gaps remain in the implementation of the program. A recent evaluation of ICDS by the Planning Commission[8] concluded that although 81 per cent of children below 6 were living in areas covered by the Anganwadi Centres, only 31 per cent children received supplementary feeding and only 12 per cent received it regularly. Evaluating production models behind the Supplementary Nutrition Program will allow better understanding of their performance, reliability and ability to strengthen the service delivery of the Supplementary Nutrition Program. This study focused on the proposition of a decentralised model made-up of small-scale industrialised units run by women groups through the examination of the operational performance and economic viability of a pilot unit and the simulation of economic sustainability of units set up on loans.

We identified some of the key factors of success for such units, among which: access to subsidised wheat; preferential pricing; access to financial services; self-help group motivation and unity and trust towards the project; commitment of ICDS for regularity of purchase and payment; supervision and support; and recurrent training. It is strongly felt that sustainability of independent units run by self-help groups will require securing these factors.

Strengths, limitations and recommendations for future studies

We collected quantitative data on economic and operational aspects, and covered social impact aspects with a qualitative approach. Data was collected through site observation and repeated interaction with the WFP project manager, the women of the self-help group, ICDS officials, Anganwadi Workers and beneficiaries in the area where Raj-Nutrimix is being distributed – which allowed

covering a variety of sources. Costs and sales analysis related to the pilot unit were obtained from a WFP reporting costing sheet, reflecting real project implementation costs. It allowed providing a detailed breakdown of investment expenditures and unit operations' costs.

A similar study was proposed by AN Maretzki et al. who have evaluated the feasibility and viability of "NutriBusiness enterprises" in Kenya.[9] They used the term "NutriBusiness" to define the cooperative engagement of women (or other community residents) in a business venture to process and market nutritious, shelf-stable foods made from locally grown crops and/or locally raised animals. They described operations of such ventures and studied economic viability through detailed assumptions on initial costs, operating costs and sales and revenues. Another paper[10] described the conditions which must prevail for a NutriBusiness enterprise to be successful. Bureaucratic cooperation, capacity building and community engagement, operational support, and availability of infrastructure were identified as some of the factors that could ensure success.

One limitation of the study is that the data for the analysis was limited to only one pilot unit, 8 months into its operations. Although we identified similar experiments of women-run small-scale industrial units for the SNP (in Madhya Pradesh, Jhabua district, by the WFP and in Indore, by the Bharatiya Grameen Mahila Sangh NGO), there was no data available in the public domain on these experiments at the time of the study. For this reason it was not possible to compare the performance of the pilot unit to other similar units.

Drawing conclusions on the feasibility and sustainability of a decentralised, industrialised model at a larger scale will require setting up and tracking performance of more pilot units. It was not possible to integrate how costs are likely to vary over time (especially raw materials costs) and from one unit to another in this study. By covering several units, future studies would get a sense of the variability in terms of feasibility, viability and performance.

It must be underlined that the cost analysis did not take into account costs for training the women and preparing them for running the unit independently. The pilot unit in Banswara has benefited from the support of a manager dedicated to the project on a full-time basis; and it is felt that this person has been instrumental in setting up the unit and sustaining the activity by providing any support needed. Future scale up modeling would need to factor in the cost of managing and sustained capacity building as the women self-help groups would require long term support. Funding and organisation of trainings is still to be defined for a sustainable model at scale. Support provided to future pilot units for starting the activity, initial training and running operations should be documented (which was not the case in a systematic way for this first pilot unit) and its costs evaluated. It will be possible to reduce costs of training, awareness generation and other similar activities through organising common trainings and communication campaigns.

An important assumption was made in the simulation of economically independent units on access to finance and credit (for the amount needed for capital investment, with no initial contribution) which still needs to be verified.

In the context of the FANTA project, Maggie Huff-Rousselle et al conducted an evaluation of decentralised models for the SNP [11]. They described the diversity of decentralised food models used for the supply of food for the ICDS and analysed their financial viability and operational performance. They also provided highlights on the impact of decentralised models on the ICDS core program and described implications for replication and scale-up. Among the decentralised models studied, the assessment concluded that a model based on small-scale industrialised units run by women self-help groups offers many advantages as it is "more effective, robust, transparent and provides more of the crucial spill-over benefits". The example provided of this model in Madhya Pradesh demonstrated that state-wide scale-up can be done successfully. Policy decisions were found as the main factor to affect the success of such units.

In the future, cost structure, monthly and annual economic performance of the first pilot unit and of future units should be tracked and used to understand better how such units evolve in their first years of activity. Also, future pilot units should be set up on loans to allow understanding better how they can achieve economic independence and long-term sustainability, as well as to confirm the optimum for working capital availability. Discussion on optimum organisation of the units (number of self-help groups to be involved and shares distribution) were mentioned to the survey team and are still on-going. Complete evaluation of the potential of the model at scale would demand to collect the opinion of high-level stakeholders such as ICDS officials and the Government of Rajasthan.

Operational performance of suppliers certainly affects the service delivery of the SNP. However, it must be underlined that suppliers deliver the food to the ICDS at the block level, and that the regularity of distribution of the food to the beneficiaries also depends on ICDS' ability to organise the supply chain from the block level to the Anganwadi Centres and on the competency of the Anganwadi Workers to distribute it to the right beneficiaries with the adequate frequency. In addition, it has been largely recognised that the limited success of the ICDS in making a significant dent in reducing child malnutrition results from poor targeting of the program and lack of attention towards nutrition and health education versus food supplementation [12].

The assessment of the pilot unit's performance is encouraging. Based on data available (one pilot unit, 8 months of activity), small-scale industrialised units seem to be technically feasible and can be economically viable, although more pilot data is needed to identify and evaluate parameters ensuring units' viability and feasibility. Understanding of the feasibility of a decentralised, industrialised model at the State level also requires more research, especially in terms of resources needed, allocation and organisation. The relevance of the industrialised, local production system proposed comes from its conformity to the Supreme Court's recommendations on food quality standards and from its potential to provide economic opportunities locally; however it should not be overemphasised, as only 10 women per unit are concerned.

There is a need for assessing the performance, merits and applicability of other ICDS' production models through a complete review. It will allow identifying models that are the most reliable and that ensure high quality (safety, nutritional value and acceptance), leading to improved service delivery and potentially to greater impact of ICDS on children nutrition.

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AUTHOR DISCLOSURES

All authors declare that there was no conflict of interest in this paper, and that no author is directly or indirectly affiliated to any profit making units that may be related to conflict of interest.

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Original Article

Production of fortified food for a public supplementary nutrition program: performance and viability of a decentralised production model for the Integrated Child Development Services Program, India

Clémentine Antier MD, Salil Kumar CA, Sadhana Bhagwat MD, Rajan Sankar MD

Global Alliance for Improved Nutrition (GAIN), New Delhi, India

生產營養強化食品為公眾補充計畫：印度整合兒童發展服務的去集中化生產模式的成果及可行性

印度整合兒童發展服務的營養補充計畫，涵蓋全國超過 1 億名的兒童、孕婦及哺乳婦。每天供應 3-6 歲的兒童一餐熱食，6-36 個月的幼兒、懷孕婦女及哺乳婦則提供可帶回家的口糧。整合兒童服務面臨提供一個包含品質、規律性及相當規模服務的艱鉅任務。不同的州政府採用多種採購及分發食物策略，特別是帶回家的口糧。代理採購或分發食物的中間商或承包商，從由女性團體為食品製造者的大型食品製造廠直接採購。印度最高法院，透過 2004 年的指示，鼓勵政府聘僱女性團體生產補充食物。印度營養補充計畫是女性團體經營的小規模工廠的去集中化生產模式，本研究旨在評估其營運績效、經濟的永續性以及對社會影響。透過觀察、訪談、及與利害關係者的小組討論收集資料。營運績效是透過分析包括產品的一致性、符合品質標準的程度及分送規律等標準績效指標。經濟生存力的評估包含成本結構分析、五年預測及財務比率。以質性方法評估社會影響。前驅研究已證實它的營運績效及成本效益。需要更多的資料來評估這個去集中化模式的擴展性及永續性。

關鍵字：去集中補充食品生產、可行性、女權、印度、整合兒童服務