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FULL-LENGTH RESEARCH ARTICLE

Women as Drivers of Change for Nutrition-Sensitive Agriculture: Case Study of a Novel Extension Approach in Wardha, India

R Rukmani[1] · R. Gopinath[1] · G. Anuradha[1] · R. Sanjeev[1] · Varun Kumar Yadav[1]

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Abstract What can a case study of an initiative for empowerment of women farmers tell us about nutrition-sensitive agriculture? Through this case study, the paper highlights how women farmers act as drivers of change and manage to bring about production and consumption diversity, even in a cash crop growing region; how women farmers' groups serve as important social networks in aiding the spread of these changes; and how bundling of women's empowerment programmes with agricultural extension has the potential to promote nutrition-sensitive farming. The spread of mixed cropping practices among women farmers was crucially related to the context-specific technical guidance that was provided. Women farmers adopted different cropping pattern designs, integrating pulses, millets and vegetables with cotton/soyabean as main crops. They perceived tangible benefits in terms of enhanced availability of food grains and vegetables for household consumption through mixed cropping practices. The paper brings to light the need for the State to strengthen the agricultural extension system for scaling up nutrition-sensitive agricultural practices among small farmers.

Keywords Women farmers · Women empowerment · Nutrition-sensitive agriculture · Consumption diversity · Mixed cropping

Introduction

One of the major issues concerning India is the persistent problem of malnutrition. In 2015–2016, 38.4% of India's children, below the age of five, were stunted and 35.7% were underweight; one-fifth of women in the reproductive age group were estimated to be suffering from chronic energy deficiency while another one-fifth were obese [14]. Malnutrition is caused by diverse factors, and any effort in addressing this problem needs a holistic, multidimensional approach [30]. In a context where a significant section of the population are malnourished and are dependent on agriculture, such as in India, a pathway for addressing malnutrition by leveraging agriculture would have great potential [3, 10, 12, 23, 28].

There are different pathways through which agriculture can influence nutrition outcomes [7, 9, 32, 34]. 'Agriculture as a source of food' is a pathway that mainstreams nutrition into the farming system and is capable of bringing about direct changes in food production system. 'Agriculture as a source of food' pathway when practised in a holistic manner is the farming system for nutrition approach and is defined by M. S. Swaminathan as: 'The introduction of agricultural remedies to the nutritional maladies prevailing in an area through mainstreaming nutritional criteria in the selection of the components of a farming system involving crops, farm animals and wherever feasible, fish' [22]. A diversified food production system has the potential to diversify the consumption basket of farm families, particularly small farmers [15, 25, 27]. This is particularly so when women farmers are able to make decisions regarding the cropping pattern and choose 'what to grow and what to retain for the

✉ R Rukmani
rukmani24@gmail.com

[1] M S Swaminathan Research Foundation, III Cross Road, Taramani Institutional Area, Chennai 600 113, India

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household'. Women are important drivers of change in stimulating production and consumption diversity in rural populations. Women tend to value household nutrition more than men and are the primary decision makers on consumption diversity [13, 18]. However, women face several constraints in agricultural decision making, particularly on crop choice, as they often have little to no control or property rights over land, livestock, agricultural machinery and implements [5]. Women farmers are denied institutional credit as the title to their family land holdings is often not in their names [26]. Several of these constraints derive from the status of women in society, and improving role of women in agriculture necessarily entails the empowerment of women in multiple dimensions [19]. The bundling of women's empowerment programmes with agricultural extension thus has the potential to improve the role of women in farming, as well promote nutrition-sensitive farming.

Many studies have looked into the link between introduction of agricultural interventions and resultant increase in household availability of food and the impact on improving nutrition [23, 33]. Although strong empirical evidence on the contribution of agriculture to nutrition outcomes is yet to be built, there is an emerging consensus among academics that bringing about consumption diversity through production diversity is an attainable, sustainable goal for agriculture rather than aiming at direct changes in nutritional outcomes [31]. The Global Panel on Agriculture and Food Systems for Nutrition notes, 'Improving diets for all household members is a much more logical, reasonable, and achievable goal for agriculture than addressing childhood stunting, and it is equally important for global development' [11].

There are discussions in India on the contribution of the agricultural sector for diversification of the dietary pattern of farm households [16]. However, our understanding on feasible nutrition-sensitive approaches that enable cash crop-growing women farmers to diversify their crop production system remains limited. This paper is an attempt at addressing this gap. The paper analyses the linkages that prevail between women's empowerment, agriculture and household consumption, through a case study of an initiative for empowerment of women farmers, *Mahila Kisan Sashaktikaran Pariyojana* (MKSP), undertaken by the M S Swaminathan Research Foundation (MSSRF), which became a government-funded national-level programme in 2010.. The paper discusses how structured trainings received by women farmers on nutrition literacy and 'mixed cropping practices' motivated them to modify their cropping pattern such that household availability of pulses, millets and vegetables increased. The objectives of the paper are to discuss:

- the role of women farmers in adopting practices that enhance food availability at the household level; and
- the implications of crop production diversity on household consumption.

Materials and Methods

The MSSRF initiated the MKSP in Wardha and Yavatmal districts of Vidarbha region of Maharashtra, in 2007. MKSP aimed at strengthening the livelihoods of women farmers by building their capacities to practice agriculture in a sustainable manner, to reduce the cost of cultivation and to lower the risk in farming. This involved a range of capacity-building measures, on management of groups, sustainable agricultural practices and nutrition literacy [29] (Table 1). Nutrition literacy covered a range of aspects related to food, nutrition, health, hygiene, sanitation, safe drinking water and government entitlements. The main focus was on creating awareness on the importance of balanced diet, on the nutrients available in food items—cereals, pulses, vegetables, fruits, meat, milk, eggs—and on the scope to grow nutrition-rich crops for household consumption. Trainings on nutrition literacy involved conducting diet display, cooking demonstrations, rallies, lectures as also health camps.

In the MKSP, women farmers' group was first formed in 2008. However, the programme could increase its coverage and strengthen its activities, since 2012 with funding support from Government of India and Government of Maharashtra. MKSP expanded to cover 2000 farmers in 2012 and 3265 farmers between 2013 and 2017. The 3265 women farmers, across 60 villages, were formed into 215 women farmers' groups. A total of 2213 women farmers across 40 villages and 1052 women farmers across 20 villages were covered in Wardha and Yavatmal districts, respectively. Majority of these farmers were small holders—83% classified as marginal/small/semi-medium farmers. It is reasonable to assume that the status of farmers who operate up to 4 hectares in rain-fed areas is equivalent to small farmers of irrigated areas.

This paper uses two primary data sources collected by MSSRF—routine monitoring data collected from all member women farmers in the period 2012–2017 and a sample study of selected women farmers conducted at the end of the programme in 2017. The monitoring data recorded attendance and adoption of practices recommended at trainings conducted under the MKSP. The data were collected at first by programme staff (2012–2014) and later by progressive women farmers of MKSP called Community Resource Persons (CRPs) (2014–2017). Data collection by the CRPs involved focus group discussions (FGD) on mixed cropping practices within the women

Table 1 Classification of women farmers, in MKSP, by family land holding. *Source*: MKSP database

Size of land holding (in acres)	Number of women farmers	Percentage of members
Landless	417	12.8
Marginal (0.01–2.49)	378	11.6
Small (2.50–4.99)	1639	50.2
Semi-medium (5.00–9.99)	704	21.6
Medium (10.00–14.99)	97	3.0
Medium (15.00–24.99)	20	0.6
Large (25.00 and above)	10	0.3
Total	3265	100.0

Data on landholding pertains to one time point, during 2008 to 2013, when a woman farmer became a member in MKSP

farmers' groups in each of the 60 villages and field verification to validate the results of FGDs. Mixed cropping practices included the systems where more than two crops are cultivated together. As cultivation of two crops—cotton/soybean inter-cropped with red gram—is the conventional practice in the study area, anything above two crops is considered to be mixed cropping

The monitoring data on adoption of mixed cropping practices for the year 2016–2017 were used to draw a simple random sample of 33 farmers for an in-depth study. Quantitative and qualitative information on the operational landholding of the family for the main agricultural season of 2016–2017 was collected through structured interviews of the beneficiary farmer and senior members of their household. The data were analysed using simple statistical tools.

Results and Discussion

Structured trainings were provided to the entire set of MKSP women farmers on different elements of sustainable agricultural practices covering soil conservation, seed management, integrated nutrient and pest management and harvesting. Training sessions were routed through the women farmers' groups, providing scope for active discussion on the topic by members. Trainings adopted a participatory approach with due recognition for traditional knowledge. Trainings on mixed cropping practices focused on their benefits for enhancing the household availability of food and also as a measure to enhance soil fertility and reduce pest infestations. Study area has a history of mixed cropping (pulses, oil seeds and millets with cotton and sorghum). In mid-1980s, soyabean was introduced, and since then, the mixed cropping practices rapidly disappeared [28].

In Wardha and Yavatmal districts, cotton or soyabean intercropped with red gram was the prevalent cropping pattern when MKSP was initiated. The training provided on mixed cropping practices aimed at increasing the number of food crops in the cotton/soyabean fields, by providing guidance on suitable pulses, millets and vegetables that may be cultivated. The prevalent cropping pattern usually involves 6–8 rows of cotton/soyabean intercropped with one or two rows of red gram. The training sessions in MKSP demonstrated different mixed cropping designs: sowing a combination of black gram/-green gram/cow pea/lentil/sorghum/sesame in a separate line in between cotton rows or in red gram rows as mixed crop; and vegetables in the bunds/border area of the field. Trainings on mixed cropping practices aimed at making available a diversified range of pulses, sorghum and vegetables for household consumption. In particular, pulses as inexpensive source of plant-based proteins, vitamins and minerals were emphasised [6] (Table 2).

Analysing the data on adoption of mixed cropping practices by women farmers, it is seen that in 2013–2014, 664 reported adoption. This practice spread and by 2016–2017, 2144 women farmers were adopting this practice. This rapid increase in adoption rates of mixed cropping practices clearly suggests that women farmers have accepted this practice as a viable and beneficial one. This validates the training programme of MKSP that focused on nutrition literacy and enhancing the availability of pulses, millets and vegetables through modifications in crop production system.

In adopting the mixed cropping practices, women farmers usually adopt a scientific approach of testing the practice in a small portion of their land and making an assessment of the merit of this practice before expanding the area under this practice [29]. More often than not, the results of the trials act as a motivational factor for them to expand area under mixed cropping. This practice of trying out a technique hands-on, in a small portion of one's land, and expanding the adoption based on one's own experience

Table 2 Adoption of mixed cropping practices by women farmers, MKSP. *Source*: MKSP database

Year	Number of women farmers who adopted mixed cropping practices
2013–2014	664 (23%)
2014–2015	1708 (60%)
2015–2016	1870 (66%)
2016–2017	2144 (75%)

Figures in brackets are percentages to the number of women farmers with landholdings, i.e. 2848

has resulted in a high degree of conviction, and it is this conviction which often drives farmers to act as catalysts in motivating fellow farmers. Thirty-two out of the 33 sample farmers reported that each of them influenced an average of 13 farmers to practice mixed cropping. In this, the women farmers' groups have played an important networking role in facilitating social learning and in improving access to information among members [1, 2, 4, 17, 20]. Further, their own experiences of adopting mixed cropping practices have helped women farmers to influence their men folk.

In order to get some insights into the mixed cropping practices and understand the factors that motivate women farmers to adopt such a practice in a cash crop, market-oriented agricultural context, interviews were conducted with 33 women farmers in September 2017. The detailed survey of 33 women farmers brought out interesting results.

Pattern of Adoption

An analysis of the cropping pattern adopted by the 33 women farmer households indicates that, in general, adoption of mixed cropping practices has been confined to a portion of their field. Only nine out of 33 farmers have adopted the mixed cropping practices in their entire land holdings, of which seven were small farmers. Generally, the larger the holding size, the lower was the proportion of area under mixed cropping practices. From Table 3, it can be seen that small and semi-medium farmers have relatively larger percentage of their operational area under mixed cropping practices—79% among small farmers and 70% among semi-medium farmers. This is likely to be related to the conscious choice women farmers make, guided by their household requirement for various produces from their mixed-crop field. Mixed cropping practices usually require close supervision of crops and involve more work for the women farmers, and therefore, perhaps to reduce their drudgery to a manageable limit, they may not be adopting the practice in their entire land holding.

The food crops that were cultivated in the immediate pre-training phase by the 33 women farmers are: red gram by all 33 farmers; sorghum by six farmers; sesame by two farmers; black gram and green gram by just one farmer; and vegetables by ten farmers. With the adoption of mixed cropping practices, after training, a range of food crops (black gram, green gram, sorghum, pearl millet, maize, sesame and a variety of vegetables) have been introduced by the 33 women farmers. In 2016–2017, black gram and green gram were cultivated by 29 farmers each; sorghum, pearl millet and maize by 10, 4 and 1 farmers, respectively; sesame by ten farmers; and vegetables by 32 farmers. Thus, there is a rapid increase in adoption of pulses, millets, sesame and vegetables by farmers.

Women farmers have internalised the concept of mixed cropping system and have adopted various designs with different combinations of crops to suit to their specific context. Size of the plot, its location and household requirement for the farm produce usually determined the cropping pattern design that was adopted. There are different cropping pattern designs practised by the 33 women farmers, and interestingly each design is unique. For instance, one cropping pattern design involves cultivation of eight rows of cotton followed by one row of mixed cropping of black gram, green gram and sorghum followed by eight rows of cotton and one row of red gram. This pattern is repeated in the entire land holding; another design involves six rows of cotton followed by one row of red gram followed by six rows of sorghum, three rows of black gram and four rows of pearl millet. Here again, this pattern is repeated, and another design involves two rows of soyabean followed by two rows of green gram, one row of red gram, one row of black gram and one row of cow pea. Cultivation of vegetables between two cotton rows is a design followed by almost all farmers though the type of vegetables and extent of area under vegetables vary from one to another.

Benefits of Adoption

In the perception of women farmers we surveyed, major benefits of mixed cropping practices relate to: (1) an increase in the variety and quantity of food grains available

Table 3 Salient features of sample households practicing mixed cropping, 2016–2017. *Source*: Primary Survey, September 2017

Size class of land holding	Number of sample HHs	Average area of operational holdings/HH (in acres)	Average area with mixed cropping/HH (in acres)	Percentage of area under mixed cropping
Small	16	3	2.4	79
Semi-medium	11	6	4.2	70
Medium	6	14	6.5	47
Total	33	6	3.75	63

HH household, sample included one HH with marginal holding, and this is included along with HHs with small holdings

for consumption at the household level; (2) an increase in the scope for cash flow during the agricultural season through market sales of produce; and (3) an enhancement in soil health. In response to a question on why they were adopting mixed cropping practices, as many as 22 out of the 33 farmers who were surveyed reported they perceive all these three aspects as major benefits of mixed cropping. Of the various food crops that are cultivated in the mixed cropping systems, green gram, black gram and red gram are the most predominant and details of production and utilisation of harvested produce are presented for these crops. Though 32 out of 33 women farmers cultivate different types of vegetables, it has not been possible to collect details on production of vegetables.

From Tables 4 and 5, it is clear that the harvested produce of pulses that were introduced in the mixed cropping systems was retained for household consumption as well as used for sales in the market. Farmers cultivating green gram have retained an average of 16 kg for household consumption while those cultivating black gram have retained an average of 12 kg. On an average, a farmer retains 23% of green gram and 12% of black gram production. As regards red gram, on an average a farmer retained 16% of production. Of the 33 farmers that were interviewed, 26 reported that their household consumption of red gram remained the same even with adoption of mixed cropping practices while seven households felt their household consumption from own production had in fact increased. Of the 29 farmers that cultivated green gram, household consumption was reported to have increased due to own production, by 20 households. Similarly, of the 29 farmers that cultivated black gram, household consumption was reported to have increased in 16 cases. Thus, the practice of mixed cropping has enabled production of other varieties of pulses, in addition to the red gram that is conventionally grown, thereby increasing the household availability of a variety of pulses. Farmers clearly stated that their consumption of pulses has changed from being irregular to regular and from lower quantity to higher quantity. Farmers pointed out that high market price of pulses used to be a deterrent for purchase of pulses in the market and own production has increased household availability (Table 6).

For other intercropped varieties, retention for consumption depended on local diet. Ten out of 33 households reported cultivation of sorghum as one of the crops in the mixed cropping systems adopted by them. All the ten households have retained their produce for their own consumption (on an average, 257 kg per household) and have also shared a portion of the produce with friends and relatives while none seem to have cultivated sorghum with an intention of selling it in the market; so is the case with maize while just about 5% of total pearl millet production was sold in the market. This clearly shows that revival of

Table 4 End uses of green gram harvested produce, sample households, 2016–2017. *Source*: Primary Survey, 2017

Size class of landholding	Number of sample HHs	Utilisation of green gram produce by cultivating households (in kg)				
		Average production	Average qty retained for HH consumption	Average qty retained for seed	Average qty sold	Average qty for other use
Small	15	82.4	13.2	4.7	58.5	5.9
Semi-medium	10	44.0	19.5	3.7	19.6	1.2
Medium	4	97.5	19.8	3.0	74.8	0.0
Total	29	71.2	16.3	4.1	47.3	3.5

Other use would refer to distribution among relatives and friends as in Table 3

Table 5 End uses of black gram harvested produce, sample households, 2016–2017. *Source*: Primary survey, 2017

Size class of landholding	Number of sample HHs	Utilisation of black gram produce by cultivating households, (in kg)				
		Average production	Average qty retained for HH consumption	Average qty retained for seed	Average qty sold	Average qty for other use
Small	14	63.2	10.5	4.5	44.5	3.7
Semi-medium	9	41.7	13.3	3.9	22.2	2.2
Medium	6	303.3	14.9	0.3	288.2	0.0
Total	29	106.2	12.3	3.4	88.0	2.5

As in Table 4

Table 6 End uses of red gram harvested produce, sample households, 2016–2017. *Source*: Primary Survey, 2017

Size class of land holding	Number of sample HHs	Utilisation of red gram produce by cultivating households, (in kg)				
		Average production	Average qty retained for HH consumption	Average qty retained for seed	Average qty sold	Average qty for other use
Small	16	521.9	108.1	16.9	389.7	7.3
Semi-medium	11	704.5	149.5	24.2	496.4	34.5
Medium	6	1650.0	127.3	37.8	1471.7	13.2
Total	33	787.9	125.4	23.1	622.0	17.4

As in Table 4

millets among farmers who were traditionally accustomed to consuming millets resulted in farmers cultivating primarily for consumption purposes. The ten households that cultivated sesame retained an average of 9 kg and sold an average of 6.6 kg. Sesame was used in regular cooking and for making sweets and was not used for oil extraction. As each farm household practicing mixed cropping has introduced a minimum of two additional food crops to a maximum of six additional food crops, it is clear that the range of items that are available for household consumption from own production has increased.

Adopting mixed cropping practices that included a variety of vegetables also ensured availability of vegetables during the entire *kharif* season for household consumption. Common vegetables that are grown are chilli, lady's finger, brinjal, tomato, cucumber, ash gourd, bitter gourd, cluster beans, cow pea, field beans, fenugreek, different types of greens, edible leaves and coriander. While cultivating vegetables in the field had been a conventional practice, there has been an increase in the range and quantum of vegetables cultivated as a result of the training provided in MKSP.

In addition to enhancing the availability of food at the household level, the introduction of mixed cropping system regularized cash flow for the farmer during mid- *kharif* season. The two pulses that have been introduced in the mixed cropping system are short duration crops—green gram can be harvested in 60–65 days and black gram in 70–75 days. These crops are ready for harvest in September–October. In the conventional system, farmers cultivate cotton–red gram or soyabean–red gram and the harvested produce of cotton can be sold latest by January, soyabean by November and red gram by February. When green gram and black gram are cultivated in the mixed cropping system, it provides scope for farmers to sell the harvested produce in September–October and realise income. From Tables 4 and 5, it is clear that on an average a farmer sells 82% of his black gram production and 66% of his green gram production in the market. Thus, a substantial portion of what is produced is used for market sales and the income earned from sales has also been a motivating factor for farmers to adopt mixed cropping practices. While we have not actually estimated the actual changes to household income as a result of adoption of mixed cropping practices, farmers do not perceive a loss in income and if anything, only a gain in monetary terms is reported. Thus, the tangible benefits in terms of enhanced availability of food at the household level, an increase in cash flow as also a clear perception of positive impact on soil health have all made women farmers go back to their traditional wisdom of adopting mixed cropping practices. Further, farmers perceive that adoption of mixed cropping systems has reduced pest infestations in their field. Twenty-eight out of 33 women farmers report enhancement in soil health as an additional reason for adoption of this practice. Notwithstanding the benefits that accrue to farmers from mixed cropping, a major limiting factor for its spread is the higher possibility of wildlife attack on fields cultivating food crops [8].

Conclusions

This paper describes how systematic training to women farmers as part of the MKSP in Vidarbha resulted in a preponderant section of them adopting mixed cropping practices, integrating food crops with cash crops. Adoption of mixed cropping practices spread rapidly among women farmers as they recognised the benefits, including enhancement of household availability of pulses, millets and vegetables; scope for market sales and realisation of income much before the main harvesting period; and improvement in soil health. While just about one-fourth of women farmers adopted the mixed cropping practices in 2013–2014, the adoption rate tripled and by 2016–2017 nearly three-fourth of women farmers had adopted this practice. Introduction of black gram and green gram in the prevalent cropping pattern enhanced the availability and diversity of pulses at the household level. On an average, every farmer cultivating green gram and black gram could

retain 16 kg/annum and 12 kg/annum, respectively, for consumption purposes, in 2016–2017. This is over and above the red gram that is typically cultivated and retained for household consumption in the traditional cropping system. Although this study provides in-depth evidence of farmers internalising and operationalising nutrition-sensitive agriculture in meaningful ways, there is scope for further quantitative research to evaluate the mechanisms and impact of the programme at scale.

The case study of MKSP demonstrates that various complementary interventions aimed at building the capacities of women farmers such as dissemination of nutrition information and appropriate technical advice on suitable cropping pattern designs based on traditional knowledge have been crucial for making small farmer households adopt recommended nutrition-sensitive agricultural practices. Focused measures that facilitated farmer-to-farmer extension in MKSP helped women to become drivers of change and bring about production diversity leading to consumption diversity. Women farmers' groups facilitated social learning among members.

Based on the MKSP experience, policies to promote nutrition-sensitive agriculture can gain by focusing on small farmers, preferably women farmers, in the following areas:

- Dissemination of nutrition literacy;
- Provision of context-specific technical guidance on feasible, doable cropping pattern designs that integrate nutritious crops without greatly altering the prevalent cropping pattern. In this, tapping the traditional knowledge would be crucial;
- Provision of seed support, at the initial stages, for the new crops that are introduced.

The paper in bringing to light the role that can be played by an agency such as the MSSRF in promoting nutrition-sensitive agriculture among a set of target farm households also highlights the need for the State to strengthen the agricultural extension system for scaling up such good practices among small farmers in India. Adoption of nutrition-sensitive agricultural practices by small farmers would require an extension system that has a constant engagement with small farmers, understand the field realities and provide context-specific technical advice. Further, the State has a crucial role to play in providing nutrition literacy and making available quality inputs and credit for small farmers.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

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