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CONTENTS

Technology adoption and productivity enhancement in groundnut cultivation: An impact assessment of farm women groups

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ABSTRACT: Agriculture sector as a whole has developed and emerged with the infusion of science and technology. Women play a crucial role in agricultural development and allied fields. The extent of women's active involvement in agriculture varies greatly from region to region. It is also estimated that 45.3% of the agricultural labour force consists of women, but a large number of women have remained as invisible workers. This study focuses on impact of farm women groups on groundnut cultivation. The sampling design followed was simple random sampling. Sample of 240 Farm women was interviewed, 180 from member of Farm Women Group (FWG) and 60 from Non-member Farm Women. It was observed that well trained women were aware of loss in productivity. The improved groundnut production technology gave 38 per cent higher yield, generated 71 percent more income and reduced unit cost by 16 per cent. Farm women from groups follow proper way of doing the activities required while adopting technology and at proper time as they remained focused compared to men. The reason for non adoption by other women was lack of awareness and knowledge compared to trained women.

Key words: Farm women group, Groundnut cultivation, Impact study

Groundnut (*Arachis hypogaea L.*) is an important oilseed crop in India which occupies first position in terms of area and second position in terms of production. In India, Groundnut is grown over an area of 7.5 million hectares with total production of 9.3 million tonnes and an average productivity of 1.4 metric tons per ha. China is the largest producer as well as consumer of groundnut in the world with 171.50 lakh tonnes in 2017-18 followed by India (91.79 lakh tonnes), United States (32.81 lakh tonnes), Nigeria (24.20 lakh tonnes) and Sudan (16.41 lakh tonnes)(*Directorate of Economics and Statistics, 2019*).In India its cultivation is mostly confined to the western and southern states, *viz.,* Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu and Maharashtra where 70% of the area and 75% of the production are concentrated in these five states. In Tamil Nadu, the area under groundnut cultivation was 3.2 lakh hectares in 2015-16 with a production of 4 lakh tonnes. Thiruvannamalai, Villupuram, Vellore, Namakkal, Salem, Erode and Cuddalore are the major groundnut producing districts in the state.

Over the last 25 years, studies on the role of women in agriculture contributed to a basic understanding of the increasingly complex human dimensions of food production, farm management structure, and rural development. Work participation rate among women declined from 63 per cent in bottom quintile to 43 per cent in top quintile income group. The lower employment and high unemployment among landless farmers shows the importance of land for providing employment in women (Reddy and Kumar, 2011).Women sometimes could not benefit from technological change because new technology was not introduced to them due to the notion that women were not really responsible for farming. Persistently, certain technologies were introduced to male farmers even though women were in reality primarily responsible for the particular crop or task.Global research experience demonstrates, gender is a critical variable in the social analysis of technology promotion and in the constraints and success of technology adoption. The role of women is critical in the well-being of farm households (Gupta, 1987).

One of the study conducted by ICRISAT in Zimbabwe, men preferred improved varieties, while women seek out the open pollinated varieties. The underlying reasons for different preference is that women have less access to the credit and cash required for certified seed and fertilizer. Share of farm women in agricultural operations like land preparation is 32%, seed cleaning and sowing (80%), inter cultivation activities 86% and harvesting-reaping, winnowing, drying, cleaning and storage (84%). Women are involved in all aspects of agriculture, from crop selection to land preparation, sowing, planting, weeding, pest control, harvesting, crop storage, handling, marketing,

and processing (Fabiyi *et al.,* 2007). That is why, the importance of developing farming technologies relevant to women has been recognized (Damisa *et al.,* 2007).The adoption of package of groundnut technologies (including new land preparation and planting methods, seed treatment, fertilizer use and irrigation) recommended for farmers in Maharashtra has led to aggregate increase in female labour demands. Kolli and Bantilan (1997) studied the gender-related impacts of a crop and resource management technology package in Maharashtra, India. The study indicated that to ensure effective and committed involvement of men and women in agriculture, views and perceptions of both men and women of the farming communities needed to be incorporated during technology generation and development

Farm Women Groups (FWGs), generally consisting of 15 to 20 farm women, some trained, some not. These groups had gradually evolved into Self-Help Groups (SHGs). They were given training in group formation as well as in specialized training in both agriculture and other income-generating activities. If adoption of modern varieties and fertilizer depends on the access to land, labour, or other resources, and if in particular context men tend to have better access to these resources than women, then in such a context the technologies will not benefit men and women equally. Policy changes thus may be needed to increase women's access to the key resources; alternatively, it may be desirable to modify research efforts by deliberately targeting technologies that are particularly suited for the resources available to women. The fundamental issue is that it is important to examine both the nature of technology itself and the physical and institutional context in which the technology is implemented in order to predict whether it will be adopted successfully by women as well as men. The objective was to assess whether training farm women group increase the agricultural productivity and technology adaptation thereby increasing farmer's welfare through groundnut cultivation.

MATERIALS AND METHODS

The sampling design followed was simple random sampling. From each selected district, taluk and revenue villages a list of farm women group details was prepared after consulting agricultural officials, panchayat authorities, peoples' representatives. In the first stage, based on cropping intensity, the districts shown in Table 1 were selected.

From each district, 30 members of farm women group and 10 non members of farm women group were selected randomly to assess the technology adoption and the productivity changes. Totally a sample of 240 Farm women's were interviewed, 180 from member of Farm Women Group (FWG) and 60 from Non-member Farm Women during 2015. Primary data was collected using structured questionnaire through interview schedule method. Secondary data were collected from Agriculture Department, Commissioner of Agriculture, Tamil Nadu and Joint Director of Agriculture, Coimbatore, Tamil Nadu.

Table 1: Selection of Sample Respondents in Numbers

S. No	District	Member of Farm Women Group (Number)	Farm Women (Number)	Total (Number)
1	Coimbatore	30	10	40
2	Erode	30	10	40
3	Thanjavur	30	10	40
4	Ramanathapuram	30	10	40
5	Thiruvannamalai	30	10	40
6	Villupuram	30	10	40
	Grand Total	180	60	240

The number of groundnut cultivators was derived from the total respondents. Awareness and adoption level were calculated only for groundnut cultivators. Role and participation of gender in labour activity, time and decision making behavior in technology adoption were collected. To find out impact on technology adoption and productivity changes, economics of groundnut cultivation and level of technology adoption verses recommended technology packages for groundnut cultivation by women groups were calculated. Finally for impact on livelihood, income distribution of women from groups was also compared with ordinary farm women.

RESULTS AND DISCUSSION

i) Demographic details of the sample respondents.

The demographic details of the sample respondents are shown below:

It could be inferred from the Table 2, that two-third of respondents were more than thirty five years old *i.e.* economically active population. Education status shows that all were literates. Intermediary school educated women were high in member of women groups than non-members. Fifty per cent were having less than 10 years of farming experience and 33-45 per cent of them were having less than 25 years. Almost 80 per cent of women's main occupation was only agriculture.

ii) Land area under groundnut cultivation and number of adopters of groundnut production technology

Among the women farmers groups, only 33 per cent of farmers grew ground nut and 88 per cent adopted the improved ground nut technology as shown in Table 3.

Table 3 reveals that among FWG majority of the farmers (46.67%) had more than 2.5ac of land under groundnut, followed by 36.67 per cent having 2.51 to 5.0 ac. The

Table 2: General Profile of Sample Farmers **(N=240)**

S.No	Category	FWG (180)		FW (60)	
		Number	Per centage to Total	Number	Per centage to Total
1	Age Distribution (years)				
	a. < 35	47	26.11	10	16.67
	b. 35-45	110	61.11	38	63.33
	c. 46-60	21	11.67	12	20.00
	d. >60	2	1.11	0	0.00
2	Educational Status				
	a. Illiterate	0	0.00	1	1.67
	b. Primary	23	12.78	17	28.33
	c. High school	62	34.44	15	25.00
	d. Secondary	66	36.67	17	28.33
	e. Degree	29	16.11	10	16.67
3	Family Size (no)				
	a. Up to 3	34	18.89	6	10.00
	b. 4 – 6	134	74.44	49	81.67
	c. >6	12	6.67	5	8.33
4	Family type				
	a. Nuclear	125	69.44	35	58.33
	b. Joint	55	30.56	25	41.67
5	Farming Experience (years)				
	a. <10	106	58.89	31	51.67
	b. 11 to 25	60	33.33	27	45.00
	c. >25	14	7.78	2	3.33
6	Occupational Status (in numbers)				
	a. Agriculture as primary occupation	150	83.33	49	81.67
	b. Agriculture as secondary occupation	30	16.67	11	18.33

(FWG = Farm Women Group, FW =Farm Women)

Table 3: Number of Adopters of Groundnut Production Technology **(N=90)**

Particulars	FWG (60)		FW (30)	
	No	%	No	%
Number of groundnut growing households	60	33.33	30	50
Number of technology adopters	53	88.30	18	60
Per centage of farm households growing Ground nut by land holding size < 2.5 Ac (Marginal)	28	46.67	15	50
2.51 to 5.00 (Small)	22	36.67	10	33.33
5.01 to 10.00 (Medium)	9	15.00	5	16.67
> 10 Ac (Large)	1	1.66	0	0
Per centage of groundnut growing households adopting Groundnut Production Technology	60	100	30	100
< 2.5 Ac (Marginal)	27	75	8	44.44
2.51 to 5.00 (Small)	19	87.2	6	33.34
5.01 to 10.00 (Medium)	7	76.59	4	22.22
> 10 Ac (Large)	0	0	0	0
Total	53	100	18	100

(FWG = Farm Women Group, FW = Farm Women)

majority of the sample farmers had marginal and small size of land holding under groundnut. Among the growers 75-87 per cent adopted improved production technology. Groundnut growers and adopters were less in non-members compared to women groups.

iii) Gender role in groundnut production

Kolli and Bantilan (1997) identified the following indicators with strong implications for gender due to the introduction of the Groundnut Production Technology (GPT). These indicators are a) labour-activity pattern and time allocation, b) decision-making behavior of men and women with regard to resource use and utilization of crop products; and c) user perspective - differential perceptions of men and women with implications for technology development.

It could be inferred from the Table 4, that gender activities performed in groundnut cultivation indicate that men alone participate in selection of variety, land preparation, seed treatment, weeding, plant protection measures, transportation and stacking fodders in the case of both categories of farmers. Whereas, the women participation is important in the activities like field cleaning, chemical fertilizer application, hand weeding and harvesting (Singh and Vinay, 2013) in both categories of farmers. It is noticed that the joint participation of men and women in the activities like sowing seeds, irrigation, watching, harvesting of main crop and harvesting of fodders in farmers and similar results was expressed in control group as well.

Women from groups followed proper way of doing the activities by adopting technology at proper time as they remained focused compared to men which is important for increasing yield in trained group. Use of power-operated shellers reduces the cost of shelling considerably. Enriched farm yard manure, seed hardening, rhizobium treatment, micro nutrient application, raised bed planting, plant population and gypsum application boosts the groundnut cultivation. While some of the additional grain

Table 4: Gender Role in Groundnut Production(% participation)

S.No	Activities	FWG (N=60)			FW (N=30)		
		Male	Female	Joint	Male	Female	Joint
1.	Decision on selection of groundnut crop cultivation	33.7	5.3	61.0	52.4	0.0	47.6
2.	Selection of variety	78.0	22.0	0.0	63.6	11.4	29.0
3.	Field cleaning	40	13	57	38	8	54
4.	Clod crushing	75	25	0	67	33	0
5.	Ploughing	100	0	0	100	0	0
6.	Harrowing	100	0	0	100	0	0
7.	Preparation of BBF/ridges and furrow	36	9	55	85	15	0
8.	Seed selection & storage	13.3	55.7	31.0	33.9	44.1	22.0
9.	Transport of organic manure	58	17	25	78	4	17
10.	Application of organic manure	64	9	27	0	0	0
11.	Chemical fertilizer (basal)	8	77	15	0	67	33
12.	Chemical fertilizer (top dressing)	13	73	13	0	100	0
13.	Seed treatment	62.4	24.2	13.5	73.8	4.2	22.0
14.	Sowing seed	0.8	14.6	84.6	14.3	8.3	77.4
15.	Gap filling	11	11	78	100	0	0
16.	Irrigation (Sprinkler)	58	8	33	88	0	12
17.	Hoeing	81	14	5	100	0	0
18.	Hand weeding	0	90	10	6	94	0
19.	Application of gypsum, borax, zinc, etc.	43	47	10	65	25	10
20.	Spraying of pesticides	92	0	8	93	7	0
21.	Watching	11.7	11.7	76.6	9.3	8.5	82.2
22.	Harvesting main crop	7	10	82.5	10.4	5.5	84.1
23.	Picking pod from plant	2.5	77.0	20.5	0.0	69.2	30.8
24.	Packing and transport	63	13	25	65	0	35
25.	Marketing	87	7	7	95	5	0
26.	Purchasing inputs	92	8	0	95	5	0
27.	Transport of fodder	69	8	23	78	4	17
28.	Fodder collection from field	15	15	69	36	8	56
29.	Stacking of fodder	57	5	38	33	0	67
30.	Shelling pods and sorting kernels for seed	13	27	60	17	0	83

production is used for household consumption, a major share is sold and the cash income is controlled by men. Men were mostly concerned about financial viability of the technology while women were found to perceive the advantage of the new technology options(Begum and Yasmeen, 2011) in terms of workability and implications for drudgery and occupational hazards.

iv) Comparative analysis of economics of groundnut production per hectare among women farmers and farm women groups

To assess the economics of Groundnut cultivation, costs have to be related to the returns as shown in the Table 5.

Trained farm women applied gypsum and micronutrient for increasing productivity and their net income by Rs. 18613. This explicitly showing productivity changes and incremental benefits of adopting technologies by women groups and thereby increases livelihood of farm women. Hence it is possible to increase production if women are trained (Amin *et al.,* 2009; Khan *et al*.,2012; Begum and Yasmeen, 2011).If farmer use their own seed from previous crop they can avoid purchasing seed at exorbitant cost in the season. There is a need to consider the distinct needs of both men and women in prioritizing varietal traits. Similarly these differences may also affect varietal adoption patterns and seed marketing strategies.

v) Level of technology adoption and recommended technology packages for groundnut cultivation

Land management and Raised bed furrow (RBF) /Broad bed furrow (BBF) are an important operation for conserving moisture, pod development and good germination with 1.5-m bed preparation. Raised bed furrow / Broad bed formation was adopted by 47 per cent of the farmers. Among these, only 76 per cent adopted fully. They require implements specific to form raised bed and also requires more labour. Hence they go for broad bed furrow instead of RBF. Ninety per cent of FWG followed timely operations compared to other FW. Around 70- 80 per cent of FWG members adopted technologies like seed hardening, Enriched Farm Yard Manure (EFYM), gypsum and micronutrient applications compared to very low level among other FW. Seed hardening is done to

Table 5: Economics of Groundnut Production per hectare (Rs/ha)

S.No	Cost details	FWG	FW	Difference
1.	Land preparation costs - One tractor ploughing	500	500	0
2.	One bullock ploughing	1440	187.5	1253
3.	Land leveling @10 men		360	-360
4.	Seed cost - 125 Kg seed per ha	3750	4537	-787
5.	Soil preparation	555	0	555
6.	FYM & application	375	375	0
7.	EFYM	1250	1753	-503
8.	Bio fertilizers & application	56	0	56
9.	Seed treatment & seed hardening cost - 1/4 litre chlorpyriphose	125	125	0
10.	Sowing cost - 6 women labour	600	750	-150
11.	Gypsum & application	660		660
12.	Micro-nutrient & application	850		850
13.	Weeding cost - Two times	1500	2250	-750
14.	Irrigation cost	375	375	0
15.	Fertilizer cost	1224	2000	-776
16.	Pesticide cost	500	625	-125
17.	Harvest (6 x 14 days)	12600	9000	3600
18.	Cleaning and shelling	500	500	0
19.	Total cost	26860	23212	3648
20.	Output quintals	22.22	12.37	10
21.	Per quintal cost	2100	2100	0
22.	Haulm output per acre is 1 to 3.5 tones cost @300/t	2500	1050	1450
23.	Gross returns per ha	49162	27027	22135
24.	Expenditure	26860	23337.5	3523
25.	Net profit per ha	22302	3689.5	18613
26.	Benefit Cost Ratio (BCR)	1.83	1.16	0.67
27.	Cost of producing one kg of Groundnut	12.09	18.77	-6.68

(Positive sign indicates the women group value is higher).

withstand drought conditions, reduces seed requirement and helps in better germination thereby maintaining optimum population and increase in yield.

Seed treatment involves subjecting the seeds to bio-control agents, Rhizobium and phosphobacteria. Treat the seeds with biocontrol agent *Trichoderma viridi* @ 4g per kg of seeds just before sowing. If the seeds are treated with biocontrol agent as *Trichoderma*, such seeds should not be treated with fungicide. Fungicide seed treatment must be done 24 hrs earlier to Rhizobium seed treatment. Timelines of these operations is also important which is well understood by members of FWG than non-members. Hence it is included that both adoption of recommended dose and time of adoption among FWG was high and it contributed in increasing productivity of groundnut.
Enriched FYM combined with rhizobium increases the yield to a tune of 500kg to 1000 kg. Enriched farmyard manure @750 kg/ha can be used for higher yields of groundnut as alternatives to farmyard manure. This is important for optimum NPK availability and to preserve moisture in the root zone for longer time for drought resistance. It helps to reduce cost of input, application cost and helps to manage unavailability of required bulk quantity of FYM.

Micronutrient deficiency is very important cause for reducing yield to 10 -15 per cent. The maximum yield of 1.52 t ha^{-1} was obtained with soil application of Zn, B and Mo. This treatment produced the maximum shelling percentage of 72 per cent and oil content of 38.4 per cent. Sahu *et al.* (1991) reported that groundnut significantly responded to Mo application, producing 32.1 per cent higher yield than recommended NPK dose. Soil application of Zn + B + Mo registered the highest net return (Rs 11010 ha^{-1}) and increased the benefit-cost ratio 12.5 kg per ha of Micro nutrient mixture with sand to main filed on the surface immediately after sowing. Applying nitrogenous fertilizers and phosphotic fertilizers improve the development of roots and pods. Potash application develops resistance in the plant for pest and disease and also for drought. This crop requires more of phosphorous than other fertilizers.

The data from the study reveals adoption of components ranging from 35 to 100 per cent. In order to achieve maximum productivity, farmers adopted the components of the package to varying levels depending upon their resources. Informal discussions with farmers revealed that non-availability of gypsum and micronutrients were the main reason for their comparatively lower level of adoption. The generation of good quality seed material from the crop, by selection and segregation, for re-use or sale, emerged as an important activity related to the technology package.Farm women group members were aware of not only advantages but also loss of not adopting

Table 7: Recommended Package of Practices of Technology Trained by Department

List of technology	Recommended dose	Purpose	Expected Yield increase
Enriched farm yard manure preparation	10 N+25 P +30 K + 750kg FYM / hectare	Loosen the soil in order to facilitate good pod development, contains more per centage of nutrient compare to FYM.	EFYM +Rhizobium increases 30 % yield
Seed hardening	25g of KCl in 25 lit of water for 6 hrs	Helps to withstand drought, reduce seed rate, better germination and ensures required population hence increase yield.	Mean pod yield increases by 20 per cent over untreated
Seed treatment with Rhizobium	3 packets/ 55 kg of seed	Increases pod development by fixing atmospheric nitrogen.	yield increase of 5.5-17.1%
Micro nutrient application	12.5 kg MN mixture with sand- application of zinc sulphate @ 10-50 kg or 0.02% foliar spray	Produced the maximum shelling outturn of 72% and oil content of 38.4%	32.1% higher yield than recommended NPK dose.
Raised bed planting	—	Conserve moisture, better pod development and goodplant population	5% increase in yield
Plant population	33 hills/Sq.m.	Getting good yield with recommended dose of inputs. Less than optimum population leads to weed problem.	Increase 11.3 % of yield
Gypsum application	200kg /ha of gypsum on 40-45th day after sowing and earthing up is to be done.	Calcium -pod setting and development. Sulphur improves the oil content	15 % increase in yield

Source: Crop production technology, Government of Tamil Nadu

Table 8: Distribution of Farm Women group and Farm Women according to Income and Expenditure

	Yield Kg/ha	Frequency		MeanYield Kg/ha		Income Rs./ha		Expenditure Rs/ha		Profit	
		FWG	FW	FWG	FW	FWG	FW	FWG	FW	FWG	FW
1	<1500	2.7	29.4	1491	1275	31311	25500	26860	23337	4451	2163
2	1501-2000	25.3	51.4	1928	1579	40488	31580	24667	24954	15821	6626
3	2001-2500	32	19.2	2440	2096	51240	41920	25812	24194	25428	17726
4	>2500	40	0	3030	0	63630	0	26350	0	37280	0
	Mean			2222	1238	46667	24750	25922	18121	20745	6628.8
	Difference				985		21917		7801		14116

technology effectively. Both adoption of recommended dose and time of adoption among FWG was high that is contributed for increasing productivity of groundnut.

vi). Distribution of farm women group and farm women according to income and expenditure

The difference between sample groups was also confirmed by the Table 8 to show how income and expenditure distribution among farm women and farm women group.

Adoption of the technology had positive impacts in terms of higher gains, yield and income, better farm prices, and saving of important inputs. The technology generated employment (particularly for the female labour force) and improved labour productivity. Farmers also modified the technology options according to their needs, convenience, and resource endowments. In comparison to the prevailing technology, the groundnut production technology gives 38 per cent higher yields, generates 71 per cent more income and reduces unit cost by 16 per cent. Higher yields from GPT allowed households to diversify use of the products of the groundnut crop. In this process, women gained control over the products retained for household use. Initial benefits in the form of higher profits and income were reinvested in order to obtain long term benefits and to stabilize the farming system.

Problems in cultivation of groundnut

Farmers are reluctant to invest in fertilizers and pesticides because of the risk involved in raising rainfed groundnut crop due to uncertainty in rainfall during the crop period leading to instability in production and productivity and widely fluctuating price pattern due to intense speculative trade in groundnut. Hence, seed hardening is recommended by using KCl (Potassium Chloride).Non-availability of bulky FYM and increases both purchase and application cost and so recommended to go for Enriched FYM @750 kg/ha. If price support is offered to the farmers, they may invest on inputs like fertilizers and pesticides and increase productivity. Shelling of seed-pods by manual labour is a costly operation. The sowing period is short and the market price of seed is very high at sowing time. Harvesting by pulling out plants is another operation requiring considerable manual labour. The large number of labourers engaged in stripping of groundnut pods may considerably be reduced using mechanical strippers. Groundnut diggers operated with bullocks or tractors have to be popularized to reduce the harvesting costs. Better methods of drying and storage of seed-pods, better pod and seed selections and seed treatment with fungicides may lead to reduction in seed rate per hectare. Line sowing also facilitates inter cultivation with bullock-drawn implements and reduces cost on manual labour for weeding.

CONCLUSION

Research on the adoption of the groundnut crop management technologies suggests the complexity of efforts to measure impacts of technological change on gender and family welfare. Literature suggests that technologies targeted toward the needs of women will have a greater likelihood of improving family food security broadly and child nutrition in particular. Survey evidence suggests aggregate production and income gains which seem to improve the welfare of both men and women. The ultimate distribution of benefits is difficult to measure. In tracking benefit flows from technology adoption, it is thus necessary to establish relationships between different factors and interventions, which are likely to affect the flow of benefits as well as the groups who may benefit. The investment on fertilizers and plant protection has to be increased so that higher productivity is achieved and the cost of production is reduced. It was observed that a stream of benefits flowed to adopters due to changes resulting from the use of the Groundnut production technology innovation. These include direct benefits (i.e., benefits measured in terms of increases in on farm groundnut yields and income) and indirect benefits (i.e., changes in community welfare and farming system viability).

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