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Comparative performance and gender appraisal of random and line planting in paddy (*Oryza sativa*) cultivation

K PONNUSAMY[1], JYOTI NAYAK[2], ANANTA SARKAR[3], M P S ARYA[4] and MANORANJAN PRUSTY[5]

Directorate of Research on Women in Agriculture, Bhubaneswar, Odisha-751 003

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Transplanting of rice (*Oryza sativa* L.) in puddle fields is one of the prominent activities of women in India (Das 2003). Although improved methods of planting such as line planting, two-row rice planter, four-row rice planter, machine planting and direct paddy drum seeder have been introduced and popularized with incentives, random planting (conventional planting) continue to be practised and difficult to be replaced despite several advantages of improved methods of planting. Since women are outsourced to perform transplanting by the land owners (rice farmers), it is imperative to feel that gender has a significant role to adopt improved methods of planting due to varied perceptions and field realities. The transplanting activity results in physiological, economical and sociological overburden of work in season on women (Singh and Tiwari 2009). The paddy productivity in Odisha was 1 616 kg/ha as against national productivity of 2 239 kg/ha during 2010-11 (Department of Agriculture and Cooperation 2012). In this backdrop, an experimental study was conducted to understand the relationship between gender, agronomical and socio-economic dimensions of random planting versus line planting in rice cultivation and work out modalities in incentivizing a cost-effective transplanting technology for improving rice productivity.

Directorate of Research on Women in Agriculture (DRWA) adopted a village namely Giringaput in Khurda district of Odisha for a project on "Technology application and gender mainstreaming in agriculture to develop a model village".

Rice is a major crop cultivated in 400 acre in both *kharif* and *rabi* seasons in Giringaput village. The gender analysis indicated that women continued to perform conventional method of rice transplanting which is a time consuming and drudgery prone activity and also help them to secure a livelihood for specified duration. Based on the matrix analysis to choose a cost-effective improved method of rice transplanting, line planting was chosen to compare the different parameters with random planting method traditionally practised by women.

DRWA brought the Department of Agriculture (DoA), Government of Odisha to Giringaput village in its efforts to popularize line planting in the year 2012 during *kharif* season under "Bringing Green Revolution to Eastern India" —a flagship programme of Government of India, 'Pallishree'— a Non-Governmental Organisation (NGO) was identified by Odisha government for implementing line planting in parts of Khurda district. Accordingly, DRWA, Pallishree and DoA mobilized 210 farmers to carry out line planting in 270 acres.

DRWA organised a training on gender and improved methods of paddy cultivation on 13 July 2012 wherein all stakeholders participated. Fifty farmers and 50 women agriculture labourers were indentified for monitoring of farms and collection of different parameters. Random planting with the adopted farmers and neighbouring farmers was considered as control so that field level comparisons were possible by both researchers and respondents. A semi-structured interview schedule was used to collect the primary data from both farmers and women agriculture labourers. The collected data were analyzed using appropriate statistical software.

Women participation in line transplanting of paddy (Table 1) indicated that two-third of them involved in pulling out seedlings (68%) and making bundles of seedlings (65.60%). However, four-fifth of men was involved in carrying seedlings from nursery to main field. While males either farm owner or men agricultural labourers also helped in stretching rope for line planting, transplanting was predominantly done by women (98.80%). This reflects stereotypical gender roles and load of women were found to be maximum in line planting of paddy.

[1]Principal Scientist (e mail: ponnusamyk@hotmail.com), [2]Senior Scientist (e mail: jyotinayak44@gmail.com), [3]Senior Scientist (e mail: ananta8976@gmail.com), [4]Principal Scientist (e mail: omarya_nrcwa@rediffmail.com), [5]Technical Assistant (e mail: manoranjan.ouat@gmail.com).

Table 1 Women participation in line transplanting of paddy (Mean values)

Activity	Women labourers (%)	Standard Deviation
Pulling out seedlings	68.00	30.57
Making bundles of seedlings	65.60	22.42
Carrying bundles to main field	19.80	23.52
Distribution over field	47.00	12.16
Actual planting	98.80	5.94
Stretching rope for line planting	51.00	21.40

Table 2 indicated that line planting consumed 20% more time as compared to random planting. Similar trend could be noticed in usage of excess labour in line planting as perceived by both farmers and women labourers.

Table 2 Technical parameters (Mean values) in random planting (RP) versus line planting (LP)

Parameters	RP	LP	P > | t |
No. of hours/acre	73.30	84.20	<0.0001
No. of persons required/acre	12.04	13.92	<0.0001
No. of seedlings used/hill	3.68	2.36	<0.0001
No. of hills/sq.m	53	44	<0.0001
Space maintained between plants (cm)	9.92	13.30	<0.0001
Space maintained between lines (cm)		19.40	<0.0001
No. of times bending/hr	12	25	<0.0001
Average transplanting time (min/day/person)	375	375	
Remaining in bending position in standing water (min)	337	307	<0.0001

It was also noticed that number of seedling per hill was minimum in line planting and slightly higher space was maintained between plants in line planting. Both category of respondents perceived that line planting had higher expenditure to the tune of ₹ 2 100 to 2 500/acre. This indicates the more manpower usage resulting in enhanced expenditure in paddy cultivation and perceived as disincentive by section of the farmer respondents.

Musculo skeletal disorders results in reduced working capacity and productivity (Hagberg *et al*. 1995). Intensity of musculo skeletal problems while performing the line planting in paddy cultivation was recorded in a five point score varying from 1-5, i.e. 1 for very mild and 5 for very severe discomfort in the affected parts. It can be seen that magnitude of discomfort was highest in midback (Mean score = 4.5), while lowest in ankle (Mean score = 1).

Changes in physiological cost of respondents before and after the activity revealed that before line planting the maximum heart rate was 92 beats/min and energy expenditure was 5.7 kj/min. After completion of work, heart rate was found to be maximum 123.4 and energy expenditure was 10.9 kj/min. Hence heart rate had increased. So also the mean heart rate after completion was 103.4 beats/min and energy expenditure was 9.6 kj/min. It indicates that heart rate during work increases over heart rate at rest when the activities are being performed by the farm women. It gradually increases when the activity is initiated to a certain period that steadily stabilizes as the period increases. Saha *et al.* (1979) furnished acceptable work load for Indian workers as work using 35% of maximum oxygen consumption capacity and at this load the corresponding heart rate would be around 110 beats/min. Thus the line planting activity was within acceptable limit. As per the classification of work given by Astrand and Rodalh (1977) heart beats in the range 90-110 beats/min is graded as moderate. Hence the activity of line planting was graded as moderate work.

Table 3 indicated that farmers could get an additional 20% more yield and income by adopting line planting and benefit cost ratio was also found be positive. Wide spacing give plants more time and space for tillering and root growth (Satyanarayana 2004) which could possibly increase the yield in line planting of paddy.

Gender differences could be observed as per the differential perception of farmers and women labourers (Table 4). The conventional planting was requiring less labour as compared to line planting. Women rated random planting as easy as they could plant the seedling as per their will whereas space maintenance between plants is critical in line planting than conventional planting. Random planting was consumption of time and thereby achieving less labour expenditure. These advantages were perceived as more helpful during labour shortage period. Per day wage disparity between

Table 3 Comparison on economic parameters for random planting and line planting of paddy

Economic parameters	Random planting	Line planting
Cost of transplanted activity/acre (₹)	1 778.60	2 099.00
Cost of weeding/acre (₹)	900	750
Grain yield (kg/acre)	1 200	1 500
Gross return (₹/acre)	12 000	16 000
Average cost of cultivation (₹)	9 000	10 800
Net profit (₹)	3 000	5 200
Benefit: cost ratio	1:33	1.48

Table 4 Perceived advantage of conventional planting

Perceived advantages	Farmer (%)	Labour(%)
Suitability for labour shortage time	28	18
Less labour requirement	62	22
Less labour expenditure	58	36
Quick planting	32	40
Easy planting	34	62
High yield	2	

Table 5 Perceived advantages of line planting in paddy cultivation

Perceived benefits	Land owners (%)	Women labourers (%)
Plants get more sunlight	20	00
More tillering and panicle	48	16
More grain and straw yield	24	00
Easy for weeding	60	76
Easy for pesticide application	54	28
More aeration	24	00
Presence of less weed	28	12
Easy for harvesting	12	36
Less labour cost for weeding/fertilizer and pesticide application	10	00
Aesthetic value	06	00
Easy for machine operation	16	04
Equal distribution of fertilizers/ nutrients to each plant	06	00
Less seed rate	08	00
Easy eye inspection for pest monitoring	18	00

male (₹ 200) and female labour (₹ 150) was also observed.

Although farmers felt the increased expenditure due to adoption of line planting as disincentive, the hidden advantages of line planting were explicitly expressed by the farmers at the time of data collection (Table 5). Women perceived weeding as comfortable farm activity. Farmers also experienced more tillering and panicle due to better photosynthesis activity and thereby resulting higher yield of grain and straw. Incidentally 10% of farmers could feel reduced labour usage in line planting in paddy fields.

SUMMARY

Promotion of line planting alone is likely to increase 15 to 20% paddy yield as per the results of present study. In fact, the area under line planting in the ensuing *rabi* season has increased significantly from the normal *rabi* season area in the village. Men involved mostly in carrying seedling to main field (80.20%) and stretching rope for line planting (49%). Line planting consumed 20% more time and expenditure as compared to traditional random planting. Ergonomical parameters such as musculo skeletal discomfort (highest in midback and lowest in ankle), physiological stress (heart rate 88.7 to 103 beats/minute) and grip fatigue were within the acceptable range. Advantages of line planting outweighed the disadvantages. Despite strong extension delivery mechanism and incentives as rendered by government under several schemes, farmers are yet to catch up with even least cost technological interventions. More popularization efforts and reinforcement mechanisms are critically required for realizing higher paddy productivity and profitable agricultural systems in the country and thereby ensuring sustainable and prosperous livelihood.

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