CUSTOMIZED ROW MARKERS: AN INNOVATION ENHANCING FOOD SECURITY AND REDUCING DRUDGERY IN TRIBAL COMMUNITIES OF KORAPUT TRACT, ODISHA, INDIA

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Abstract: Millets and rice serve as major cereal crops in the tribal communities of Koraput tract, Odisha, India. Low agricultural productivity due to adverse agro-climatic conditions, rainfed agricultural system and absence of scientific agronomic practices threaten food security in this hilly terrain. To augment productivity, an initiative under crop intensification through line sowing in millet and paddy was taken up. The row marker developed by Indian Council of Agricultural Research, India needed customization to meet local requirements. The revised row markers were employed in millet and paddy cultivation in community participation. Need based capacity building programmes were conducted with constant technical support and social mobilization. The present paper attempts to study the contribution of customized row markers towards food security and reduction of drudgery in the tribal communities of Koraput tract. Use of customized row markers enhanced productivity, reduced drudgery in line sowing/transplanting and generated additional employment for agricultural laborers.

Keywords: Drudgery; Food security; Row marker; Sustainable Agriculture; Tribal farmer

INTRODUCTION

Agriculture is the primary occupation of tribal communities in the hilly terrain of Eastern Ghat mountain range, Odisha, India. *Poraja, Kandha* and *Penthia* are native tribal communities of this land with rice and millets as their staple food. The traditional agriculture is distinguished by rich agro-biodiversity, small landholding and absence of farm mechanization and irrigation facilities. Aberrant monsoon in a rainfed agricultural system added uncertainty to agricultural productivity and food security in this mountainous tract. Climate change in recent years with adverse agro climatic conditions were regarded as major hurdles for improving farm productivity and enhancing food and nutritional security [1]. Low literacy rate and poor financial condition of the farmers further limited the challenge of improvement in productivity. These socioeconomic conditions highlighted the necessity for introduction of simple, affordable and user-friendly technologies suitable for undulating topographic regions.

The traditional practice in paddy cultivation involved broadcast sowing of seeds in upland and transplanting of seedlings in medium and low land. The cultivation of finger millet (*Eleusine coracana*) and little millet (*Panicum sumatrense*) in upland engaged broadcast sowing [2]. This resulted in irregular interplant distance leading to unequal availability of nutrients because of uneven plant density per unit area. Weeding was difficult and labour intensive under this agricultural practice. Absence of weeding at regular intervals further decreased the availability of nutrients to the crop due to the presence of a substantial weed population competing with the crop for soil nutrient availability. This vicious cycle affected the production and the productivity of food grains negatively [3]. The population growth with shrinking agricultural land area threatened the sustainability of cultivation of cereal crops.

Figure 1: Row marker in use

Figure 2: Line sowing of millets using row marker

MATERIALS AND METHODS

To enhance agricultural productivity, crop intensification in paddy and millets was introduced by line sowing in upland and line transplanting only in case of paddy in medium and low land. Scientific cultivation practices in pure crops and intercrops of millets were promoted with an objective of facilitating conservation, cultivation, consumption and commerce of nutritious underutilized millets. Line sowing in upland paddy was encouraged to increase production and productivity of the most widely consumed cereal crop in this hilly terrain for alleviating poverty and malnutrition. This required an innovative approach to develop a light weight agricultural equipment for row marking. Sound social mobilization and technology transfer demonstrations in participatory mode with the tribal communities were employed for higher effectiveness of this agricultural intervention.

The multi furrow row marker developed by Indian Council of Agricultural Research, India needed some modifications to suit to local conditions. The original design consisted of a cross bar attached to three tines for marking three rows at a time [4]. The modified version is comprised of a stainless steel bar with nine tines having a row spacing of 25 centimeter. The nine centimeter long tines are curved inwards with an effective depth of operation of five centimeter. The width of coverage is two meter marking nine rows simultaneously. This structure is attached to two hollow galvanized iron rods of two meters length to be drawn manually. This customized light weight multi furrow marker weighed twelve kilograms. It could be drawn by a male farmer covering on an average 0.11 acres per hour (Fig.1). Ten row markers were introduced in six tribal villages of Kundra block in Koraput district, inhabited by 243 households. Yield enhancement trials demonstrating scientific practices were conducted in farmers' fields in participatory mode (Fig.2). Use of scientifically recommended seed rate and thinning to regulate plant population were followed.

Table 1: Cost benefits analysis of pure crop and inter crop trials in finger millet and pure crop trials in paddy

Particulars	Method of practice	Gross return (INR /Hectare)	Cost of cultivation (INR /Hectare)	Net return (INR /Hectare)	Increase in net return over farmers' practice (in %)
Finger millet (Pure crop)	Improved practice	13509.90	11099.37	2410.53	137.35
	Farmers' practice	7453.15	6437.55	1015.60	-
Finger millet (Intercrop)	Improved practice	14532.15	10461.14	4071.01	194.45
	Farmers' practice	7344.56	5961.99	1382.57	-
Paddy (Pure crop)	Improved practice	38862.69	20609.42	18253.27	43.68
	Farmers' practice	22432.07	9728.83	12703.24	-

(INR is Indian National Rupees).

Table 2: Reduction of drudgery of farm laborers

Sl. No	Particulars	Sowing in millets and paddy		
		Farmers' practice (per hectare)	Initial attempt under improved practice (per hectare)	Improved practice (per hectare)
1	Name of the instrument	Broadcast sowing	Hand hoe using a rope tied to two sticks on both ends	Row maker
2	Performed by (Male/Female/Both)	Male	Both	Both
3	Human days required (8 working hours/day)	One	Eight	Three
4	Differences between farmers' practice and improved practice	Least expensive, involves minimum human labor	More expensive, involves more human days, backache reported by laborers	62.5% saving of time in comparison to initial attempt under improved practice
5	Productivity	Low	High	High

Table 3: Labor involved in line sowing in finger millet (in upland per acre)

Sl No	Activity	Number of laborers involved under farmers' practice	Gender of laborers involved	Number of laborers involved under improved practice	Gender of laborers involved
1	Broadcasting	1	M	-	-
2	Line sowing	-	-	8	M(1)+F(7)
3	First weeding	12	F	10	F
4	Thinning	-	-	9	F
5	Second weeding	8	F	8	F
6	Third weeding	-	-	8	F
7	Harvesting	4	F	4	F
8	Threshing	8	M (1)+F (7)	10	M(1)+F(9)
	Total	M (2)+ F (31)		M (2)+ F (55)	

(M denotes male laborer, F denotes female laborer)

Table 4: Labor involved in line transplanting in paddy (in medium land per acre)

Sl No	Activity	Number of laborers involved under farmers' practice	Gender of laborers involved	Number of laborers involved under improved practice	Gender of laborers involved
1	Transplanting	18	F	22	F
2	First weeding	8	F	8	F
3	Second weeding	8	F	8	F
4	Harvesting	13	F	13	F
5	Transporting	4	M	5	M
6	Threshing	3	M	5	M
	Total	M (7) + F (47)		M (10) + F (51)	

Need based capacity building programmes were designed, developed and conducted to familiarize the tribal farmers with scientific agronomic interventions. Demonstration trial plots involving both farmers' practice and improved practices were evenly spread across the intervention area showcasing the contrast between the practices in the same piece of agricultural land. The trials involved the same variety of crop and seed under both the practices for a comprehensive study on the effect of scientific interventions on productivity

RESULTS AND DISCUSSION

Sustainability through increased productivity

In the first year of intervention, 24 pure crop trials and 20 intercrop trials in millets were conducted in participatory mode with the tribal farmers. The following year, the number of pure crop and intercrop trials in millets rose to 69 and 23 respectively with active participation of the community. The findings from pure crop yield enhancement demonstrations of finger millet under field conditions registered a 137% increase in the net return to the farmer. The farmers' practice in pure crop of finger millet yielded 740.2 kg/hectare where as the adoption of improved practices yielded 1345.9 kg/hectare enhancing the productivity by 81.8%. Intercropping of finger millet with leguminous crops such as pigeon pea and black gram in 6:2:6:2 ratio yielded an increased net return of 194%. Promotion of intercropping of millets with legumes further added dietary diversity to household nutrition. The productivity of paddy following farmers' practice and improved practices were 1869.33 kg/hectare and 3238.55 kg/hectare respectively which registered an average increase of 73% in paddy productivity in uplands. The practice of line sowing was most widely accepted by 53% *Kandha* farmers, followed by 39% *Poraja* farmers and 18% *Penthia* farmers.

Sustainability through reduction of drudgery of farm laborers

The traditional practice of broadcasting of seeds employed less human power than that of line sowing. To increase productivity, initially line sowing involved a basic method of use of hoes to mark lines along a rope attached to two sticks at both ends. After completing each row, the sticks had to be removed and fixed again parallel to the previous row. This was an expensive and labor intensive activity with the limitation of marking one row at a time. This also required long duration of back bending activities resulting in ache in the lower backbone. The introduction of multi furrow light weight row markers saved human labor and time reducing drudgery of farm laborers. This could be carried to

agricultural field on hilly terrain because of its light weight.

Sustainability through employment generation

Farm mechanization in agriculture usually leads to higher economic return because of increased productivity and saving from labor cost. This may result in loss of employment opportunity for farm laborers adversely affecting their socioeconomic condition. But the introduction of row markers created additional employment opportunity for semi-skilled farm laborers. This intervention generated employment opportunity for female semi-skilled laborers as the intercultural operations in agriculture such as weeding, thinning, harvesting and transplanting are usually performed by women. In case of line sowing in millets, the labor requirement increased by 73%, whereas line transplanting in paddy generated an additional labor requirement of 13%.

CONCLUSIONS

Food and nutritional security in subsistence agriculture is challenging especially under rainfed agricultural system. Tailor-made interventions keeping in view the feasibility under the regional agro-ecological parameters ensure sustainability in the future. Planning, customization, promotion, implementation and adoption of simple scientific technologies are pivotal for alleviation of poverty and malnutrition in tribal communities of Koraput. Economic and user-friendly innovations such as adoption of customized row markers contributed remarkably towards enhancing food and nutritional security in the *Poraja*, *Penthia* and *Kandha* communities. This simple innovation not only contributed towards reduction of drudgery of farm laborers but also generated additional employment strengthening local economy. This women-friendly technology significantly improved the efficiency of farm laborers attracting the attention of local media and administration. Increased productivity led to enhanced household income and dietary diversity. Skill upgradation training and in-time technical assistance with favorable support from policy makers will definitely be able to address the issues of endemic hunger and hidden hunger. Empowerment of tribal communities through adoption of pro-women, pro-nature and pro-poor practices ensure sustainable community development in the hilly tract of Koraput.

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