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Participatory variety evaluation and influencing factors appraisal for off-season cabbage cultivation on rainfed uplands of Odisha

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Abstract

A study was conducted at Krishi Vigyan Kendra, Semiliguda in Koraput district of Odisha from 2009-12 to evaluate the performance of cabbage variety 'Konark' during off-season in farmers' field. Front line demonstrations (FLD) were conducted with scientific package of improved cabbage cultivation under rainfed conditions and factors influencing its adoption were analyzed. Head yield of cabbage was higher (59%) under demonstrations as compared to farmers' practice (FP), which was 80-82% of variety's potential yield as the technology was practiced in off-season. Extension gap oscillating 101-118 qha^{-1} in yield was perceived between FLD and FP whereas average technology gap was 57 qha^{-1}. Economic analysis reveals that with marginal increase (Rs. 1700 ha^{-1}) in cost of cultivation 92% increased net returns to the tune of Rs. 1,25,585 ha^{-1} (average) were obtained. Mean extension gap (109 qha^{-1}) and IBCR (38) are sufficiently high to motivate the farmers for adoption of off-season cabbage cultivation. Correlation and regression analysis of various independent variables showed that young trained cultivators are high adopters of off-season cabbage cultivation.

Keywords: Cabbage, off-season, frontline demonstration, technology gap

Introduction

Cabbage is one of the most popular winter vegetable grown in India. It is cultivated in 0.42 mha with a production of 5.62 mt and average productivity of 23tha^{-1} (Vanitha *et. al.,* 2013). The major cabbage producing states are Uttar Pradesh, Odisha, Bihar, Assam, West Bengal, Maharashtra and Karnataka. Cabbage is used as salad, boiled and dehydrated vegetable as well as in cooked curries and pickles. Cabbage is rich in minerals and vitamins A, B_1, B_2 and C. In terms of cabbage productivity; India as well as Odisha needs a quantum jump to match Asian counterparts (Fig.1). Koraput district of southern Odisha possess a poor productivity of 15 tha^{-1} from an area of 3376 ha (production; 0.05 mt). The productivity can be raised with adoption of modern cultivation techniques and improved cultivars.

In rainfed areas, cabbage is largely grown as winter crop in irrigated patches of medium lands with perennial streams as source of irrigation. Owing to peak production in *rabi* (winter) season combined with poor storage facilities in backward tribal region of Odisha, there is market surfeit which leads to fall in sale price coupled with substantial spoilage. Summer and rainy seasons are the lean periods for cabbage production where demand remains high. In order to avoid such oversupply and spoilage, emphasis is directly needed on off-season cabbage cultivation. Thus its availability is regulated throughout year; beside the farmers can fetch premium prices. During south-west monsoon season, a larger chunk of medium sloping lands remains fallow despite of having good potential to support vegetable production even under heavy rainfall; otherwise leads to water erosion based soil-nutrient losses (Dass *et al.*, 2008). The traditional cabbage cultivars are poor performer in monsoon season due to problems of rotting, poor head formation and wilting owing to heavy rain. Likewise, farmers commonly use old degenerated seed material without any seed treatment along with imbalanced use of fertilizers. These are the major constraints leading to poor harvest.

A range of cabbage production technologies have been generated by State Agricultural Universities (SAU), ICAR institutes and other research stations in Odisha, however the productivity is low due to poor transfer of technologies from the research farms to the farmers' fields. Very little new knowledge percolates to the farmers and gap lies between knowledge production and knowledge utilization; which leads to wider technology as well as extension gaps. To bridge these gaps Front Line Demonstrations (FLD's) programme is a vital tool

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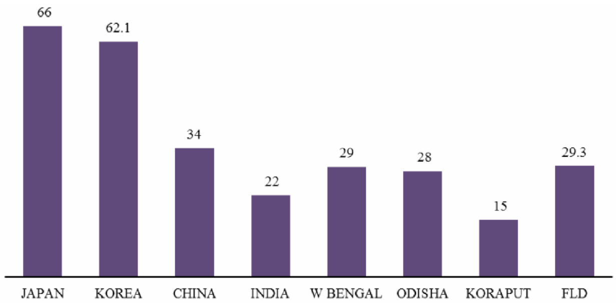

Fig. 1. Cabbage productivity (t/ha) in Asia and India (2014)

for extension agencies. Likewise FLD on cabbage cultivation for newly released early maturing, high yielding and disease resistant variety *Konark* on farmers' field may be helpful to boost cabbage production specifically in off-season. *Konark* variety is resistant to leaf blight, fungal, bacterial wilt and yields up to 35 tha^{-1} in 100-110 days after transplanting. Hence a FLD was planned to evaluate cabbage variety 'Konark' on farmers' field during off-season on rainfed sloping medium and uplands.

Materials and Methods

A total of 40 FLD's were conducted in eight villages of Koraput district of Odisha (Fig. 2) during the rainy seasons of 2009-12. Climate of the study area is sub-tropical and sub-humid type with mean annual maximum and minimum temperature of 30.6 and 17.0 °C, respectively. Mean annual rainfall of the area is 1450 mm, of which 80% is received during June to October. First of all the constraints in off-season cabbage cultivation were identified through participatory rural appraisal (PRA), farmers' meetings, field diagnostic visits and training programs. Thus based on the farmers' demand for a newly released variety (*Konark*) was evaluated using demonstration package (Table 1) along with farmers practice (FP) in same area. Before execution of FLD, each year training programs were

Fig. 2. Location of the study area.

organized for the selected village farmers to impart the technological know-how on off-season cabbage cultivation. All other steps like site selection, layout of demonstrations, farmers' participation *etc.* were followed as suggested by Choudhary (1999).

The data was collected through survey method and major tools used were exhaustive village survey, interview schedules (structured and semi-structured), in-depth discussion and secondary data sources. Taking into consideration the scope and objectives of the study, a well-structured interview schedule was prepared. Based on the result of pre-test, suitable modifications were made and a final interview schedule was prepared. All the data was collected as per extension codes following Bhairamkar *et al.,* (2011) and tabulated for

Table 1. Demonstration package and farmers' practice under FLD's in off- season cabbage cultivation

S no.	Technology component	Demonstration plot	Farmer practice
1.	Variety	Hybrid	Any variety not confirming to season
2.	Seed rate	250 gha^{-1} (hybrid)	300 gha^{-1} (hybrid)
3.	Seed treatment	Bavistine @ 2g kg^{-1} seed + Streptocycline@1g kg^{-1}	Nil
4.	Nursery management	Low tunnel/ low hut Raised bed, line sowing	Open conditions Flat sowing, Broadcasting
5.	Fertilizer application (NPK $kgha^{-1}$)	Recommended (75%N+ full P_2O_5+ full K_2O 150:125:150+ seed inoculation with Azotobacter 500g/ha+ seedling treatment with 1kg/ha Azotobacter+ soil application with Azotobacter @ 3kg/ha)	Partial (<75: <30:0, NPK)
6.	Micronutrient	Boron @ 6 $kgha^{-1}$,Lime 5 qha^{-1}	Nil
7.	Weed control	Fluchloraline@0.5 $kgha^{-1}$ + 1 hand weeding	2 Hand weedings
8.	Conservation measures	Contour ridge furrow planting, bunding	Small bunds
9.	Technical guidance	Time to time	Nil

statistical analysis. The statistical tools and tests such as percentages, mean, standard deviation, correlation and regression were used wherever found appropriate and data were analyzed systematically to draw valid inferences. The rainfall data was collected form annual reports of IISWC, Research Center- Sunabeda (Anonymous, 2014). Yield of demonstrations as well as FP (local check) were recorded and analyzed according to different parameters suggested by Verma *et al.* (2014). On the basis of prevailing market prices; income, technological and adoption gaps were calculated as following given details:

1. Extension Gap = Demonstration yield - FP yield
2. Technology Gap = Potential yield - Demonstration yield
3. Technology Index = (Pi - Di)/ Pi X 100

   Where, Pi = Potential yield of i^{th} crop

   Di = Average demonstration yield of i^{th} crop.
4. Additional Return = Demonstration return -FP return
5. Effective Gain = Additional return (Ar) -Additional cost (Ac)
6. Increment B: C ratio = Additional return (Ar)/ Additional cost (Ac)

Results and Discussion

Rainfall pattern and crop establishment

The rainfall received during the off-season cabbage cultivation is presented month wise in Fig. 3. A cursory gaze to the rainfall pattern shows its erratic trend during September, 2009 and August, 2012. On an average; 9, 17, 18, 12 and 6 rainy days aroused in June, July, August, September and October months, respectively, across the years (2009-14). With the inception of monsoon (June) heavy showers and gusty winds harshly affects cabbage nursery. This ultimately affects main crop yield with poor germination, seedling mortality and thin plant stand. Hence, much care is required in raising the off-season cabbage nursery therefore low tunnel technique of nursery raising (Thakur and Devi, 2013) was adopted. During the grand growth period (August and September) rainfall volume was sufficient to meet the irrigation demand however in 2009, a paltry rainfall (297 mm) was received which created mild stress in the standing crop. Adequate soil moisture availability during the nursery raising and transplanting paved the way for healthy crop establishment in the field. From this elucidation it can be concluded that advantage of early monsoon showers should be taken by raising seedlings in protected nursery as well as timely planting to harvest higher yield.

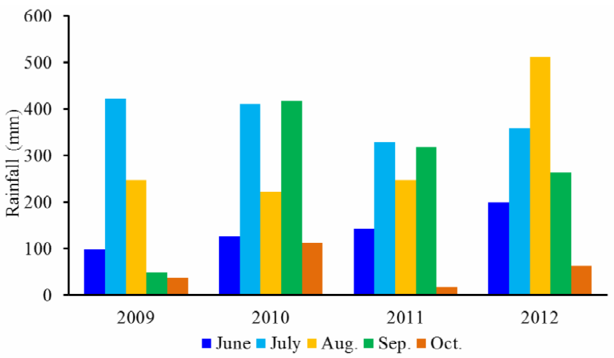

Fig. 3 Rainfall distribution during the off-season cabbage cultivation

Knowledge level of farmers

The knowledge level and perception of improved off-season cabbage cultivation was analyzed amid farmers of eight villages. Farmers' feedback was categorized into low, medium and high categories based on the score (Table 2). The total adoption score for each farmer was computed by adding up the scores of 10 point package of practice of off-season cabbage cultivation. The mean score for knowledge was 14.5 out of maximum score of 18. Majority of the cultivators were found to have medium (50%) to high (19%) level of knowledge followed by low (18%) score. This determines that initiation of off-season cabbage cultivation has boosted confidence level of the cultivators in the area. This is an encouraging finding and further efforts should be made to bring the low adopter to high adoption category.

Yield and gap analysis

Head yield of hybrid cabbage was greater (59%) under demonstrations as compared to existing FP (Table 3) which was 80-82% of variety's potential yield as the technology was practiced in off-season. Under demonstrations plots improvement in cabbage yield was to the tune of 60% (average) over existing FP. Maximum yield (298 qha^{-1}) was noted in 2010 followed in 2012 (297 qha^{-1}) which can be attributed better soil moisture availability due to adequate rainfall. An average of 60%

Table 2. Knowledge level of farmers and extent of adoption of off-season cabbage cultivation in (n = 60)

Knowledge level	Farmers
High (> 14)	19 (32)
Medium (9 to 14)	30 (50)
Low (< 9)	11 (18)
Total	60

Note: Figures within the parentheses are % to total farmers (n)

Table 3. Yield and gap analysis under front line demonstrations in farmers' fields

Year	No. of FLD's	Demo Area (ha)	Yield (qha^{-1})			Increase over FP (%)	Extension gap (qha^{-1})	Technology gap (qha^{-1})	Technology index (%)
			Potential	Demo	Farmer practice (FP)				
2009	10	0.80	350	283	175	62	108	67	19
2010	10	0.80	350	298	180	66	118	52	15
2011	10	0.80	350	296	195	52	101	55	16
2012	10	0.80	350	297	186	60	111	53	15
Average	10	0.80	350	293	184	60	109	57	16

yield advantage was recorded under FLD's which can be attributed to improved seed material, scientific technology package and practices of conservation agriculture in comparison to FP. Similar findings are reported by Mohanty (2004) and Chatterjee *et.al.* (2012). An extension gap oscillating from 101-118 qha^{-1} in yield was perceived between FLD and FP throughout years. The average extension gap was 109 qha^{-1} with lowest values was 101qha^{-1} in 2011 which is attributed to higher yield. Whereas, highest extension gap of 118 qha^{-1} was obtained in 2010 which points towards poor yield due to seedling mortality, poor nutrient supply under FP and contrary highest yield of 293 qha^{-1} in demonstration plots. Overall such gaps are attributed to improved seed material, healthy seedling nursery and adoption of improved production technology in the demonstrations (Maharana *et al.*, 2014).

Narrow technology gaps were observed during the course of demonstrations. The average technology gap of 40 FLD's for tested variety was 57 qha^{-1}, which is only 16% of variety's potential yield. Generally, the technological gap appears even if the FLDs are conducted under the strict supervision of the scientists in the farmers' fields. This may be attributed mainly to ill distribution of rainfall, variations in biotic and abiotic stresses observed across different plant growth stages. The study also showed a wide gap between the potential yield and demonstration yields, which suggests further refinement in generated farm technology. Therefore, location-specific crop management recommendations are needed to bridge the gap in potential and demonstration yields (Choudhary and Suri, 2014).

Technology index designates the feasibility of the evolved technology in the farmers' fields. Lower the value of technology index, higher is the viability of the improved technology. Technology index spun around 16% during the years FLD's. Technology index for all the demonstrations during different years was in accordance with technology gap. Effort should be made with better extension to bridge this gap with better demonstration of technology in farmers' field (Rai *et al.*, 2005).

Economic analysis

Economics of off-season cabbage cultivation under FLD's was appraised on then market prices. All the variable costs were considered in calculating the cost of cultivation and the detailed economic returns with incremental benefit cost ratio (IBCR) are presented in Table 4. It imitates that owing to improved seed, treatment, fertilizers and other inputs; the cost of cultivation in demonstration plots was higher in comparison to FP. Average cost of cultivation (2009-12) in demonstration plot was ? 41,125 ha^{-1} which is ? 1,725 higher than FP. Monetary returns are a function of yield and market price which varied along the years but showed ascending trend in progressive years (2009-12). In incites that higher market price during off-season makes improved variety cultivation a profitable endeavor. Mean net returns incite 92% increase over FP. This shows that with a small hike in cost of cultivation, worthy net returns can be obtained provided better market projections. On similar lines IBCR registered maximum values of 50 in year 2011. Enhanced fiscal returns in terms of gross, net and additional returns through improved farm technology have also been reported by Balai *et al.,* (2013). Overall, economic analysis showed that transfer of improved technology of off-season cabbage cultivation and its adoption can substantially enhance the productivity and farmers' profitability. This also provides a better livelihood option for farmers effecting rainfed farming in tribal region of Odisha.

Table 4. Economic analysis of front line demonstrations in farmers' fields

Year	Cost of cultivation (₹ ha^{-1})		Net returns (₹ ha^{-1})		Add. cost in demo. (₹ ha^{-1})	Effective gain (₹ ha^{-1})	Incremental B:C ratio (IBCR)	Wholesale market price (₹ q^{-1})
	Demonstration	FP	Demonstration	FP				
2009	39,400	38,000	1,02,100	49,500	1,400	52,600	39	500
2010	42,000	40,000	1,21,900	59,000	2,000	62,900	32	550
2011	41,000	39,800	1,36,300	77,200	1,200	59,100	50	600
2012	42,100	39,900	1,42,040	75,420	2,200	66,620	31	620
Average	41,125	39,425	1,25,585	65,280	1,700	60,305	38	568

Package of practices wise adoption

Off-season cabbage cultivation technology was sub-divided in to 10 point practices starting from across slope cultivation to head packing. On these 10 practices, feedback of farmers was obtained and adoption level of each practice was measured. The responses of the farmers (in percentage) were divided into low, medium and high category (Fig. 4). It was found that majority of the respondents were in low category for all the practices. Across slope cultivation (50%), sowing time and spacing (each 40%) and boron application (40%) were under medium adoption category. Critical practices like; seed treatment, fertilizer dose, disease pest management and head packing scored maximum under low level of adoption in comparison to other practices. Form this analysis we can conclude that, the practices which require literacy and technical guidance are not easily adopted by farmers. As off-season cabbage cultivation needs precise management starting from nursery to packing better extension approaches and demonstration are needed to increase the adoption level of diverse practices.

Relationship between adoption and selected variables

Relationship of adoption behavior with socio-personal, economic and communication variables of cultivators were studied using multiple correlation and regression coefficients. The values designated in Table 5 shows the association of different variables with off-season cabbage cultivation technology. Age of cultivators (60) was having negative but significant correlation (-0.585) with adoption at 5% level of significance. This communicates that younger the farmer, higher is the adoption. This explanation holds true for education status too, which registered a positive significant value of 0.490. However, family size and land holding were found to be non-significant. Annual income of the farmers exhibited correlation values to the tune of 0.248, which implies that financial security gives an impulsion to farmer for exploring new avenue in vegetable cultivation. Farmers with higher income from farming motivated to enhance their knowledge to further maximize their profit by applying scientific practices of farming. Another variable registering significant correlation was training experience (0.78). This incites that training and skill development had significant impact on farmers' adoption. Thus, the extension strategy should be of targeted approach of training the young farmers who had high adoption rate and old age group farmers should be educated regarding new innovations.

Higher significance values of risk orientation (0.416) displays that farmers risk bearing ability for new endeavors. Extension contact and mass media exposure play significant role in improvement and adoption of off-season cabbage cultivation. A positive significant value of extension contact and mass media exposure to the tune of 0.473 and 0.296, respectively endorses this perception. The regression analysis reveals that different independent variables; education, training, annual income and extension contact had a significant positive contribution towards adoption of off-season cabbage cultivation. Results of the study corroborate findings of Barua *et al.,* (2015) and Dutta *et al.,* (2015).

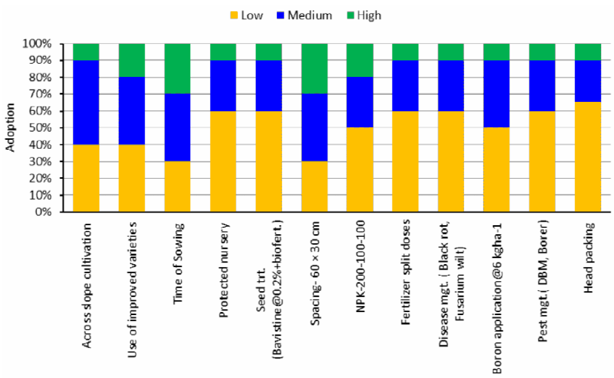

Fig. 4: Recommended package and practice wise adoption of off season cabbage production technology (n=60)

Table 5. Relationship between off-season cabbage cultivation and selected variables (n=60)

S no	Variable	Std. dev.	r value	Regression coefficient	Std. Error	t - value
1	Age	10.362	-0.585**	0.095	-0.072	0.943
2	Education	8.445	0.490**	0.574	-1.288	0.203
3	Family size	1.246	0.023NS	0.460	-0.356	0.723
4	Land holding	1.081	0.131NS	0.600	0.565	0.575
5	Training	0.813	0.248*	0.736	0.187	0.852
6	Annual income	0.666	0.945**	0.412	14.531	0.000
7	Risk orientation	1.598	0.416**	0.592	0.291	0.772
8	Economic motivation	0.928	0.511**	0.624	0.488	0.627
9	Extension contact	0.958	0.473**	0.509	1.423	0.160
10	Mass media exposure	1.095	0.296*	0.521	0.915	0.364

NS – Non-Significant, ** , * Significant at 1% and 5% level of probability, respectively

Conclusion

In rainfed uplands of Odisha, improved cabbage cultivars in combination with scientific production technologies led to an increase of the yield by 60% over existing FP. That too with the incremental increase in cost of cultivation by ?1700 ha^{-1} which even the small (progressive) and marginal farmers can afford. The mean extension gap (109 qha^{-1}) and IBCR (38) are sufficiently high to motivate the farmers for adoption of off season cabbage cultivation. FLD program was also effective in changing attitude, skill and knowledge of vegetable growers towards adoption of conservation based improved practices of cultivation in the study area.

सारांश

पत्तागोभी की प्रजाति 'कोनार्क' का बेमौसमी मूल्यांकन निष्पादन क्षमता ज्ञात करने के लिए कृषि विज्ञान केन्द्र, सेमिलीगुडा, जिला कोरापुर (ओडिशा) में वर्ष 2009–12 में परीक्षण किया गया। अग्रिम पंक्ति प्रदर्शन (एफ.एल.डी) वैज्ञानिक संस्तुतियों के आधार पर किया गया तथा इस पर प्रभाव डालने वाले घटकों का विश्लेषण किया गया। पत्तागोभी का सर्वाधिक उपज (59 प्रतिशत ज्यादा) प्रदर्शित दशा की तुलनात्मक विचार किसानों के क्रिया–कलापों से किया गया जो 80–82 प्रतिशत प्रजाति उपज की क्षमता तकनीकी बेमौसम के लिए उत्तम थी। प्रसार दूरी दोलन 101–118 कु./हे. प्राप्त हुई जो अग्रिम पंक्ति प्रदर्शन एवं कृषक पद्धति में थी जहां औसत तकनीकी दूरी 57 कु./हे. थी। आर्थिक विश्लेषण से ज्ञात होता कि बहुत कम (रू. 700/– हे.) खेती लागत में लगा, 92 प्रतिशत शुद्ध आय में वृद्धि रू. 1,25,858/–हे. पाया गया। माध्य प्रसार दूरी (109 कु./हे.) तथा लाभ–लागत अनुपात (38) जो उच्च है जो बेमौसमी पत्तागोभी की खेती को अपनाने को प्रेरित करता है। कई अनिर्भर घटक के सह–सम्बन्ध तथा प्रतिगमन विश्लेषण से स्पष्ट होता है कि युवा प्रशिक्षित कृषक बेमौसम पत्तागोभी की खेती को अपनाने के लिए उत्सुक है।

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