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Impact of front-line demonstration on yield and economics of elephant foot yam (*Amorphophallus paeoniifolius*) in Mungeli District of Chhattisgarh

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Abstract
The study on front line demonstration was conducted in Mungeli district of Chhattisgarh during 2017-2018 and 2018-2019. The demonstration was conducted at 10 farmer's field according to recommended package of practices of ICAR-Central Coastal Agricultural Research Institute, Goa. The demonstration was carried out with the objective to provide improved variety of Elephant foot yam and production technology to farmers with the aim to increase their income. The outcome of the study revealed that the average maximum demonstration practice yield was recorded 346 q /ha, whereas in farmers practice the yield was 236 q/ha. The percent increase in yield over farmer's practices was recorded 49.47. The average technology and extension gap were computed 220.50 q/ha and 118 q/ha respectively. The demonstration gave higher average net return Rs. 923250/- And B: C ratio is 2.84. The result showed that yield can be increased by adopting improved variety and recommended package of practices.

Keywords: Frontline, demonstration, technology, production, zimikand

Introduction
Elephant foot yam *Amorphophallus paeoniifolius* (Dennst.) Nicolson, belongs to family araceae is a remunerative and profitable stem tuber crop. Its origin and center of domestication was formerly considered to be India, where it is most widely utilized as a food resource in recent times. The crop is gaining popularity due to its shade tolerance, easiness in cultivation, high productivity, less incidence of pests and diseases, steady demand and reasonably good price. Tubers are mainly used as vegetable after thorough cooking. Its edible part in called corm which is modified stem. Chips are made of starch-rich tubers. Tender stem and leaves are also used for vegetable purpose dry cuttings of tuber and zimikand badi is very popular in Chhattisgarh state. The tubers are also used as medicine in many Ayurvedic preparations. Tubers contain 18.0% starch, 1-5% protein and up to 2% fat. Leaves contain 2-3% protein, 3% carbohydrates and 4-7% crude fibre. In India it is mainly cultivated in Andhra Pradesh, Gujarat, Maharashtra, west Bengal, Kerala, Bihar and Uttar Pradesh. In Indian Elephant foot yam is known by different names in different states in West Bengal and neighboring country Bangladesh it is called Ol. In Uttar Pradesh and Gujarat, called Suran, in Chhattisgarh, it is called Zimmikanda, in Tripura, it is called Batema, in Southern India, especially Kerala, it is known as Chena, in Tamil it is called Kaaraa Karunai Kizangu. The acridity and irritate state due to presence of crystals of calcium oxalates. After introduction of non acrid and high yielding variety this crop is being adopted for commercial cultivation in northern and eastern India. Elephant foot yam is a subtropical and tropical crop which requires humid and warm climatic conditions for its vegetative growth and cool and dry climate for its corm development. In India Zimikand is cultivated in area 30 '000 ha with production 774 '000 mt. with productivity of 258 q/ha (Horticulture Statistics at a Glance 2018). In Chhattisgarh state total area under Zimikand is 3046 ha with production 31604 metric ton and productivity 103.76q/ha (Horticulture Statistics 2018-2019). The major constraint of farmer's practices of Zimikand cultivation is low productivity due to the use local variety. This demonstration was framed to provide high yielding variety of zimikand to the farmers.

Materials and Methods
The front line demonstration (FLD) is a unique approach to provide a direct interface between researcher and farmers as the scientists are directly involved in planning, execution and monitoring of the demonstrations. It is the method for transfer of technology from research to the farmer's field with the objective to maximum utilization of available resources for crop

production and yield enhancement. To improve the yield of elephant foot yam with replacing local acrid variety with high yielding non acrid variety demonstration was conducted by krishi Vigyan Kendra, Mungeli during kharif 2017-2018 and 2018-2019 in ten farmer's field of Mungeli district. In this front line demonstration was carried out in an area of 0.4 ha adjacent to the farmers fields in which the crop was cultivated with farmers practice/ local variety.

The package of practices included in Improved practices were improved variety, seed treatement, seed rate, sowing method, recommended fertilizer dose, weed management, irrigation management, plant protection measures, etc. Improved variety of zimikand named Gajendra was developed at Acharya N.G. Ranga Agricultural University, Hyderabad. This variety is local selection from Kovvur area of Andhra Pradesh is able to yield 50-60 t/ha. The potential yield of this variety at Chhattisgarh is 50 t/ha (AICRPTC Centre at Raipur 2015-16, ICAR-CTCRI Kerala, India). The tubers are non-acrid, well shaped and generally devoid of cormels or propagules. Before starting the demonstration, farmers were trained with skill training on various technological interventions to be utilized in elephant foot yam cultivation. All the participating farmers were guided time to time during crop production. The sowing of Gajendra variety was done in first week of April month with spacing 90×90 cm (between plant to plant and row to row). The seeds of corms were treated with mancozeb 0.3% (3 grams/liter of water) for 25 to 30 minutes. These treated corms were dried under shade for 4 hours before planting in the field. Before sowing the pits were filled with half top soil, well decomposed farm yard manure @ 2 to 3 kg/pit and paddy straw. Recommended dose of fertilizer 200-250 q/ha FYM and NPK 100:50:150 kg/ha. The performance of crop was periodically observed by the scientist of Krishi Vigyan Kendra and advisory recommendations were followed. Data from FLDs and farmers practices were collected and analyzed to study the impact of front line demonstration. Finally cost of cultivation, net income, cost benefit ratio was calculated. Average of cost of cultivation, yield and net return of different farmers was calculated by formula:

$$\text{Average} = \frac{(F1+F2+F3.....+Fn)}{N}$$

Where,

F = Summation of all values (n).

N= No. of values.

The extension gap, technology gap and technology index were calculated using formula suggested by Samui *et al.* (2000).

Technology Gap = Pi (potential yield) – D_i (Demonstration yield)

Extension Gap = Di (Demonstration yield) – F_i (Farmers yield)

$$\text{Technology index} = \frac{\text{Potential yield} - \text{Demonstration yield}}{\text{Potential yield}} \times 100$$

$$\text{B: C ratio} = \frac{\text{Net income (Rs ha}-1)}{\text{Cost of cultivation (Rs ha}-1)}$$

$$\text{Percent increase over farmer's practices} = \frac{\text{Improved practices} - \text{Farmers practices}}{\text{Farmers practices}} \times 100$$

Results and Discussion

The data were collected and analyzed on cost of cultivation, production, productivity; gross return and net return. The productivity results of improved practices under demonstration verses farmers practice are given in Table 1. It is evident from results that the average yield of elephant foot yam (Gajendra) were 346 q/ha and 367 q/ha during kharif 2017-18 and 2018-19, respectively using improved practices however, in farmers practice the average yield were recorded 236 q/ha and 241 q/ha during respective years. The average percent increase over the farmer practice was 49.47. The results clearly indicate the positive effect of FLDs over the conventional practice. Increase in yield was due to high yielding variety, corm treatment with fungicide, timely sowing, recommended dose of fertilizer, proper and timely irrigation and plant protection measures. The results are in consent with findings of Mishra *et al.* (2016) [8] and Narayan *et al.* (2018) [9]. The difference in yield of Gajendra variety of elephant foot yam in different years may be to variation in soil moisture availability, rainfall etc.

Extension gap of 110 and 126 q/ha was recorded in Gajendra variety and farmers local variety yield. On an average extension gap in yield of two year front line demonstration was 118 q/ha during 2017-18 and 2018-19 respectively indicating the need to educate the farmers in adoption of improved technology (Table - 2) by various extension ways including block/village demonstrations in large area along with timely supply of quality inputs in technological guidance so as to minimize the technological gap in different components of elephant foot yam production technology reported in this investigation. This indicates the gap between tradition cultivation practice and improved cultivation practice. This gap can be reduced subsequently by using improved technology for production of elephant foot yam. Technology gap (Table. 2) which is the difference between potential yield and front line demonstration yield was observed 154 q/ha and 133 q/ha during year 2017-18 and 2018-19 respectively. The average technology gap in two years FLD programme was recorded 143.50 q/ha. This difference between potential yield and demonstration yield was may be due to difference in soil fertility, management skill of individual farmer and climatic condition of the area. These findings are in accordance with Mishra *et al.* (2016) [8], Narayan *et al.* (2018) [9], and Shil *et al.* (2014) [13].

The technology index shows the plausibility of the demonstration technology at farmer's field. The technology index was calculated 30.80 percent and 26.60 per cent during the year of demonstration. An average technology index was computed 28.70 percent. This proves the strength of new technology with recommended package of practices. This changes the thoughts of farmers to differentiate between conventional and improved technology and will help them to adopt this technology to increase their production and economics. The economics (Table. 3) of the crop under demonstration were determined on the basis of the observation taken during year 2017-18 and 2018-19. The economics over tow year between front line demonstration and farmer practice indicates that the cost of production of elephant foot yam under demonstration was Rs. 323000 to 326000/ ha with an average Rs.324500/ha as compare to farmers practice that is Rs. 265000 to 272000/ha with an average Rs. 268500/ha. The additional cost increased in demonstration was due to more cost included in procurement of improved high yielding variety, balance dose of fertilizer and IPM practices. These findings were in agreement with, Markam *et al.* (2019) [6, 7], Wadkar *et al.* (2018) [17] and Shil *et al.* (2014) [13]. Gajendra variety of elephant foot yam is very profitable it gave higher net return of Rs. 888000/ha and 958500/ha on respective years with an average of Rs.

923250/ha. In farmers practice this net return was calculated Rs.395800/ha and Rs. 402800/ha in respective years 2017-18 and 2018-19 with an average of Rs. 399300/ha. This is very less as compare to demonstration. The benefit cost ratio of demonstration was calculated 2.74 and 2.94 with mean 2.84 in farmers practice benefit cost ratio varied from 1.49 to 1.48 with mean 1.48, which is not that profitable in farmers practice. This is due to higher yield potential of Gajendra variety of elephant foot yam used in demonstration and improved package of practices applied during the growth period of the crop. These findings are similar of Desai *et al.* (2016) [2] Verma *et al.* (2016) [16], and Dashora *et al.* (2011) [3].

Before demonstration at the farmer's field this variety was not very well known to the farmers and they were not aware of the improved technology for cultivation of this crop. The result of front line demonstration come out with the fact the potential of improved production technology is beneficial for farmers.

Table 1: Yield and yield difference of elephant foot yam under front line demonstration.

Year	Yield (q/ha)			Additional yield over local check (q/ha)	Per cent increase over local check
	Potential	FLD	Farmer Practice		
2017-18	500 q/ha	346 q /ha	236 q/ha	110	46.61
2018-19	500 q/ha	367 q/ha	241 q/ha	126	52.28
Average	500 q/ha	356.5 q/ha	238.5 q/ha	118	49.47

Table 2: Yield gap and technology index in front line demonstrations

Year	No. of farmer	Technology Gap (q/ha)	Extension Gap (q/ha)	Technology Index (%)
2017-18	10	154	110	30.80
2018-19	10	133	126	26.60
Mean	-	143.50	118	28.70

Table 3: Economics of front line demonstrations.

Year	Cost of cultivation (Rs/ha)		Gross return (Rs/ha)		Net return (Rs./ha)		B:C ratio	
	FLD	Farmers practice	FLD	Farmers practice	FLD	Farmers practice	FLD	Farmers practice
2017-18	323000	265000	1211000	660800	888000	395800	2.74	1.49
2018-19	326000	272000	1284500	674800	958500	402800	2.94	1.48
Average	324500	268500	1247750	667800	923250	399300	2.84	1.48

Conclusion

There is wide gap between scientific practices and conventional practice in cultivation of elephant foot yam. The front line demonstration programme was effective in changing attitude, skill and knowledge of farmers regarding recent technology innovating in different research stations. The FLD initiated a significant positive result and given an opportunity to demonstrate the productivity of the new intervention under real farming situation. The demonstration study summarized that FLDs conducted by KVK, Mungeli made significant impact on horizontal spread of this technology. The net return gained by farmers participated in this demonstration by cultivation of Gajendra variety of elephant foot yam has created greater awareness and motivated other farmers to adopt demonstrated technology for production of this crop in Mungeli district. This helps to improve linkage between scientists and farmers and also enhance the tuber production, consumption, nutritional security and overall livelihood security of the farmers of Mungeli district of Chhattisgarh.

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