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Quantification of yield gaps in different planting of sugarcane in western Maharashtra

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ABSTRACT : This paper is an attempt the yield gaps analysis in different planting types of sugarcane in western Maharashtra. Results reveal that the magnitude of yield gap-I was higher, which implies that, the technology developed at research station cannot be duplicated on demonstration plots to exploit the full potential of sugarcane. This gap was attributable to environmental differences and non-transferable component of technology. The orthodox practices being followed on farmer's field lead to yield gap-II. The farmers usually do not adopt a technology as a package but take up individual practices suitably trimmed to fit into their budget and skills (management and operational) which lead to the variation in the adoption of cultural practices and consequently to the yield gaps. The yield gaps cannot be completely eliminated, but can be minimized by efficient and effective resources management.

Key Words : Sugarcane, Yield gaps, Quantification

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Maharashtra is the highest sugar producing state of India. Maharashtra sugarcane yield in 2011-12 was 80.10 tonnes /ha, much higher compared to the yield of 59.58 tonnes/ha for the second highest sugar producing state Uttar Pradesh and national average of 70.31 tonnes/ha. The average sugar recovery rate of the four sugarcane cultivation types in Maharashtra was 11.32 per cent in 2011-12; the recovery rate of Adsali sugarcane was even higher at 12.3 per cent. The average recovery percentage of Maharashtra was way above the recovery percentage of Uttar Pradesh at 9.16 per cent and all India percentage of 10.25 per cent. In terms of the land productivity adjusted for recovery rate is even higher for Maharashtra at 98.8 tonnes/ha (161.14 tonnes/ha for Adsali) compared to 61.04 tonnes/ha for Uttar Pradesh.

Of the four sugarcane cultivation types prevalent in Maharashtra, ratoon is most popular with 40 per cent cane area under it, possibly since it has shortest duration of 11 months, fitting almost perfectly with the annual October to March cane crushing season. Same can be said about Suru type, which is having duration of 12 months and coverage of 20 per cent. Adsali type has the highest yield and recovery rate, but has only 10 per cent of the sugarcane area is under cultivation, possibly due to the longest duration of 17 months. Pre-seasonal type, as the name suggests, is planted about 2.5 months before the season, and stands between ratoon and Adsali in terms of duration, yield and recovery rate (Sandrp, 2013).

Estimation of yield gaps:

The concept of yield gaps in crops originated from different constraint studies carried out by International Rice Research Institute (IRRI) during the seventies. The yield gap comprises at least two components. The first component-yield gap I is the difference between experiment/research station yield (potential yield) and the potential farm yield. The first of these cannot be narrowed, is not exploitable, and mainly owes to factors that are generally not transferable, such as the environmental conditions and some of the built-in technologies that are available at research stations or experimental farms. It is hypothesized that yield differences exist between the levels obtained at experimental or research station and the potential of the same varieties on farmers fields.

The second component- yield gap II is the difference between the potential farm yield and the actual average farm yield and provided a similar description of the yield gaps and components. The second component arises when farmer

deviates from the recommendation to achieve the agronomic yield potential. This yield gap II is exploitable and is the focus of the study. A large yield gap II implies that farmers did not fully adopt the existing technologies because they were not packaged appropriately or because economic conditions made them unattractive. A small yield gap, on the other hand, indicates that the available technologies are almost fully used. The yield gap reflects mainly differences in management practices (for example, the amount of fertilizer used, land preparation, time of the year of different practices) under similar agro ecological conditions. For example, the national average yield is not an appropriate indicator of farm-level performance because it is an average across different agro climatic zones, different soil types, different crop ecologies, crop types, and technologies. For this reason, it is important to obtain average yields from homogenous agro ecological conditions, similar to those used to measure potential yields, and also under similar production systems (technologies).

Even though large-scale verification trials and demonstrations are conducted to test the feasibility and suitability of any new technology before it is released for adoption on farmers' fields, the actual yields obtained are considerably lower than those recorded in the demonstration plots and research station farms. Several studies show the existence of considerable untapped yield potential in various crops and attribute this gap to difference in the cultural practices and differences in input use levels between the farmers' fields and demonstration plots. Application of the recommended inputs and better cultural practices are the solution for improvement in crop productivity. To narrow down the yield gap between the farmers' fields and the demonstration plots, there is a need to take up an in-depth analysis. It may not always be possible for the farmers to raise the crop productivity to the level of research stations. However, demonstration plot yield or potential farm yield level could be aimed at realistically. Hence, this study lays more emphasis on yield gap-II, *i.e.*, the difference between the demonstration plot yield and the yield of a farmer's field. To analyze the fact empirically the present study on quantification of yield gaps in different planting types of sugarcane in Maharashtra.

RESEARCH PROCEDURE

The study is based on the primary data collected during the year 2011-12 from 250 sugarcane cultivators were selected from three tehsils (Baramati tehsil of Pune, Karveer tehsil of Kolhapur and Karad tehsill of Satara) and then categorized into three groups according to operational holding of sample farmers in small (Below 2.00 ha), Medium (2.01 to 4 ha) and large (above 4.01 ha) size groups. The ratoon sugarcane cultivators were largest (47.60%) followed by adsali(24%), preseasonal (18%) and suru (10.40%). The 42.40 per cent sugarcane cultivators were from Baramati tehsil of Pune district whereas sugarcane cultivators from Karveer tehsil of Kolhapur were 26.40 per cent. Sample cultivators from Karad tehsill of Satara district were 31.20 per cent.

The differentials between the recommended and actual use levels of important inputs like seed, manure and fertilizers have been estimated. The two yield gaps have been calculated on the basis of per hectare potential yield, potential farm yield and actual yield obtained using simple statistical tools. It may not possible for all farmers to raise the crop productivity on their farms to the level of research station. However, it would be realistic to aim at demonstration plot yield (potential farm yield) level. Therefore, emphasis was given on yield gap-II and here in after simply referred as yield gap.

RESEARCH ANALYSIS AND REASONING

The results of the present study as well as relevant discussions have been presented under following sub heads:

Inputs -use gaps:

The farm sizewise average gaps in the recommended and actual use levels of inputs on of adsali, preseasonal, suru and ratton sugarcane farms are presented in Table 1.

Adsali sugarcane:

The average use of inputs such as planting material, phosphorus and potash at the overall level for adsali sugarcane was excess than the recommendations. The proportionate gap between the recommended and actual use levels of manure was the maximum at 91.14 per cent followed by nitrogen at 13.18 per cent at overall level. Considering the size groups, planting material, phosphorus and potash used were excess than the recommended levels. The maximum per cent gap in recommended and actual use levels of all input was observed in large size groups.

Preseasonal sugarcane:

At the overall level, the average use of manure, nitrogen and phosphorus for preseasonal sugarcane were below recommended. The proportionate gap between the recommended and actual use levels of manure was the maximum (83.11%) followed by nitrogen (15.91%) and phosphorus (14.72 %).

Regarding the size groups, excess planting material was used by the small and large sized farms but the gap was noticed in medium size farms (3.84%). The per cent gap in manure was the highest in larger size farm followed by medium and small size farms. Among the plant nutrients, per cent gap in nitrogen and phosphorus was more in large sized farms followed by medium and small sized farms.

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Table 1 : Gaps in the recommended and actual use levels of inputs of adsali, preseasonal, suru and ratton sugarcane

(Particulars		Planting material (qt)			Manure(qt)			Nitrogen(kg)			Phosphorus(kg)			Potash(kg)		
Adsali sugarcane																
Resource use levels		Recom.	Actual use	Per cent gap	Recom.	Actual use	Per cent gap	Recom.	Actual use	Per cent gap	Recom.	Actual use	Per cent gap	Recom.	Actual use	Per cent gap
Size groups	Small	50.00	54.24	-8.48	300.00	57.14	80.95	500.00	448.95	10.21	200.00	226.00	-13.00	200.00	233.96	-16.98
	Medium	50.00	57.26	-14.52	300.00	40.80	86.40	500.00	438.02	12.40	200.00	218.04	-9.02	200.00	222.18	-11.09
	Large	50.00	48.44	3.12	300.00	9.80	96.73	500.00	427.41	14.52	200.00	213.33	-6.67	200.00	209.63	-4.82
	Overall	50.00	51.85	-3.70	300.00	26.57	91.14	500.00	434.10	13.18	200.00	216.84	-8.42	200.00	217.34	-8.67
Preseasonal sugarcane																
Size groups	Small	50.00	54.70	-9.40	250.00	50.74	20.00	400.00	365.77	8.56	170.00	157.72	7.22	170.00	230.54	-35.61
	Medium	50.00	48.08	3.84	250.00	40.34	83.86	400.00	364.55	8.86	170.00	147.92	12.99	170.00	219.32	-29.01
	Large	50.00	53.16	-6.32	250.00	12.08	95.17	400.00	350.45	12.39	170.00	140.59	17.30	170.00	206.69	-21.58
	Overall	50.00	52.28	-4.56	250.00	42.22	83.11	400.00	336.38	15.91	170.00	144.97	14.72	170.00	213.32	-25.48
Suru sugarcane																
Size groups	Small	50.00	53.52	-7.04	200.00	23.98	88.01	300.00	329.58	-9.86	140.00	201.06	-43.61	140.00	209.15	-49.39
	Medium	50.00	48.46	3.08	200.00	20.06	89.97	300.00	288.27	3.91	140.00	187.03	-33.59	140.00	216.05	-54.32
	Large	50.00	46.86	6.28	200.00	14.79	92.61	300.00	274.42	8.53	140.00	195.47	-39.62	140.00	190.86	-36.33
	Overall	50.00	48.66	2.68	200.00	20.80	89.60	300.00	289.60	3.47	140.00	202.54	-44.67	140.00	204.78	-46.27
Ratton sugarcane																
Size groups	Small	0.00	0.00	0.00	0.00	3.17	-3.17	300.00	268.52	10.49	140.00	190.86	-36.33	140.00	184.24	-31.60
	Medium	0.00	0.00	0.00	0.00	-	-	300.00	275.17	8.28	140.00	176.12	-25.80	140.00	178.03	-27.16
	Large	0.00	0.00	0.00	0.00	0.81	-0.81	300.00	263.79	12.07	140.00	166.62	-19.01	140.00	165.20	-18.00
	Overall	0.00	0.00	0.00	0.00	1.83	-1.83	300.00	267.27	10.91	140.00	174.17	-24.41	140.00	172.30	-23.07

Note: Negative sign indicates excess use of inputs .Recom.-Recommended

Suru sugarcane:

The average use of planting material, manure and nitrogen at overall level for suru sugarcane was below recommended level whereas the use level of phosphorus and potash was more than recommended level. The proportionate gap between recommended and actual use levels of manure was the maximum at 89.60 per cent. At the overall level, the gap of 2.68 per cent between the actual and recommended use of planting material was small. Regarding the size groups, excess planting material and nitrogen was used in small farms but maximum gap was noticed in large sized farms. The per cent gap in manure was the highest in large size group followed by medium and small size groups. The excess use of phosphorus and potash was observed in all size farms.

Ratoon sugarcane:

It is evident from the table that actual use level of nitrogen were below recommended level whereas the use level of phosphorus and potash was more than recommended level. It is not recommended to use manure for ratoon sugarcane but still farmers holding small and large size farms use the manure in anticipation of higher productivity. Size groupwise analysis indicated that, per cent gap in nitrogen was more in large sized farms followed by small and medium sized farms. The use of planting material showed the excess use in all planting type of sugarcane. In the study area, sugarcane cultivators use traditional method for cultivating sugarcane.

It is interesting to note that, use of manure was far below recommended level in adsali, preseasonal and suru sugarcane due to high cost and non availability of F.Y.M. Among the various inputs of sugarcane production, excess use of fertilizers like nitrogen, phosphorus and potash by farmers in anticipation of maximising the sugarcane yield. The excess use not only increase the cost but also converts the soil to more alkaline decreasing the soil fertility thus productivity of the sugarcane.

Yield gaps:

Yield gap has two components. The first component cannot be narrowed or is not exploitable because it is mainly due to factors that are non-transferable such as environmental conditions.The second component is mainly due to difference in management practices. Yield gap (II) is manageable and can be bridged by deploying more efficient research and extension services. With the advent of new technology in agriculture, significant improvements in the crop productivity was noticed.

Table 2: Adsali, preseasonal, suru and ratton sugarcane yield levels realized and the estimated yield gaps under different field situations (Tonnes/ha)

Particulars		Types of yield gaps								
		Yield gap I= (PY-PFY)			Yield gap II= (PFY-AY)			Total yield gap= (PY-AY)		
		PY	PFY	% gap	PFY	AY	% gap	PY	PY	% gap
Adsali sugarcane										
Size groups	Small	210	160	23.8	160	126	21.4	210	125.76	40.11
	Medium	210	160	23.8	160	121	24.42	210	120.93	42.41
	Large	210	160	23.8	160	112	29.74	210	112.41	46.47
	Overall	210	160	23.8	160	117	26.83	210	117.08	44.25
Preseasonal sugarcane										
Size groups	Small	185	130	29.7	130	109	16.39	185	108.69	39.19
	Medium	185	130	29.7	130	105	19.38	185	104.8	41.35
	Large	185	130	29.7	130	98	24.87	185	97.67	44.43
	Overall	185	130	29.7	130	101	22.29	185	101.02	42.95
Suru sugarcane										
Size groups	Small	160	115	28.1	115	96	16.1	160	96.48	39.7
	Medium	160	115	28.1	115	94	18.41	160	93.83	41.36
	Large	160	115	28.1	115	90	21.94	160	89.77	43.89
	Overall	160	115	28.1	115	88	23.86	160	87.56	45.28
Ratton sugarcane										
Size groups	Small	125	110	12	110	77	30.12	125	76.87	38.5
	Medium	125	110	12	110	73	33.81	125	72.81	41.75
	Large	125	110	12	110	68	38.05	125	68.14	45.49
	Overall	125	110	12	110	71	35.34	125	71.13	43.1

Note: PY- Potential yield, PFY- Potential farm yield, AY- Actual yield

However, proper resources mix and appropriate cultivation practices become prerequisite for the adoption and success of new farm technology, which are often beyond the reach of a majority of the farmers. It is observed from Table 2 that there existed a wide gap in adsali, preseasonal, suru and ratoon sugarcane.

Adsali sugarcane:

Adsali sugarcane yield realised on the research station (210 tonnes per hectare) and on demonstration plots (160 tonnes per hectare) were significantly higher than yield on sample farms (117.08 tonnes per hectare). It is inferred that there is 23.81 per cent of yield gap between potential yield realised at research station and the yield that was reported at the demonstration plots.

This gap is nothing but yield gap I, which explains the extent of the untapped potential yield that is possible to achieve at the sample farms. Yield gap II which is the difference between the potential farm yield (Yd) and the actual yield (Ya) was 26.83 per cent. The total yield gap which indicates the difference between potential yield (Yp) and actual yield (Yp) was 44.25 per cent. Among the size groups, maximum gaps were observed in large size.

Preseasonal sugarcane:

The potential yield at research station was 185 tonnes per hectare while potential farm yield at demonstration plots was 130 tonnes per hectare. The actual yield of sample farms was 105.55 tonnes per hectare. The yield gap I for preseasonal sugarcane was 29.73 per cent and yield gap II was 22.29 per cent. The total yield gap III was observed at 42.95 per cent at overall level. Among the size farms maximum yield gap I, yield gap II and yield gap III were noticed in range of 24 to 44 per cent on large sized farms, respectively.

Suru sugarcane:

Table 2 presents the average yield performance of suru sugarcane under different field situations. It is observed from table that there existed a sizable gap in the suru sugarcane productivity between research station, demonstration plots and the sample farmer's fields. Suru sugarcane yield realised on the research station (160 tonnes per hectare) and on the demonstration plots (115 tonnes per hectare) were amply higher than on farmers fields (87.56 tonnes per hectare).The total yield gap (yield gap III) was noticed to the extent of 45.28 per cent while, yield gap I and yield gap II were 28.13 per cent and 23.86 per cent, respectively. Among the size groups yield gap II and yield gap III were maximum for large sized farms followed by medium and small size farms.

Ratoon sugarcane:

The gap between productivity of research station, demonstration plots and sample farms of ratoon sugarcane. Ratoon sugarcane yield realised on the research station farms, demonstration plots and sample farms were 125 tonnes per hectare, 110 tonnes per hectares and 71.13 tonnes per hectares, respectively. It is inferred from table that there was 12 per cent yield gap between potential yield and the potential farm yield. Yield gap II was 35.34 per cent and total yield gap (yield gap III) was 43.10 per cent at overall level. Among the farm size, as the size increased the yield gap II and III were also increased showing increasing trend.

The higher yield levels on research stations and demonstration plots were attributed to the fact that the experiments were conducted on scientific lines and were equipped with the all requisite resources including the technical input on the research station, while the demonstration trails were carried out under the supervision of agriculture extension workers. Higher yield gap I implies that greater amount of potential yield was left untapped on demonstration plots. This was attributable to the significant environmental differences and partly to the non-transferable component of technology like cultural practices. Hence, the technology developed at research station cannot be fully replicated on the demonstration plots. The results of the study are in conformity with (Gaddi *et al.*, 2002) for cotton production .

As mentioned earlier, the yield gap I is non exploitable because mainly due to differences in the environmental factors. Yield gap II can be bridged because it is mainly due to the difference in farmer's management (Bhatia *et al.*, 1994 and Aggrawal *et al.*, 2008).

Conclusion:

The magnitude of yield gap-I at overall level, was higher for preseasonal sugarcane (29.73 %) followed by suru (28.13%), adsali (23.00%) and ratoon (12.00%) which implies that, the technology developed at research station cannot be duplicated on demonstration plots to exploit the full potential of sugarcane. This gap was attributable to environmental differences and non transferable component of technology.

The orthodox practices being followed on farmer's field lead to yield gap-II at overall level. Maximum yield gap-II was observed in ratoon sugarcane (35.34%) because of poor management practices followed for ratoon sugarcane. The yield gap-II for adsali, suru and preseasonal sugarcane farms was 26.83 per cent, 23.86 per cent, 22.29 per cent, respectively.

The farmers usually do not adopt a technology as a package but take up individual practices suitably trimmed to fit into their budget and skills (management and operational) which lead to the variation in the adoption of cultural practices and consequently to the yield gaps.The yield gaps cannot be completely eliminated, but can be minimized by efficient and effective resources management. Smaller the input gaps between the demonstration plots and the farmer's fields, larger the productivity gains on farmers' fields. It is also essential to

promote collaboration among various institutions engaged in agriculture productivity (research, extension, NGOs and State Agricultural Universities and private sector) to develop appropriate technology with a view to minimize the yield gaps.

LITERATURE CITED

Aggarwal, P.K., Hebbar, K.B, Venugopalan, M.V., Rani, S, Bala, A., Biswal, A. and Wani, S.P. (2008). Quantification of Yield Gaps in Rain-fed Rice, Wheat, Cotton and Mustard in India, Global Theme on Agro ecosystems, Report no. 43, International Crops Research Institute for the Semi-Arid Tropics.

Alam, M. (2006). Factors affecting yield gap and efficiency in rice productions in some selected areas of Bangladesh, A Thesis, for the degree of Ph.D. Department of Economics, Jahangir Nagar University, BANGLADESH, INDIA .

Basavraja, H. (1988). Yield gaps and constraints in cotton production in Karnataka- An economic analysis, University of Agricultural Sciences, Dharwad (KARNATAKA) INDIA

Bhatia, R., Nakhija, V.K. and Laharia, S.N. (1994). Adoption of improved sugarcane production technology in Haryana, *Agric. Situ. India*, **48**(11): 781-784.

Commission for Cost and Prices (2011). Price policy for sugarcane-The 2012-13 sugar season, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, NEW DELHI, INDIA, 2011.

Gaddi, G.M., Mundinamani, S.M. and Basavraj, H. (2002). Yield gap and constraints in the production of *Rabi* sorghum in Karnataka – A path co-efficient analysis. *Agric. Econ. Res. Rev.*, **15**(1): 13-23.

Sandrp (South Asian network on dams, rivers and people), (2013). How efficient is Maharashtra Sugarcane crop?