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Research Article

ESTIMATION OF YIELD GAPS IN SELECTED MAJOR CROPS OF SAURASHTRA REGION

NAGANI C.M.*[1] AND SHIYANI R.L.[2]
[1]Department of Agricultural Economics, Junagadh Agricultural University, Junagadh, 362002, Gujarat, India
[2]College of Agriculture, Mota Bhandariya, 365610, Junagadh Agricultural University, Junagadh, 362002, Gujarat, India
*Corresponding Author: Email - charlsnagani31@gmail.com

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Abstract: The present study was undertaken with a view to examine the yield gaps in the major crops in Saurashtra region of Gujarat state. In all, 180 farm households were personally interviewed, spread over 12 villages of Amreli, Junagadh and Rajkot districts, for the rear 2020-21. yield gap analysis was carried out adopting the procedure developed by International Rice Research Institute (IRRI), Philippines. This investigation revealed a wide yield gap in major crops of the Saurashtra region. The average Yield Gap II was realized about 605 kg/ha in both bunch and spreading cultivars of groundnut, which ranged from 459 kg/ha in spreading to 691 kg/ha in bunch groundnut. In cotton, wheat, sesame and pigeonpea, the Yield Gap II was realized about 845, 1345, 487 and 652 kg/ha respectively. The Yield Gap I was also high in groundnut and pigeonpea. The yield gap statistics indicated that the sample farmers have harvested nearly 76, 70, 78, 70 and 52 per cent of farm potentials of groundnut, cotton, wheat, pigeon pea and sesame, respectively.

Keywords: *Yield Gap, Yield Gap I, Yield Gap II, Saurashtra region*

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Introduction

Groundnut, cotton, pigeonpea, sesame and wheat are the major crops of the Saurashtra region [Table-2]. Saurashtra occupies 83.32, 70.83, 5.20, 84.96 and 15.68 per cent share in area and 67.52, 57.15, 36.93, 4.77 and 18.19 per cent share in production of groundnut, sesame, bajra, wheat and cotton in Gujarat state, respectively [1]. All these major crops have higher productivity in Saurashtra as compared to Gujarat state. The Saurashtra region has achieved impressive growth in agriculture especially in groundnut, sesame, wheat, cotton, castor, cumin, and mango production during the last two decades. Concerns are now being raised that the existing high level of crop productivity could be sustained. In this study, the central idea of a yield gap is crucial to understand the severity of different constraints that need urgent research attention.

Material and Method

The objectives of the study, the farm household survey was carried out adopting the multi-stage sampling technique. In the first stage, Amreli, Junagadh and Rajkot districts were purposively selected, which properly represent the soils and agro-climatic conditions of Saurashtra; and the majority farmers extensively grow groundnut, cotton, pigeonpea, sesame and wheat crops under study. In the second stage, two talukas were randomly selected from the each chosen district. In the next stage, three villages were randomly selected from each of the six selected talukas from each selected villages, 10 farmers representing small, medium, and large holding were randomly selected. Thus, a total of 180 farmers were selected. The primary data pertaining to the, *kharif* and *rabi* crop seasons of the year 2020-21 were collected from the sample farmers with the help of pre-tested questionnaire well designed for the purpose, through personal interview.

Estimation of yield gaps

The methodology developed by the International Rice Research Institute (IRRI), Philippines have been followed to estimate the magnitudes of yield gaps, Yield gap is the difference between potential yield and actual yield. The difference is explained by several constraints - biological, physical, and socio-economic. All these constraints together account for the total yield gaps. It can be decomposed into two parts *viz*., Yield Gap I and Yield Gap II. These are also referred as technology gap and extension gap [2], respectively. Yield gap I is the difference between an experiment station's maximum yield and on-farm experiment's maximum yield [3]. This gap arises from differences in environment, which cannot be managed in farmers' fields. Yield Gap II which is primary concern of the present study, is the difference between yield attained in on-farm experiments and the average actual farm yield. This gap reflects the effects of biotic, soil and water, physiological, genetic, and abiotic constraints. Some researchers define Yield Gap I as the difference between an experiment station's average yield and on-farm experiment's average yield [4]. In present investigation, average attainable maximum potential yield obtains in large scale trials (of two to three varieties under cultivation and at different locations) has been considered as research station's potential yield, comparing last three years results to eliminate extreme values, if any. Average maximum yield obtained in Field Demonstration Trials (FLDs at least at two different locations) has been taken as on-farm experiment potential yields. Whereas, average actual farm yield to be obtained by survey of households during the *kharif* and *rabi* seasons of the year 2020-21 is considered as actual farm yield for yield gap calculations.

Results and Discussion

Estimation of yield gaps in selected crops

In Gujarat state, especially Saurashtra region known as the “Peanut Bowl” of India for their significant production in the groundnut. In Saurashtra region, about 85-90 per cent of groundnut production is practiced under un-irrigated conditions in *kharif* season. The estimates of groundnut yield gaps are presented in [Table-1]. The results of these estimates illustrate considerable yield gaps in both bunch and spreading genotypes. The Yield Gap II realized about 667 kg/ha in spreading cultivars on an average basis, which ranged from 528 kg/ha spreading to 760 kg/ha in bunch groundnut.

The bunch groundnut revealed relatively higher yield gap than spreading cultivar, because the bunch groundnut is the mainly summer season variety and it is mainly grown in the areas having and inadequate and uneven distribution of rainfall whereas, the cultivation of spreading varieties is confined mostly in Junagadh district and its surrounding areas where rainfall condition is relatively better.

Table-1 *Estimated yields and yield gaps in groundnut in Saurashtra (Kg/ha)*

	Particular of yields	Bunch	Spreading	Overall
1	Experiment station yield	3750	3812	3784
2	On-farm experiment yield	2480	2638	2592
3	Actual farm yield	1720	2110	1987
4	Yield Gaps			
a.	Yield Gap I	1270	1174	1192
b.	Yield Gap II	691	459	605
c.	Total Yield Gap (I+II)	1961	1633	1797
d.	Total Yield Gap (per cent)*	114	77	90
e.	Yield Gap II (per cent)*	40	22	30
	*Based on actual yield			

The average total yield gap ranged from 77 per cent in spreading varieties to 114 per cent in case of bunch cultivars with the overall average of 90 per cent. This could be attributed mainly due to substantially higher yield realized in experiment station yield. Technologies such as different land configurations (Broadbed and furrow system (BBF), ridge and furrow system, raised and sunken bed and watershed development can help in the more efficient use of water and applied nutrients resulting in improvements in the productivity of groundnut. Besides, concerted extension efforts need to be made to abridge the yield gap. This will not only improve the farmers' income, but will change the macro scenario as well. These findings are supported with the findings of Solanki *et al*. (2020) [5].

The sample farmers realized nearly 74 per cent (index of realized on-farm experiment yield) of farm potential in the study area. Thus, if the sample farmers adopt all recommended package of practices and technologies that were used on the demonstration plots, they would have harvested 26 per cent higher yield than the present level. These results corroborate with the findings of Dhandhalya and Shiyani (2009) [6].

The yield gap analysis of cotton and wheat is presented in [Table-2]. It can be observed that the total yield gap (1482 kg/ha) was higher than the half of the actual yield (2080 kg/ha). The results presented in the table revealed that the extension gap (Yield Gap II) was slightly higher than the technology gap (Yield Gap I). The total yield gap constituted about 73 per cent of actual farm yield, while the Yield Gap II was 41 per cent of actual farm yield. The magnitude of Yield Gap II was as high as 845 Kg/ha. This might be because hirsutum hybrid cotton varieties are highly susceptible to wide range of pests, and they demand more nutrients and frequent irrigations, which are quite inadequate in Saurashtra region. Gaddi *et al.,* (2002) [7] obtained the similar results in their study of Karnataka state. Besides, in recent years, Bt. cotton varieties become highly susceptible to pink bollworms which cause drastic reduction in cotton yields.

Table-2 *Estimated yields and yield gaps in cotton in Saurashtra (Kg/ha)*

	Particular of yields	Cotton	Wheat
1	Experiment station yield	3500	7125
2	On-farm experiment yield	2863	6225
3	Actual farm yield	2018	4880
4	Yield Gaps		
a.	Yield Gap I	637	900
b.	Yield Gap II	845	1345
c.	Total Yield Gap (I+II)	1482	2245
d.	Total Yield Gap (per cent)*	73	46
e.	Yield Gap II (per cent)*	41	27
	*Based on actual yield		

Thus, the availability and affordability of inputs as well as knowledge of recommended practices and adoption of required practices for a particular type of cotton could prevent yield loss and subsequently improve the productivity and efficiency of cotton production. These suggestions are given by Elum and Sekar (2015) [8].

The estimates of wheat yield gaps are presented in [Table-2]. The experimental station yield was as high as 7125 kg/ha, whereas it was 6225 kg/ha on demonstration plots. Contrary to this, the actual yield harvested by the sample farmers was only 4880 kg/ha. This indicates that nearly 2.0 t/ha of potential yield left untapped by the farmers, which comprised of major portion of Yield Gap II (1345 kg/ha) than the Yield Gap I (900 kg/ha). The total yield gap accounted for 46 per cent and Yield Gap II about 27 per cent of the actual yield obtained by the farmers. Inadequate irrigation facilities, nutrients deficiency like, Zn, Fe, S in the soils, unfavourable weather conditions, etc. were some of the important factors responsible for yield gap. Similar results were obtained by Jha *et al*., (2021) [9].

[Table-3] revealed a considerable yield gap in pigeonpea and sesame crops. Pigeonpea yields realized on the research station (2550 kg/ha) and on demonstration plots (2215 kg/ha) were relatively higher than the average yield obtained on farmers' field (1573 kg/ha). The magnitude of total yield gap found to be 652 kg/ha which is nearly less one-third of the actual farm yield. Yield Gap II accounts for about 41 per cent of the actual yield obtained by the pigeonpea growers. The probable reason for the same could be the use of marginal land for pigeonpea cultivation due to shifting of a acreage under commercial crops. Yield Gap II formed a significant part of the total yield gap of the pigeonpea, indicating the need to scale-up the improved production technologies from on-farm demonstration sites to farmers in the production zones as suggestion given by the Bhatia *et al*. (2006) [10].

Table-3 *Estimated yields and yield gaps in pigeonpea in Saurashtra region (Kg/ha)*

	Particular of yields	Pigeonpea	Sesame
1	Experiment station yield	2550	1374
2	On-farm experiment yield	2215	1024
3	Actual farm yield	1563	537
4	Yield Gaps		
a.	Yield Gap I	335	350
b.	Yield Gap II	652	487
c.	Total Yield Gap (I+II)	987	799
d.	Total Yield Gap (per cent)*	63	148
e.	Yield Gap II (per cent)*	41	90
	*Based on actual yield		

The yield gap analysis of sesame is presented in [Table-3]. It can be observed that there existed a wide gap in sesame production among the research station (1374 kg/ha), On-farm experiment (1024 kg/ha) and the sample farmers' fields (678 kg/ha). The magnitude of total yield gap fund to be 799 kg/ha in sesame was more than the average yield obtained on farmers' fields. This was due to combined effect of Yield Gap II (487 kg/ha) and Yield Gap I (350 kg/ha). The total yield gap accounts for about 148 per cent of the actual yield obtained by the sesame growers. This might be since sesame crop is generally grown in the soil having poor nutrient and highly influenced by water stagnation or stress in initial growth stage. Moreover, weather conditions also cause severe diseases and pests problems which are significantly contributed in decrease the production. Kaul *et al*. (2020) [11] obtained similar results in their study of yield gap analysis of sesame crop in the Pathankot district of Punjab.

Thus, it is confirmed that there existed a wide yield gap in selected major crops of the Saurashtra region. The sample farmers have harvested nearly 76, 70, 78, 70 and 52 per cent (index of realized potential farm yield) of farm potentials of groundnut, cotton, wheat, pigeonpea and sesame crop, respectively in the study area. This clearly shows that, if sample farmers had adopted all the recommended package of practices and technologies that were used on the demonstration plots, they would have obtained 24, 30, 22, 30 and 48 per cent more output in case of groundnut, cotton, wheat, pigeonpea and sesame crops, respectively.

Furthermore, extension agencies like KVK, ATMA, NGO's of the respective district need to provide more technical support to the farmers through method demonstration, training programme, exposure visit to other fields and field days which increased the horizontal spread of the technology to more number of farmers in the district, with its positive effect on livelihood of farmers.

Conclusion

It was observed that there existed a wide yield gap in selected major crops of the Saurashtra region. The average Yield Gap II was realized about 605 kg/ha in both bunch and spreading cultivars of groundnut, which ranged from 459 kg/ha in spreading to 691 kg/ha in bunch groundnut. The yield Gap I was also very large in both the genotypes.

Therefore, it indicated that the need to further refine the production technology and develop varieties that can perform still better in each environment. In cotton (irrigated) the Yield Gap I and Yield Gap II has marginal difference with, 637 kg/ha to Yield Gap I and 845 kg/ha to Yield Gap II. This was mainly due to high susceptibility of hirsutum hybrid cotton to wide range of pests and they demand more nutrients and frequent irrigations. In case of wheat, nearly 2.0 t/ha of potential yield was left untapped by the sample farmers. The yield Gap II accounted for 27 per cent of the actual yield (4880 kg/ha) obtained by the farmers. Inadequate irrigation facilities, nutrient deficiency in the soils, unfavourable weather conditions, etc. were some of the important factors responsible for yield gap. The magnitude of total yield gap found to be 799 kg/ha in sesame was about 148 per cent of the actual average yield obtained on farmers' fields. Yield Gap I and Yield Gap II were worked about 350 kg/ha and 487 kg/ha, respectively in sesame. This might be because sesame is generally grown in the soil having poor fertility and highly influenced by water stagnation or stress in initial growth state. The magnitude of total yield gap found to be 987 kg/ha which is nearly more than half of the actual farm yield in pigeonpea. Yield Gap II accounts for about 41 per cent of the actual yield obtained by pigeonpea growers. Yield Gap II formed a significant part of the total yield gap of the pigeonpea, indicating the need to scale-up the improved production technologies from on-farm demonstration sites to farmers in the production zones. This clearly shows that, if sample farmers had adopted all the recommended package of practices and technologies that were used on the demonstration plots, they would have obtained 24, 30, 22, 30 and 48 per cent more output in case of groundnut, cotton, wheat, pigeonpea and sesame crops, respectively.

Application of research: The yield gap statistics indicated that the sample farmers have harvested nearly 76, 70, 78, 70 and 52 per cent (index of realized potential farm yield) of farm potentials of groundnut, cotton, wheat, pigeonpea and sesame crop, respectively in the study area.

Research Category: Agricultural Economics

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****Principal Investigator or Chairperson of research: Charls Nagani**
University: Junagadh Agricultural University, Junagadh, 362002, Gujarat, India
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Study area / Sample Collection: Amreli, Junagadh and Rajkot, Saurashtra region of Gujarat

Cultivar / Variety / Breed name: Cotton, Wheat, Sesame and Pigeonpea

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