

### THE RAHAD CROP YIELDS LOCATIONAL DIFFERENCES BASED ON CROP-CUTTING SURVEY RESULTS ALONG SELECTED MAJOR CANALS

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#### 5.1 INTRODUCTION

It is commonly hypothesized that the location of a canal and tenancy has a direct effect on crop yields i.e., the nearer the tenant to the main water supply source the higher the yields. This is based on the assumption that the tenants located at the head of the canal receive adequate water at the right time, at least more so than those at the tail.

This survey is designed with the intention to investigate this assumption objectively. A series of crop-cutting experiments were conducted on both Sorghum and Groundnut fields, taking the layout of canalization as the only factor on sample selection.

#### 5.2 OBJECTIVES

The main objective of this exercise is to investigate whether the location of the Minors<sup>24</sup> within the command of a Major<sup>25</sup>, Abu XX<sup>26</sup> within the Minor and the tenancy within an Abu XX has a direct effect on crop yields or not. Consequently, as a by-product of the survey design, a secondary and important objective can also be attained - to have an unbiased estimate of crop yields for the different selected major and minor canals.

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<sup>24</sup>Secondary canals.

<sup>25</sup>Sub-main canal.

<sup>26</sup>Tertiary canals.

## 5.3 METHODOLOGY

### 5.3.1 Sample Design

The whole Rahad irrigation system is covered by about 800 km of major canals. A number of Minors are branched from each Major, and consequently a number of Abu XX's are branched from each Minor. Each Abu XX irrigates sixteen tenancies. Two independent samples were selected for the crop-cutting. The first from the Sorghum fields and the other from the Groundnut fields.

The survey design for each sample was a stratified multi-stage random sample. The whole scheme is divided into three regions. From each region, a Major was selected randomly. Majors 2, 5 and 7 were selected to represent the southern, central and northern blocks, respectively. From each reach of the three Majors, one Minor was selected at random. The table below gives the location of each reach and the Minor selected for each Major:

Table 5.1. Length of reach and minor selected.

MAJOR	REACH	LOCATION OF REACH (kilometers)		MINOR SELECTED
		FROM	TO	
2	1	0.0	1.6	6
	2	1.6	3.6	32
	3	3.6	8.0	25
	4	8.0	11.0	27
	5	11.0	14.0	39
	6	14.0	17.0	31
5	1	0.0	1.5	84
	2	1.5	3.5	85
	3	3.5	12.0	97
	4	12.0	15.0	99
	5	15.0	18.0	102
	6	18.0	21.0	96
	7	21.0	26.0	161
	8	26.0	34.0	107
7	1	0.0	9.0	3
	2	9.0	15.0	4
	3	15.0	18.0	6
	4	18.0	21.0	8
	5	21.0	28.0	12
	6	28.0	39.0	17

Then the *Numbers*<sup>27</sup> - Abu XX - in each selected Minor were grouped into three equal groups according to sequence. The first represents the head of the Minor, the second the middle, and the third the tail of the Minor. From each group, one *Number* was randomly selected using systematic sampling.

<sup>27</sup>Rotational area units of 88 feddans, each served by an Abu XX.

**GROUP (A)**

1	2	3	4	I
				II
				III 5
				IV

**GROUP (B)**

1	2	3	4	I
				II
				III 5
				IV

**GROUP (C)**

1	2	3	4	I
				II
				III 5
				IV

The tenancies within each selected Number, area served by an Abu XX, were then sub-divided into four equal groups, according to sequence, also. From each sub-group one tenancy was selected using the same procedure as before. From each selected tenancy, two plots of size 2 X 2 meters were selected at random. The crop in each plot was then harvested, threshed and its weight was recorded.

**5.3.2 Coverage**

The field work started on the last week of Nov. 1993 by a Seminar of two days with the objective of training the field staff of Rahad Agriculture Corporation who would be responsible for the data collection. On the first day, the objectives, sample design, sample selection and suggested analytical procedures were discussed, while on the second day, a practical demonstration of how to select and identify the plot within the tenancy was conducted.

Only two Majors out of three, namely Major 2 and Major 7, were covered in this survey. This is mainly due to the fact that the field work started very late and most of the crops at that time were already harvested, specially along Major 5.

Within those Majors, only three out of six selected Minors were covered. Minor 6 of Reach 1 was considered as the head for major 2, Minor 25 of Reach 3 as middle and Minor 27 of Reach 4 as tail. For Major 7, Minor 3 of Reach 1, Minor 6 of Reach 3, and Minor 17 of Reach 6 were considered as head, middle and tail respectively.

Almost complete coverage within the covered Minors was achieved concerning Abu XX tenancies and plots.

## 5.4 NUMERICAL RESULTS

Two approaches were used in the analysis for each crop. The first is to analyse the data for each Major separately (i.e., consider each Major as a separate domain of study), while in the second all of the data was considered as one sample. The conclusions drawn from the two approaches were almost the same in all cases, giving a very high degree of confidence on these results. There is only one exception - - at the Minor level, where the conclusions drawn on Sorghum are completely different from those on Groundnut.

## 5.5 CONCLUSIONS

- (a) Although the yield per feddan in both crops showed a gradual decrease from head to tail in all stages - Minor, Abu XX and tenancy - the magnitude of the difference between the highest and lowest was not statistically significant. So the obvious conclusion is that the location of the Minor, Abu XX and the tenancy has no effect on crops yield.
- (b) As far as the tenancy is concerned, the average yield per feddan showed a gradual decrease from 616 kilos - 6.7 sacks - in the first quarter to 463 kilos - 5.1 sacks in the last one in case of Sorghum crop and 1030 kilos - 22.9 sacks - at the head and 782 kilos - 17.4 sacks - at the tail in the case of Groundnut. Both differences 153 kilos - 1.7 sack - (134 kilos) of the former and 248 kilos - 2.7 sack - (217 kilos) of the latter were not statically significant.  
The same conclusion can be observed taking each major as a separate sample.
- (c) At the Number - Abu XX - level, the yield of the first group exceeded that of the third group by 81 (134) kilos at major two, 24 (170) kilos at major seven in Sorghum and 161 (79) at major two, 457 (262) at major seven in case of Groundnut. All these differences were not significantly different from zero.
- (d) At the Minor level, the results obtained from the Sorghum fields do not coincides with those obtained from the Groundnut fields. The difference between head and tail showed a highly significant results in the former, while in the latter it is not significant.

The two tables below (Tables 5.2 and 5.3) give the estimated average yield per feddan in kilos and sacks for the different locations, together with the standard error of the difference between head and tail and the result of the t-test for the different levels.

The results showed that the overall mean yield of Sorghum in the two majors is 512 kilos - 5.6 sack - per feddan with a standard error of 117 kilos - 1.3 sacks. In the case of Groundnut, the minimum yield expected is 230 kilos - 5.1 sacks - and a maximum of 1534 kilos - 34 sacks - with an average of 882 kilos - 19.6 sacks.

Although the yield per feddan for Sorghum is almost the same - 512 kilos - in both major two and seven, but it is more than double in the latter Major for Groundnut.

The estimated average yield per feddan for Groundnut in the first Reach exceeds the second by 8.4 percent and the third by 37 percent. As far as the Numbers - Abu XX - are concerned, the yield obtained in the first group exceeds the second and third by 1.1 and 45.2 percent, respectively. The average yield of the tenancies in the first quarter of the Number showed an increase of 19.5 percent from the second, 20.4 percent from the third and 31.7 percent from the last.

Table 5.2. Estimated average yields per feddan in kilo for different locations.

			Sorghum (DURA)			Groundnut		
			Major 2	Major 7	Total	Major 2	Major 7	Total
Minor	Head	I	797	617	702	702	1,293	998
	Middle	II	379	573	476	495	1,346	921
	Tail	III	372	333	353	451	1,008	729
S. E.			101	97	99	112	308	231
T-Test Result			H.S.	S.	H.S.	N.S.	N.S.	N.S.
ABU XX	Head	I	555	467	511	617	1,364	990
	Middle	II	518	613	566	583	1,376	980
	Tail	III	474	443	459	456	907	681
S. E.			134	170	153	79	262	194
T-Test Result			N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Tenancy	Head	I	583	649	616	599	1,461	1,030
	Middle 1	II	467	470	469	548	1,164	856
	Middle 2	III	510	489	500	545	1,020	782
	Tail	IV	504	422	463	506	1,218	862
S. E.			152	112	134	112	286	217
T-Test Result			N.S.	S.	N.S.	N.S.	N.S.	N.S.
Overall Mean			516	508	512	549	1,216	883

S. E. = Standard error of the difference.

N. S. = Not significant.

S. = Significant at the 5 percent level.

H. S. = Highly significant i.e., Significant at 1 percent level.

Table 5.3. Estimated average yields per feddan in sacks for different locations.

			Sorghum (DURA)			Groundnut			Remarks
			Major 2	Major 7	Total	Major 2	Major 7	Total	
Minor	Head	I	8.7	6.7	7.5	15.6	28.7	22.1	
	Middle	II	4.1	6.3	3.9	11.0	29.9	20.4	
	Tail	III	4.1	3.6	5.4	10.0	22.4	16.2	
S. E.			1.1	1.0	1.1	1.2	3.4	2.5	
T-Test Result			H.S.	S.	H.S.	N.S.	N.S.	N.S.	
ABU XX	Head	I	6.1	5.1	5.6	13.7	30.3	22.0	
	Middle	II	5.7	6.7	6.2	12.9	30.6	21.7	
	Tail	III	5.2	4.8	5.0	10.1	20.2	15.1	
S. E.			1.5	1.9	1.7	0.9	2.9	2.1	
T-Test Result			N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	
Tenancy	Head	I	6.4	7.1	6.7	13.3	32.5	22.9	
	Middle 1	II	5.1	5.1	5.1	12.2	25.9	19.0	
	Middle 2	III	5.6	5.3	5.5	12.1	22.7	17.4	
	Tail	IV	5.5	4.6	5.1	11.2	27.1	19.1	
S. E.			1.7	1.2	1.5	1.2	3.1	2.4	
T-Test Result			N.S.	S.	N.S.	N.S.	N.S.	N.S.	
Overall Mean			5.6	5.6	5.6	12.2	27.0	19.6	

S. E. = Standard error of the difference.

N. S. = Not significant.

S. = Significant at the 5 percent level.

H. S. = Highly significant i.e., Significant at 1 percent level.