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Science for Better Livelihoods in Dry Areas

Technical Report

Adoption of Mechanized Raised Bed Technology for Sustainable Farming System in Sharkia and Assiut Governorates

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List of Abbreviations

ICARDA : International Center for Agricultural Research in the Dry Areas

RBM : Raised Bed Machine

MRB : Mechanized Raised Bed

Feddan : Equals 0.42 ha

Qerat : Equals 1/24 fed (175 m^2)

LE : Egyptian Pound

m^3 : Cubic meter

TVC :Total Variable Cost

FGD : Focus Group Discussion

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Executive Summary

This report outlines the results of studying two surveyed samples in Assiut and Sharkia governorates in Egypt, each comprising 80 farmers. To identify and compare the various impacts of using raised bed machine (RBM) on wheat production, each sample included 40 adopters and 40 non-adopter farmers. Half of the adopters and non-adopters in Assiut's sample are females, while all of the farmers in Sharkia's sample are males. The report covers sample characterization in terms of defining rural household livelihood with a focus on natural assets (source of irrigation water) and livestock assets. It also analyzes farmers' perceptions on RBM, motivations of adopters and obstacles facing non-adopters. Main findings indicate that net revenue per ton of wheat and revenue per water unit realized by adopters of MRB farming in Assiut and Sharkia are higher than those realized by non-adopters. All of the adopters in Assiut and most of the adopters in Sharkia believe that using RBM saves water, reduces crop losses and cost, saves time & effort, and improves yield. Main findings of focus group discussions reveal that the cost of renting the machine from cooperatives is lower than the cost of renting from private sector; however, the number of machines in coops is not sufficient to meet farmers' demand during the planting season. Such results implicate that promoting the adoption of raised bed farming requires formulating a set of policies to activate the role of agricultural extension in providing farmers with information about MRB and associated benefits, in addition to providing a sufficient number of raised bed machines at agricultural cooperatives to encourage farmers to use the machine.

Introduction

Water shortage and modest yield are two critical issues confronting the agricultural sector in Egypt. Water saving and achieving higher crop yield are increasingly becoming major challenges to the agricultural sector given the long-term impacts on poverty reduction, improving livelihoods in rural areas and achieving food security. Accordingly, researches are now focusing on how to manage water resources and raise crop yield through promoting the adoption of modern farming methods in old lands, like raised beds, in wheat production as the staple food for the population. Raised beds farming is an efficient technology package that allows more efficient use of natural resources, where it helps in saving irrigation water, seeds and fertilizers, leading to reduced production cost in addition to improved wheat productivity. As a result, net returns from wheat grown under MRB farming are higher than those realized from wheat grown under the flat traditional system.

In fact, several factors interfere in farmers' decision making on MRB adoption, the current report aims to present the major dynamics influencing farmers' behavior towards raised-bed technology in wheat production, based on a sample drawn from Assiut and Sharkia Governorates. It allows the identification of useful conclusions and recommendations in terms of policy making and institutional interventions to promote the adoption of this new technology for agricultural sector growth.

Areas under Raised Bed Farming in Sharkia

Figures in table 1 indicate that wheat area under raised bed farming in Sharkia has been increasing over the last four agricultural seasons, where it increased from 70483 feddans representing 15.7% of the total area under wheat in Sharkia during 2013/2014 to 70065 feddans representing 17.1% in 2014/2015, then up 92500 feddans representing 22.3% in 2015/2016, and further to 97023 feddans representing 26.1% in 2016/2017, indicating that adoption of raised bed farming is increasingly growing. The successive increase in adopting MRB farming can be attributed to the positive impacts farmers have been observing from neighbors, either on maximizing the use of limited land and water resources, the cost and revenue sides, in addition to benefiting from RBM in planting other crops, which eventually improvers farmers' annual income and livelihood.

Table 1: Relative Importance of Wheat Areas under MRB Farming in Sharkia Governorate over the Period 2013-2017

Agricultural Season	Total Area under Wheat (Feddan)	Area under Raised Bed Farming (Feddan)	%
2013/2014	447884	70483	15.7
2014/2015	410000	70065	17.1
2015/2016	414402	92500	22.3
2016/2017	371777	97023	26.1
Average	**411015.8**	**82517.75**	**20.1**

Source: Administration of Agriculture in Sharkia, 2017

As for the relative importance of districts, figures in table 2 reveal that Hehia district ranks first with wheat area under raised beds representing 85% of the total area under wheat in Sharkia, estimated at 371777 feddans. Ibrahimia district ranks second with wheat area under raised beds representing 56.7% of the total area under wheat in the district. Kafr Shaqr, Dirab Negm, Mashtol and Abo Kbir districts, agricultural reform lands, Faqos, Huseinia, Belbis, Menia El-Qamh and Zaqaziq districts followed with wheat areas under raised beds representing 41.7%, 35%, 28.9%, 28.8%, 27.1%, 25.2%, 25.1%, 24.4%, 21.5% and 15.4% of the total area under wheat in Sharkia, respectively.

Table 2: Relative Importance of Wheat Areas under MRB Farming at the Level of Sharkia Districts in 2017

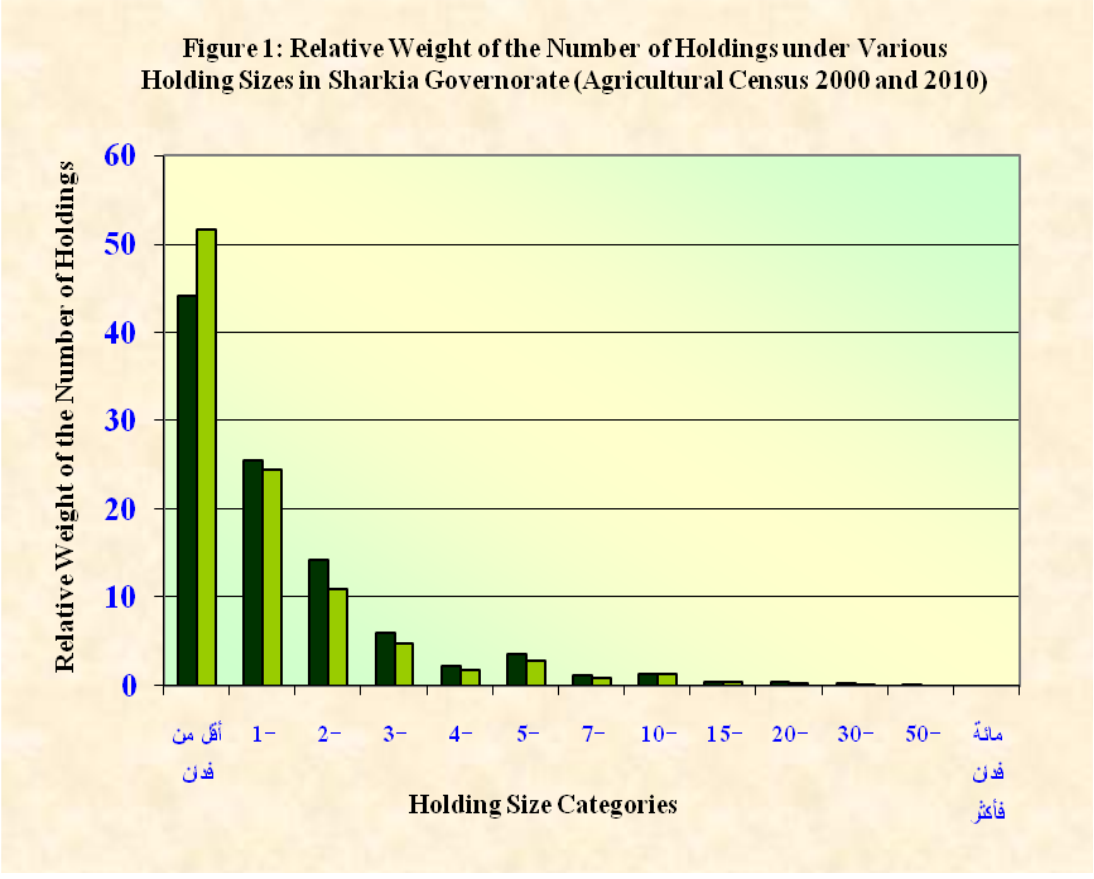
District	Traditional Farming	Raised Bed Farming	Planter	Total	%
Zaqaziq	24369	5088	3550	33007	15.4
Menia El-Qamh	23308	6430	200	29938	21.5
Belbis	14700	6300	4830	25830	24.4
Mashtool	5656	2300	0	7956	28.9
Hehia	1148	6500	0	7648	85.0
Ibrahimia	2354	3350	200	5904	56.7
Diarb Negm	12974	7000	26	20000	35.0
Abo Kbir	13751	5600	100	19451	28.8
Kafr Saqr	7175	7505	3320	18000	41.7
Awlad Saqr	13772	5150	465	19387	26.6
Faqos	35616	12050	120	47786	25.2
Huseinia	32534	15400	13542	61476	25.1
Abo Hammad	10569	3350	4050	17969	18.6
Agric. Credit Lands	197926	86023	30403	314352	27.4
Agric. Reform Lands	29645	11000	0	40645	27.1
Companies	16780	0	0	16780	0.0
Total	**244351**	**97023**	**30403**	**371777**	**26.1**

Source: Administration of Agriculture in Sharkia, 2017

Study Sample

Two samples, comprising 80 farmers each, have been drawn from Assiut and Sharkia Governorates. The sample from Assiut consists of 40 adopters and 40 non-adopters of raised bed farming. It is worth mentioning that adopters are 20 male and 20 female farmers who own farms used as pilot plots under the control of the National Extension Campaign for Wheat Crop. As for the size of holdings, around 75% of the sample farmers own less than two feddans of land (one feddan = 0.42 hectare), while the remaining 25% hold more than two feddans. Turning to Sharkia Governorate, the sample consists of 40 adopters, all of whom are males, and 40 non-adopters. Land holdings can be classified into three categories; holders of less than one feddan represent slightly more than 50%, holders of 1 to 2 feddans represent slightly more than 20%, and holders of more than 2 feddans represent less than 30%. It should be noted that the relative weight of holding sizes in the sample is not equal due to the fact that farmers' response to answering questions has been quite different.

After reviewing literature on farmers' adoption of agricultural technologies [1, 2], a questionnaire was designed to collect primary data required to serve achieve the objectives of this report.



Sample Characterization

- **Family Structure**

Studying family structure of sample farmers in **Assiut** Governorate reveals that the total number of family members of non-adopter male farmers is 138, of which 79 are males and 59 are females; while the total number of family members of adopter male farmers is 123, of which 63 are males and 60 are females. As for adopter non-adopter female farmers, the total number of family members is 170, of which 100 are males and 70 are females; while the total number of family members of adopter female farmers is 174, of which 106 are males and 68 are females. In the case of **Sharkia** Governorate, total number of family members of non-adopters is 223, of which 121 are males and 121 are females; while that of adopters in 243, of which 120 are males and 123 are females, as shown in table 3.

Table 3: Family Structure

Assiut (Males)						Assiut (Females)						Sharkia					
Non-adopters			Adopters			Non-adopters			Adopters			Non-adopters			Adopters		
Total No.	Males	Females	Total No.	Males	Females	Total No.	Males	Females	Total No.	Males	Females	Total No.	Males	Females	Total No.	Males	Females
138	79	59	123	63	60	170	100	70	174	106	68	223	121	102	243	120	123

- **Level of Education**

Classifying sample farmers according to level of education (table 4) reveals that 9 of the non-adopter male farmers in **Assiut** Governorate are illiterate, 5 can read and write, and 6 farmers received middle or high education. As for adopter male farmers, 4 are illiterate, 4 can read and write, and 12 farmers received middle or high education. Turning to female farmers, 10 of the non-adopters are illiterate, 4 can read and write, and 6 received middle or high education. On the other hand, adopter female farmers group consists of 11 illiterates, 5 can read and write, and 4 received middle or high education. In regards to **Sharkia** Governorate, 15 of the non-adopters with holdings less than one feddan are illiterate, 5 can read and write, and 16 received middle or high education; whereas 2 of the non-adopters with holdings 1-2 feddans are illiterate, one can read and write, and one received high education. On the other hand, 8 of the adopters under who hold less than one

feddan are illiterate, 7 can read and write, and 5 received middle or high education; whereas 6 of the adopters who hold 1-2 feddans are illiterate, 2 can read and write, and 7 received middle or high education. Finally, 2 of the adopters who hold more than 2 feddan are illiterate and 3 received middle or high education.

Table 4: Level of Education

Category	Assiut (Males)						Assiut (Females)						Sharkia					
	Non-adopters			Adopters			Non-adopters			Adopters			Non-adopters			Adopters		
	Illiterate	Read & Write	Middle or High	Illiterate	Read & Write	Middle or High	Illiterate	Read & Write	Middle or High	Illiterate	Read & Write	Middle or High	Illiterate	Read & Write	Middle or High	Illiterate	Read & Write	Middle or High
<1 Fed.													15	5	16	8	7	5
1-2 Fed.	9	5	6	4	4	12	10	4	6	11	5	4	2	1	1	6	2	7
> 2 Fed.																2		3
Total	9	5	6	4	4	12	10	4	6	11	5	4	17	6	17	16	9	15

- ***Land Tenure***

Results of studying the types of land tenure at the level of the two samples, presented in table 5, reveal that all of the sample farmers in **Assiut** Governorate are land owners. As for **Sharkia**, 15 of the adopters who hold less than one feddan are land owners and 21 are renters against cash money; whereas 3 of the adopters who hold 1-2 feddans are land owners and one rents the land against cash money. In regards to non-adopters, 12 of the farmers who hold less than one feddan are land owners, 7 are renters against cash money, and one is a renter against a payment in kind. As for farmers who hold 1-2 feddans, 9 are land owners, 5 are renters against cash money, and one is a renter against a payment in kind. Finally, 4 of the holders of more than 2 feddans are land owners and one is a renter against cash money.

Such characterization implicates that the majority of adopters are holders of small areas, either owned or rented, where 36 of the 40 adopters in Sharkia hold less than one feddan of land, which can be attributed to the fact that small farmers are keen to adopt new farming methods that lead to reduced production cost and higher productivity, thus higher revenue and improved livelihood. The magnitude of promoting adoption can therefore be great for farmers in Sharkia given the fact that holders of less than one feddan account for more than 50% (refer to Fig. 1).

Table 5: Land Tenure

Category	Assiut	Sharkia					
		Adopters			Non-adopters		
	Owned	Owned	Rented (Cash)	Rented (In kind)	Owned	Rented (Cash)	Rented (In kind)
<1 Fed.	-	15	21	-	12	7	1
1-2 Fed.	80	3	1	-	9	5	1
> 2 Fed.	-	-	-	-	4	1	-
Total	80	18	22	-	25	13	2

- **Sources of Income**

Figures in table 6 reveal that 19 of the non-adopter male farmers with land holdings 1-2 feddans in **Assiut** Governorate depend on farming for income, while only one depends on farm and non-farm sources for income. It is also clear from the table that the same classification applies to adopter male farmers under the same land-holding category. Results also reveal that 15 non-adopter female farmers with land holdings 1-2 feddans depend on farming for income, while 5 depend on farm and non-farm sources for income. As for adopter female farmers, it can be noted that 18 depend on farming for income, while the remaining 2 depend on farm and non-farm sources for income. Turning to Sharkia Governorate, 27 and 2 of the non-adopter farmers belonging to the land-holding categories less than one feddan and 1-2 feddans, respectively, depend on farming for income, while 9 and 2 adopter farmers belonging to the land-holding categories less than one feddan and 1-2 feddans, respectively, depend on farm and non-farm sources for income. Finally, survey results reveal that 3 of the adopter farmers who own more than 2 feddans of land depend on farming for income, while the other 2 depend on farm and non-farm sources for income.

Table 6: Source of Income

Category	Assiut (Males)				Assiut (Females)				Sharkia			
	Non-adopters		Adopters		Non-adopters		Adopters		Non-adopters		Adopters	
	Farming	Farm+ Non-farm	Farming	Farm+ Non-farm	Farming	Farm+ Non-farm	Farming	Farm+ Non-farm	Farming	Farm+ Non-farm	Farming	Farm+ Non-farm
<1 Fed.									27	9	17	3
1-2 Fed.	19	1	19	1	15	5	18	2	2	2	12	3
> 2 Fed.											3	2
Total	19	1	19	1	15	5	18	2	29	11	32	8

- **Labor Structure**

Survey results regarding labor structure in Assiut and Sharkia Governorates are presented in tables 7 and 8. It can be noted that non-adopter male farmers with land holdings 1-2 feddans mainly depend on family labor (2.1 males and 1.5 females on average), and 4 paid-labor male workers, and that average wage rate is LE 90/day. As for adopter male farmers, they hire 3.4 male workers on average for LE80/day. Non-adopter female farmers also depend on family labor (1.8 males and 1.6 females on average), for whom the paid wage rate is LE80/day, in addition to 3.4 paid-labor male workers on average, which costs them LE90/day. Finally, adopter female farmers depend on family labor (3 males and 1.6 females on average), for whom the paid wage rate is LE90/day/person, in addition to 3.2 paid-labor male workers, on average, for LE93/day. It is worth noting that family labor is permanent, while paid labor is used only during harvesting.

Sample farmers in **Sharkia** also mainly depend on family labor, and use paid labor only during harvest time. As shown in table 8, non-adopter farmers with holdings less than one feddan use 2.2 males and 1.3 females of family labor and two paid-labor male workers for LE65/day. As for non-adopters with land holdings 1-2 feddans, they also use 2.2 males and 1.3 females of family labor, and three paid-labor male workers for LE675/day.

In regards to adopters, those with holdings less than one feddan use 2.2 males and 1.55 females of family labor, in addition to 2.65 paid-labor male workers for LE73/day. Those with holdings 1-2 feddans use 2.6 males and 1.7 females of family labor, in addition to 3 paid-labor male workers for LE75/day. As for holders of more than 2 feddans, they use 1.7 males and 1 female of family labor, in addition to 7.5 paid-labor male workers for LE71/day.

Table 7: Labor Structure in Assiut Governorate

Category	Non-adopter Male Farmers			Adopter Male Farmers			Non-adopter Female Farmers			Adopter Female Farmers		
Type of Labor	M	F	Wage (LE/day)	M	F	Wage (LE/day)	M	F	Wage (LE/day)	M	F	Wage (LE/day)
Family Labor	2.1	1.5	90	-	-	-	1.8	1.6	80	3	1.6	90
Paid Labor	4	-	90	3.4	-	80	3.4	-	90	3.2	-	93

Table 8: Labor Structure in Sharkia Governorate

Category	*Non-adopters*						*Adopters*					
	Family Labor			*Paid Labor*			*Family Labor*			*Paid Labor*		
	M	F	Wage (LE/day)	M	F	Wage (LE/day)	M	F	Wage (LE/day)	M	F	Wage (LE/day)
<1 Fed.	2.2	1.3	65	2		65	2.1	1.55	73	2.65		73
1-2 Fed.	2.3	1.3	75	3		75	2.6	1.7	75	3		75
> 2 Fed.							1.7	1	71	7.5		71
Total	4.5	2.6	70	5		70	6.4	4.25	73	13.15		73

The difference between wage rates in the two Governorates is attributed to the fact that most of the work force in Assiut is either engaged in jobs outside the Governorate, work in quarries, or work abroad, and Sharkia

Wheat Production and Disposal Methods

Data collected on wheat yield and disposal methods at the level of **Assiut** sample reveal that non-adopter male farmers realize 3.37 tons per feddan, of which 0.85 ton is kept for family consumption and 2.52 tons are sold. Adopter male farmers realize a yield of 3.36 tons per feddan, of which 0.94 ton is kept for family consumption and 2.42 tons are sold. On the other hand, non-adopter female farmers realize a yield of 3.47 tons per feddan, of which they keep 0.77 ton for family consumption and sell the remaining 2.69 tons. Finally, adopter female farmers realize a yield of 3.67 tons per feddan, of which they keep 0.79 ton for family consumption and sell the remaining 2.88 tons for cash (table 9).

Table 9: Wheat Production and Disposal Methods in Assiut Governorate (Ton/Fed)

Category	*Non-adopter Male Farmers*			*Adopter Male Farmers*			*Non-adopter Female Farmers*			*Adopter Female Farmers*		
	Yield	Family Consumption	Sales	Yield	Family Consumption	Sales	Yield	Family Consumption	Sales	Yield	Family Consumption	Sales
<1 Fed.												
1-2 Fed.	3.37	0.85	2.52	3.36	0.94	2.42	3.47	0.77	2.69	3.67	0.79	2.88
> 2 Fed.												
Total	3.37	0.85	2.52	3.36	0.94	2.42	3.47	0.77	2.69	3.67	0.79	2.88

At the level of **Sharkia** sample, data presented in table 10 reveal that non-adopters with holdings less than one feddan realize 2.73 tons per feddan, of which 0.80 ton is kept for family consumption and 1.93 tons are sold. On the other hand, adopters realize a yield of 2.81 tons per feddan, of which 0.83 ton is kept for family consumption and 1.98 tons are sold for cash. Non-adopters with holdings 1-2 feddans realize 2.66 tons per feddan, of which 0.85 ton is kept for family consumption and 1.81 tons are sold, whereas adopters belonging to the same land-holding category realize 2.87 tons per feddan, of which 0.90 ton is kept for family consumption and 1.97 tons are sold. As for adopters with holdings more than 2 feddans, data reveal that they realize 2.97 tons per feddan, of which they keep 0.89 ton for family consumption and sell the remaining 2.06 tons for cash.

Table 10: Wheat Production and Disposal Methods in Sharkia Governorate (Ton/Fed)

Category	*Non-adopters*			*Adopters*		
	Yield	*Family Consumption*	*Sales*	*Yield*	*Family Consumption*	*Sales*
<1 Fed.	**2.73**	**0.80**	**1.93**	**2.81**	**0.83**	**1.98**
1-2 Fed.	**2.66**	**0.85**	**1.81**	**2.87**	**0.90**	**1.97**
> 2 Fed.				**2.97**	**0.89**	**2.06**

Crop Budget *(4, 6)*

Results of comparing crop budgets for wheat grown by non-adopters and adopters of mechanized raised bed farming are presented in tables 11 and 12. It is clear that total cost of wheat grown by non-adopter male farmers in **Assiut** amount to LE 4547 per feddan, while total revenue is LE 15443. As for wheat grown by adopter male farmers, total cost and total revenue per feddan reached LE 4447 and LE 15062, respectively. Turning to female farmers, total cost and total revenue of wheat grown by non-adopters reached LE 4756 and LE 16021, respectively, whereas total cost and total revenue of wheat grown by adopters reached LE 4751 and LE 13076, respectively.

In regards to sample farmers in **Sharkia** Governorate, calculations reveal that total cost and revenue of wheat grown by non-adopters with holdings less than one feddan reached LE 3990 and LE 12680, respectively, whereas total cost and revenue of wheat grown by non-adopters with holdings 1-2 feddans reached LE 3995 and LE 12329, respectively. As for adopters with holdings less than one feddan, total cost and revenue of growing wheat reached LE 3470 and LE 12669, respectively, whereas total cost and revenue of wheat grown by adopters with holdings 1-2 feddans reached LE 4162 and LE 13450, respectively, and finally total cost and revenue of wheat grown by adopters with holdings more than 2 feddans reached LE 4675 and LE 13646, respectively,

Table 11: Crop Budget for Wheat Grown by Sample farmers in Assiut Governorate

Cost/Revenue	Unit	*Non-adopter Male Farmers*			*Adopter Male Farmers*			*Non-adopter Female Farmers*			*Adopter Female Farmers*		
		Q	**Price**	**V**	**Q**	**Price**	**V**	**Q**	**Price**	**V**	**Q**	**Price**	**V**
Land Preparation	Feddan	1	495	495	1	482	482	1	500	500	1	500	500
RBM	Hour			0			0			0			0
Seeds	Kg	45	8	360	45	8	360	45	7	315	45	7	315
Manure	m^3			0			0			0			0
N. Fert	Bag (50Kg)	4	150	600	4	152	608	3.35	152	509	3.75	152	570
Phos. Fert	Bag (50Kg)	4	64	256	4	66	264	3.7	68	252	4.1	70	287
Potash Fert	Bag (50Kg)			0			0			0			0
Pesticides	Feddan	1		0	1	118	118	1	104	104	1	118	118
Labor	No.	25	88	2200	23	88	2024	26	92	2392	25	93	2325
Fuel	Liter			0			0			0			0
Irrigation	Hour	6	50	300	6	50	300	6	50	300	6	50	300
Harvest	Hour	3.5	96	336	3	97	291	4	96	384	3.5	96	336
Total Cost	**L.E**			**4547**			**4447**			**4756**			**4751**
Main Product	L.E	22.45	568	12752	22.4	561	12566	23.1	561	12959	18	560	10080
Byproduct	L.E	13	207	2691	12	208	2496	13.55	226	3062	14	214	2996
Total Revenue	**L.E**			**15443**			**15062**			**16021**			**13076**
Net Revenue	**L.E**			**10896**			**10615**			**11109**			**8325**

Table 12: Crop Budget for Wheat Grown by in Sharkia Governorate

Cost/Revenue	Unit	*Non-adopters*									*Adopters*								
		< Feddan			1-2 Feddans			> 2 Feddans			< Feddan			1-2 Feddans			> 2 Feddans		
		Q	Price	V	Q	Price	V	Q	Price	V	Q	Price	V	Q	Price	V	Q	Price	V
Land Preparation	Feddan	1	350	350	1	350	350				1	465	465	1	480	480	1	500	500
RBM	Hour										1	150	150	1	150	150	1	150	150
Seeds	Kg	45	5	225	45	5	225				35.3	5.5	194.2	72	5.4	388.8	35.5	6	213
Manure	m^3	10	26	260	18.3	26	475.8				12.3	26	319.8	17.5	21.5	376.3	35	28	980
N. Fert	Bag (50Kg)	2	161	322	3.4	166	564.4				2.6	157	408.2	5.1	160	816	5	160	800
Phos. Fert	Bag (50Kg)	1	63	63	1	60	60				1.2	67	80.4	2.4	65	156	2	66	132
Potash Fert	Bag (50Kg)			0			0						0			0			0
Pesticides	Feddan	1	120	120	1	120	120						0			0			0
Labor	No.	25	75	1875	19	75	1425				19	73	1387	19	70	1330	20	72	1440
Fuel	Liter			0			0						0			0			0
Irrigation	Hour	5	75	375	5	75	375				4	90	360	4	90	360	4	90	360
Harvest	Hour	4	100	400	4	100	400				1	105	105	1	105	105	1	100	100
Total Cost	**L.E**			**3990**			**3995**						**3470**			**4162**			**4675**
Main Product	**L.E**	18	560	10080	17.75	565	10029				18	563	10134	19.1	562	10734	19.8	568	11246
Byproduct	**L.E**	13	200	2600	11.5	200	2300				13	195	2535	14	194	2716	12	200	2400
Total Revenue	**L.E**			**12680**			**12329**						**12669**			**13450**			**13646**

Partial Farm Budget [3, 4]

Partial farm budget is a tool employed to help land holders make decisions on the alternative uses of available resources based on profitability gained. Many of the decisions based on Partial Farm Budgeting are incremental, such as adding land or changing how a farm is being managed. It is usually used to analyze the costs and revenues that change with partial changes, which helps land holders assess the financial impact of incremental changes. In the context of this report, partial farm budget has been used to analyze revenue generated from wheat production under both MRB and traditional farming systems.

Main Indicators (Assiut) [7, 8]

Main indicators for wheat grown under MRB and traditional farming systems, presented in table 13, reveal the following:

- ***Total Production Cost for Adopter an Non-adopter***

Total production cost per feddan reached LE 8047, 7947, 825538 and 8251 for adopter male farmers, non-adopter male farmers, adopter female farmers and non-adopter female farmers, respectively. Of these totals, total fixed cost per feddan reached LE 3500, representing land rent for all of the four mentioned categories, whereas total variable cost reached LE 4547, 4447, 4755.8 and 4751 for the mentioned categories, respectively.

- ***Gross Margin (LE/Feddan)***

Gross margin per feddan for adopter and non-adopter male and female farmers reached LE 10896, 10615, 11265.2 and 8325, respectively.

- ***Net Revenue (LE/Feddan)***

Net revenue per feddan for adopter and non-adopter male and female farmers reached LE 7396, 7115, 7765.2 and 4825, respectively.

- ***Net Revenue (LE/ton)***

Net profit per ton for adopter and non-adopter male and female farmers reached LE 329.4, 317.6, 336.2 and 268.1, respectively.

- ***Revenue per Water unit (LE/1000 m^3)***

Revenue per water unit for adopter and non-adopter male and female farmers reached LE 5.3, 5.2, 5.5 and 4.5, respectively.

Table 13: Main Indicators for Wheat Grown under MRB and Traditional Farming in Assiut Governorate

Indicator	Unit	Adopters (Males)	Non-adopters (Males)	Adopters (Females)	Non-adopters (Females)
Total Fixed Cost	**LE**	3500.0	3500.0	3500.0	3500.0
Total Variable Cost	**LE**	4547.0	4447.0	4755.8	4751.0
Total Cost	**LE/feddan**	8047.0	7947.0	8255.8	8251.0
Total Cost	**LE/ton**	358.2	353.7	337.4	356.7
Total Revenue	**LE**	15443.0	15062.0	16021.0	13076.0
Gross Margin	**LE/feddan**	10896.0	10615.0	11265.2	8325.0
Net Revenue	**LE/feddan**	7396.0	7115.0	7765.2	4825.0
Net Revenue	**LE/ton**	329.4	317.6	336.2	268.1
Revenue per Water Unit	**L E/m3**	5.3	5.2	5.5	4.5

Main Indicators (Sharkia)

Main indicators for wheat grown under MRB and Traditional farming systems, presented in table 14, indicate the following:

- ***Total Cost***

Total fixed cost per feddan for non-adopter and adopter farmers under all land holding categories reached LE 3500. However, total variable cost (TVC) varied according to land holding category, where TVC reached LE total 3990 and 3995.2 for non-adopters with holdings less than one feddan and 1-2 feddans, respectively, while reached 3469.6, 4162.1 and 4675 for adopters with holdings less than one feddan, 1-2 feddans and more than 2 feddans, respectively. Accordingly, total cost for non-adopters with holdings less than one feddan and 1-2 feddans reached LE 7490 and 7495.2, respectively, whereas total cost for adopters with holdings less than one feddan, 1-2 feddans and more than 2 feddans reached LE 6969.6, 766.1 and 8175, respectively.

- ***Gross Margin (LE/Feddan)***

Gross margin per feddan realized by non-adopters with holdings less than one feddan and 1-2 feddans reached LE 8690 and 8333.8, respectively, while adopters with holdings less than one feddan, 1-2 feddans and more than 2 feddans realized LE 9199.4, 9287.9 and 8971, respectively.

- **Net Revenue (LE/Feddan)**

Net revenue realized by non-adopters with holdings less than one feddan and 1-2 feddans reached LE 5190 and 4833.8, respectively, while adopters with holdings less than one feddan, 1-2 feddans and more than 2 feddans realized LE 5699.4, 5787.9 and 8971, respectively.

- **Net Revenue (LE/ton)**

Net profit realized by non-adopters with holdings less than one feddan and 1-2 feddans reached LE 288.3 and 272.3, respectively, while adopters with holdings less than one feddan, 1-2 feddans and more than 2 feddans realized LE 316.6, 303 and 453.1, respectively.

- **Revenue per Water unit (LE/1000 m^3)**

Revenue per water unit for non-adopters with holdings less than one feddan and 1-2 feddans reached LE 6 and 5.9, respectively, while adopters with holdings less than one feddan, 1-2 feddans and more than 2 feddans realized LE 6, 6.4 and 6.5, respectively.

Table 14: Main Indicators for Wheat Grown under MRB and Traditional Farming in Sharkia Governorate

Indicator	Unit	Non-adopters			Adopters		
		< Feddan	1-2 Feddans	> 2 Feddans	< Feddan	1-2 Feddans	> 2 Feddans
Total Fixed Cost	**LE**	3500.0	3500.0		3500.0	3500.0	3500.0
Total Variable Cost	**LE**	3990.0	3995.2		3469.6	4162.1	4675.0
Total Cost	**LE/feddan**	7490.0	7495.2		6969.6	7662.1	8175.0
Total Cost	**LE/ton**	416.1	422.3		387.2	401.2	412.9
Total Revenue	**LE**	12680.0	12329.0		12669.0	13450.0	13646.0
Gross Margin	**LE/feddan**	8690.0	8333.8		9199.4	9287.9	8971.0
Net Revenue	**LE/feddan**	5190.0	4833.8		5699.4	5787.9	8971.0
Net Revenue	**LE/ton**	288.3	272.3		316.6	303.0	453.1
Revenue per Water Unit	**L E/m^3**	6.0	5.9		6.0	6.4	6.5

Livestock Assets

Surveying livestock assets in **Assiut** reveals that non-adopter male farmers own (in average) 3sheep, 2 goats, 3 cows and 3 buffalos worth LE 4263, 1913, 60000 and 60000, respectively. Adopter male farmers own 2sheep, 3 goats, 2cows and 2 buffalos worth LE 3864, 2060, 49000 and 52041, respectively. On the other hand, non-adopter female farmers own 1.8 sheep, 2.3 goats, 1.25 cows and 1.87 buffalos worth LE 3168, 2061, 1250 and 35156, respectively; whereas adopter female farmers own 2.7 sheep, 2.7 goats, one cow and 2 buffalos worth LE 4889, 4178, 20000 and 48000, respectively, as shown in table 15.

Table 15: Average Numbers of Livestock Herds in Assiut Governorate

Livestock	*Non-adopter Male Farmers*			*Adopter Male Farmers*			*Non-adopter Female Farmers*			*Adopter Female Farmers*		
	No.	P LE	Value LE	No.	P LE	Value LE	No.	P LE	Value LE	No.	P LE	Value LE
Sheep	2.75	1550	4263	2.4	1610	3864	1.8	1760	3168	2.7	1833	4889
Goats	2.25	850	1913	2.5	810	2060	2.3	833	2061	2.7	1567	4178
Cows	3	20000	60000	2.3	21000	49000	1.25	15750	1250	1	20000	20000
Buffalo	3	20000	60000	2.4	21430	52041	1.87	18750	35156	2	24000	48000

Data in table 16 regarding livestock assets in **Sharkia** reveals that non-adopter farmers who hold less than one feddan own 3 goats, 1 cow, 1.4 buffalos and 1.3 calves worth LE 7500, 20333, 35840 and 17778, respectively. Non-adopters with holdings 1-2 feddans own one cow, 1.4 buffalo and 2 calves worth LE 20000, 34719 and 20000, respectively; whereas non-adopters with holdings greater than 2 feddans own one cow and 1.3 buffaloes worth LE 22000 and 25000, respectively. Turning to MBR adopters, those with holdings less than one feddan own 2 sheep, one goat, 1.6 cows, 1.2 buffalo and 2 claves, respectively, while those with holdings 1-2 feddans own one cow, one buffalo and 2 calves, respectively, as shown in table 16.

Table 16: Average Numbers of Livestock Herds in Sharkia Governorate

Livestock	Non-adopters									Adopters					
	< Feddan			1-2 Feddans			> 2 Feddans			< Feddan			1-2 Feddans		
	No.	P LE	Value LE	No.	P LE	Value LE	No.	P LE	Value LE	No.	P LE	Value LE	No.	P LE	Value LE
Sheep										2	2875	5750			
Goats	3	2500	7500							1	2167	2167			
Cows	1	20333	20333	1	20000	20000	1	22000	22000	1.6	21143	34735	1	22000	22000
Buffalo	1.4	25600	35840	1.4	25250	34719	1.3	25000	31250	1.2	26250	57750	1	27000	27000
Calves	1.3	13333	17778	2	13000	26000				2	13000	26000	2	12000	24000

Sources and Value of Animal Feed

Exploring various sources of animal feed at the level of male and female farmers in Assiut Governorate reveals that non-adopter male farmers use 0.72 tons of maize, 0.95 ton of wheat straw, 0.64 ton of bran and 19.8 tons of clover worth LE 3528, 802, 2861 and 7821, respectively; whereas adopter male farmers use 1.3 tons of maize, 0.9 ton of wheat straw, 3 tons of bran and 27 tons of clover worth LE 6370, 734, 13054 and 10530, respectively. On the other hand, non-adopter female

farmers use 0.875 of tons maize, 0.7 ton of wheat straw, 2.8 tons of bran and 2.8 tons of clover worth LE 4266, 666.4, 12320 and 8085, respectively; while adopter female farmers use 1.3 tons of maize, 1.05 ton of wheat straw, 2.7 tons of bran and 26.8 tons of clover worth LE 6110, 773, 11880 and 10720, respectively, as shown in table 17.

Table 17: Average Quantity, Price and Value of Animal Feed Components at the level of Sample Farmers in Assiut Governorate

Source	Non-adopter Male Farmers			Adopter Male Farmers			Non-adopter Female Farmers			Adopter Female Farmers		
	Q (Ton)	P (LE)	Value LE	Q (Ton)	P (LE)	Value LE	Q (Ton)	P (LE)	Value LE	Q (Ton)	P (LE)	Value LE
Maize	0.72	4900	3528	1.3	4900	6370	0.875	4875	4266	1.3	4700	6110
Silage												
Wheat Straw	0.95	844	802	0.9	816	734	0.7	952	666.4	1.05	736	773
Byproducts												
Bran	0.64	4458	2861	3	4425	13054	2.8	4400	12320	2.7	4400	11880
Meal (cake)												
Clover	19.8	395	7821	27	390	10530	21	385	8085	26.8	400	10720

Various sources of animal feed at the level of sample farmers in Sharkia, presented in table 18, reveal that non-adopter farmers use 1.64 tons of wheat straw, 2 tons of meal and 16.56 tons of clover worth LE 1220, 8736 and 6486, respectively; whereas adopter farmers use 1.93 tons of wheat straw, 1.36 tons of bran, 2.88 tons of meal and 26.7 tons of clover worth LE 1502, 5428, 2300 and 10284, respectively.

Table 18: Average Quantity, Price and Value of Animal Feed Components at the level of Sample Farmers in Sharkia Governorate

Source	Non-adopters			Adopters		
	Q (Ton)	P (LE)	Value LE	Q (Ton)	P (LE)	Value LE
Maize						
Silage						
Wheat Straw	1.64	744	1220	1.93	778.5	1502
Byproducts						
Bran				1.357	4000	5428
Meal (cake)	2	4368	8736	2.88	800	2300
Clover	16.56	391.67	6486	26.7	385.18	10284

Dairy Products

Results of studied quantity, price and value of dairy products in Assiut and Sharkia Governorate are presented in table 19. It can be noted that non-adopter male famers in **Assiut** sell 2700 kgs of milk, 540 kgs of cheese and 270 kgs of butter worth LE 27300, 6480 and 16200, respectively; while adopter male farmers sell 6318 kgs of milk and 450 kgs of cheese worth LE 60653 and 560, respectively. Non-adopter female farmers sell 4860 kgs of milk and 810 kgs of cheese worth 45684 and 9720 kgs, respectively; whereas adopter female farmers sell 6210 kgs of milk, 270 kgs of cheese and 270 kgs of butter worth LE 62100, 3510 and 16200, respectively. Turning to Sharkia, non-adopters of MRB sell 3522 kgs of milk and 332 kgs of cheese worth LE 36277 and 5080, respectively; whereas adopters sell 6167 kgs of milk, 589 kgs of cheese and 420 kgs of butter worth LE 66604, 9130 and 21840, respectively.

Table 19: Quantity, Price and Value of Marketed Dairy Products (in Kilograms)

Product	*Assiut*												*Sharkia*					
	Non-adopter Male Farmers			*Adopter Male Farmers*			*Non-adopter Female Farmers*			*Adopter Female Farmers*			*Non-adopters*			*Adopters*		
	Q	**P**	**V**	**Q**	**P**	**V**	**Q**	**P**	**V**	**Q**	**P**	**V**	**Q**	**P**	**V**	**Q**	**P**	**V**
Milk	2700	9	24300	6318	9.6	60653	4860	9.4	45684	6210	10	62100	3522	10.3	36277	6167	10.8	66604
Cheese	540	12	6480	450	14	560	810	12	9720	270	13	3510	332	15.3	5080	589	15.5	9130
Butter	270	60	16200							270	60	16200				420	52	21840

Source of and Value of Irrigation Water

River Nile and wells represent the main sources of irrigation water in **Assiut** and **Sharkia**. It can be noted from table 20 that River Nile is the main source of irrigation water at the level of **Assiut** sample, at an average cost per feddan ranging between a minimum of LE 540 and a maximum of LE 584. In **Sharkia**, River Nile also represents the main source of irrigation water, where 36 of the non-adopters and adopters use Nile water, at an average cost ranging between a minimum of LE 144 and a maximum of LE 820, respectively; whereas 4 of the non-adopters and adopters use wells and Nile water at an average cost ranging between a minimum of LE 280 and a maximum of LE 1310, respectively, as shown in table 21.

Table 20: Source and Average Value of Irrigation Water in Assiut Governorate

Category	*Non-adopter Male Farmers*		*Adopter Male Farmers*		*Non-adopter Female Farmers*		*Adopter Female Farmers*	
	Nile	Value	Nile	Value	Nile	Value	Nile	Value
<1 Fed.								
1-2 Fed.	20	565	20	540	20	575	20	584
> 2 Fed.								
Total	20	565	20	540	20	575	20	584

Table 21: Source and Average Value of Irrigation Water in Sharkia Governorate

Category	*Non-adopters*				*Adopters*			
	Nile	Value	Wells & Nile	Value	Nile	Value	Wells & Nile	Value
<1 Fed.	32	144	4	280	19	140	1	220
1-2 Fed.	4	267			10	275	1	415
> 2 Fed.					7	820	2	1310
Total	36		4	280	36		4	

Sources of Finance

Surveying the sources of finance at the level of Assiut and Sharkia samples indicates that none of the farmers in Assiut received any loan, while some of the farmers in Sharkia did receive loans. Exploring the sources from where farmers received loans indicate that one of the non-adopters in Sharkia received a bank loan to improve plant and animal production, while the remaining 39 did not receive loans. As for adopters, only one of the 20 adopters whose land holdings is less than one feddan received a bank loan to buy production inputs, while the remaining 19 received no loans; 2 of the 15 adopters who have land holdings between 1-2 feddans received bank loans to improve plant and animal production, as shown in table 22.

Table 22: Sources of Finance in Sharkia Governorate

Land Holding Category	Non-adopters					Adopters				
	Loan		If Yes		Reason	Loan		If Yes		Reason
	Yes	No	Bank	Trader		Yes	No	Bank	Trader	
<1 Fed.	1		1		Improve Production	1	19	1		To buy inputs
1-2 Fed.		39				2	13	2		To improve Production
> 2 Fed.							5			
Total	40		1			3	37			

Source of Information about Raised Beds

As shown in table 23, all of the adopters in **Assiut and Sharkia** knew about raised-bed farming from neighbors. By contrast, all of the non-adopter male farmers in Assiut and Sharkia, in addition to 7 of the non-adopter female farmers in Assiut never knew about raised-bed farming. However, 13 of the non-adopter female farmers in Assiut knew about it from neighbors.

As regards the reasons for not adopting raised bed farming, data in table 24 reveal that all of the non-adopters in Assiut and 26 in Sharkia mentioned that ignorance of how to use the machine is the reason, whereas 4 in Sharkia mentioned that the machine is not suitable to their land, one farmer said the cost of renting the machine is high, 3 said the reason is ignorance of how to use the machine and the machine is not suitable to their land. Finally, 6 farmers mentioned other reasons.

Table 23: Sources of Information about Raised Bed Farming

Category	Assiut								Sharkia				If yes, source of information
	Non-adopter Male Farmers		*Adopter Male Farmers*		*Non-adopter Female Farmers*		*Adopter Female Farmers*		*Non-adopters*		*Adopters*		
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
<1 Fed.										36	20		Neighbors
1-2 Fed.		20	20		13	7	20			4	15		Neighbors
> 2 Fed.											5		Neighbors
Total		20	20		13	7	20			40	40		Neighbors

Table 24: Reasons for not Adopting Raised Bed Machine at the Level of Non-adopters in Assiut and Sharkia Governorate

Governorate	Assiut		Sharkia
Reason	Males	Females	
1. Ignorance on how to use the machine	20	20	26
2. Not suitable to land			4
3. High Cost			1
4. 1 + 2			3
5. Other			6

Cost of using Raised Bed Machine

Results of asking farmers about the average cost of using RBM in wheat planting indicate that all the farmers in Assiut did not bear any cost, whereas average cost in Sharkia ranges between LE 232 and LE 266 per feddan, as shown in table 25.

Table 25: Average Cost of using Raised Bed Machine in Wheat Planting

Category	Assiut						Sharkia			
	Males			Females						
	Area (Fed)	Cost LE	First time	Area (Fed)	Cost LE	First time	Area (Qerat)*	Area (Fed)	Cost LE	First time
<1 Fed.							15.5	-	150	2
1-2 Fed.	1	Free	2	1	Free	2	4	1	300	3
> 2 Fed.							8	3	886	4

* One Qerat = 1/24 fed or 175m^2

Benefits of using Raised Bed Machine

Adopters of raised bed machine were asked to assess the level of benefiting based on their own experience. Results presented in table 26 reveal that all of the farmers in Assiut believe that using RBM saves water, reduces crop losses and cost, saves time & effort, and improves yield. In regards to Sharkia, only one farmer mentioned that it saves irrigation water, but all of the farmers said it lowers production cost, saves time and effort, and improves yield. However, 14 of the farmers mentioned that using RBM is not effective in terms of saving irrigation water, while 14 showed neutral reaction regarding this benefit. In addition, 17 mentioned that it is not effective in reducing crop losses, while 23 showed neutral reaction regarding this benefit.

Table 26: Degree of Benefiting from Raised Bed Machine

Governorate	Assiut (Males)			Assiut (Females)			Sharkia		
Benefits	Impact			Impact			Impact		
	Effective	Ineffective	Neutral	Effective	Ineffective	Neutral	Effective	Ineffective	Neutral
Water Saving	**20**			**20**			**1**	**14**	**14**
Reducing crop losses	**20**			**20**			**0**	**17**	**23**
Reducing production cost	**20**			**20**			**40**	**0**	**0**
Saves time and effort	**20**			**20**			**40**	**0**	**0**
Improves yield	**20**			**20**			**40**	**0**	**0**

Farmers' Assessment of Benefits Gained from Raised Bed Machine

Farmers were asked to assess the benefits gained from using RBM in wheat planting. Results presented in table 27 reveal that the majority of non-adopter male and female farmers in **Assiut** are either neutral or unsure about the benefits, while only few agree about some of the benefits. By contrast, responses from adopter male and female farmers ranged between strongly agree and agree about all the benefits, with only 6 neutrals about the possibility to use the machine in small areas. In **Sharkia**, results presented in table 28 reveal that the majority of non-adopters are unsure about the benefits, with some exceptions ranging between agree and neutral. Adopters' responses mostly ranged between agree and strongly agree, while 14 do not agree that it makes weed removing easy, and 20 are unsure about using the machine in small areas.

Problems Facing Adopters while using RBM

Asking adopters about problems confronted while using RBM in planting revealed the following:

- Clogging of seed tubes; results in less number seeds per planted area, leading to partial loss in production thus revenue.
- Some difficulties in maintenance; where maintenance service is relatively far and a tractor is required to transport RBM, which is an additional cost above the maintenance cost, let alone the time that passes without benefiting from the machine until fixed.
- Some weeds grow along with the crop, which requires follow-up and spraying.

Table 27: Assiut Farmers' Assessment of Benefits Gained from Raised Bed Machine

Category	Non-adopter Male Farmers						Adopter Male Farmers						Non-adopter Female Farmers						Adopter Female Farmers					
Criteria	**Strongly Agree**	**Agree**	**Neutral**	**Do Not Agree**	**Totally Refuse**	**Unsure**	**Strongly Agree**	**Agree**	**Neutral**	**Do Not Agree**	**Totally Refuse**	**Unsure**	**Strongly Agree**	**Agree**	**Neutral**	**Do Not Agree**	**Totally Refuse**	**Unsure**	**Strongly Agree**	**Agree**	**Neutral**	**Do Not Agree**	**Totally Refuse**	**Unsure**
Can be used in small areas of land			5	2	1	12	7	7	6						8	1	1	10	10	10				
Available at all times			13			7	12	8						3	9			8	17	3				
Easy to use			11	1		8	12	8						2	9	1		8	20					
Maintenance is simple			4			16	13	9							7			11	20					
Improves Production			9			11	13	7						2	12			6	20					
Saves Cost			3			17	11	9						1	3			16	20					
Affordable		1	1			18	14	6						1	3			16	20					
Allows good distribution of seeds		1	4			15	14	6							6			14	20					
Makes weed removing easy			12	3		15	13	7							15	2		3	20					
Makes harvesting easy		8	5			7	13	7						2	3			15	20					

Table 28: Sharkia Farmers' Assessment of Benefits Gained from Raised Bed Machine

Category	Non-adopters						Adopters					
Criteria	**Strongly Agree**	**Agree**	**Neutral**	**Do Not Agree**	**Totally Refuse**	**Unsure**	**Strongly Agree**	**Agree**	**Neutral**	**Do Not Agree**	**Totally Refuse**	**Unsure**
Possible to use in small areas of land		1	4	5	1	29		11	5	4		20
Available at all times		9	9			22	5	33	1			1
Easy to use		5	9	2		24	6	31				3
Simple Maintenance		1	2			37	1	28	3	1		7
Improves Production		3	12			25	3	37				
Saves Cost		3	6			31	12	28				
Affordable		6	5			29	2	38				
Good distribution of seeds		4	4			32	4	36				
Makes weed removing easy		13	5			22		22	4	14		
Makes harvesting easy		17	2			21	21	19				

Agricultural Service Providers

First: Agricultural Extension Agents

Governorate	Benefits of RBM	Targeted Farmer Categories	Common Communication Methods	Criteria for receiving production inputs	Duration to receive the service	Challenges Extension Agent face while offering the service	Ways to activate the role of Extension Agent	Resources required to activate the role of agricultural extension
Assiut	Improvement of irrigation efficiency and production; reduced quantity of inputs; lighter weight and soil texture.	Male & female farmers; either owners or tenants at the level of all categories.	Lectures, extension seminars, and group discussions with farmers at the fields, cooperatives and mosques.	Land area & agricultural ID Card (Fertilizers & Seeds)	Same day	Deficiency in quantity of fertilizers & high prices	Applying modern extension system and recommendations offered by modern scientific research	Providing an extension room equipped with modern extension means and delivering the most recent extension advices to farmers
Sharkia	Improvement of irrigation efficiency and production; reduced quantity of inputs; lighter weight and soil texture.	Male & female farmers; either owners or tenants at the level of all categories.	Lectures, extension seminars, and group discussions with farmers at the fields, cooperatives and mosques.	Seeds: a copy of personal ID, rent contract, holding document. Fertilizers: Actual size and area of land holding	Same day	Problems related to waqf lands, insufficient quantities of seeds and fertilizers	Providing needs and requirements for offering extension services	Money incentives and allowances

Second: Rural Leaders

Governorate	Benefits of RBM	Services offered by coop society	Conditions for Membership	Reasons for resorting to coop society	Procedures followed to get production inputs	Duration to receive inputs	Is there a quota for the quantity and type of inputs?	Is it seasonal?	Role played inside the village	Type of inputs offered to members of coop society	Policies followed in disbursing inputs	Challenges confronting coop society while distributing inputs	Charges paid to receive the service
Assiut	Improvement of irrigation efficiency and production; reduced quantity of inputs; lighter soil texture due to light weight.	Providing inputs and extension to farmers regarding modern farming and irrigation methods	Willingness to help farmers, dedication to social work. Familiarity with agricultural products' production and distribution markets	Inputs are sold at prices pre-set by the government and are obtained from credible sources	Owning a land holding ID, type of land holding	Same day of presenting the documents	Yes; according to land holding size	Yes; disbursed according to crop season and at rationed quantities	Participating in all occasions & accomplishing people's needs, especially widows and the needy	Seeds and fertilizers of all types	Quantities are disbursed according to land area, planted crop and season	Shortage in quantity or type of fertilize at certain time, and high prices of fertilizers and seeds	Free of charge
Sharkia	Improvement of irrigation efficiency and production; reduced quantity of inputs; lighter soil texture due to light weight.	Providing inputs and extension to farmers regarding modern farming and irrigation methods	Owning a land holding document in the name of farmer	Inputs are sold at prices pre-set by the government and are obtained from credible sources	Copies of: personal ID, land holding ID card, tenancy contract in case the farmer is a tenant, rent payment invoice, survey of cropped area	Same day of presenting the documents	Yes; according to land holding size	Yes; disbursed according to crop season	Raising farmers' awareness and solving problems facing them	Seeds and fertilizers of all types	Quantities are disbursed according to land area, planted crop and season	Not available in time; and it is hard for the farmer to pay the full value at once	LE 5/fed/year for land service

Third: Infrastructure

a) Public Utilities

Governorate	Is the electricity available for every house in the village?	Does the electricity network operate regularly?	frequency of power outage	Is there a drainage or sewage system	Does the drainage or sewage water run through houses?	Source of drinking water in the village	Percentage of households connected to governmental water network	Does the water network operate regularly?	Frequency of water cuts	Is there a fire extinguishing unit.?	Is there sanitary drainage in the village?
Assiut	Yes	Regular & strong	Once or twice per month	Yes	No	Public water network	100%	Yes	Once or twice	No	Yes
Sharkia	Yes	Regular & strong	Once or twice per month	Yes	No	Public water network	100%	Yes	3 times/month	No	Yes

- There is one Veterinary service unit, agricultural cooperative society and branches of village bank

b) Markets

Governorate	Assiut	Sharkia
Wholesale market	Not available	Available
Livestock market	Not available. The nearest market is 6 kilometers far.	Available
Fertilizers and pesticides' dealers	Available; 5 for fertilizers and 2 for pesticides	Available; 6 for fertilizers and 6 for pesticides
Bakeries	Available; 3 western bakeries and no bakeries for pita bread	Available; 12 pita bread bakeries and 7 western bakeries

c) Methods of House Waste Disposal

Governorate	**Assiut**	**Sharkia**
Collection from houses	No	Yes
Thrown in litter bins in the street	Yes	Yes
Burned	No	Yes
Thrown in the Nile and canals	No	Yes
Throw in the street	No	Yes
Used as feed for cattle and birds	No	Yes
Thrown in empty lands	No	Yes
Throw over buffalo and cow dung	No	Yes

Fourth: Infrastructure

Bank Managers

Governorate	Benefits of RBM	Experience	Borrowers Categories	Reasons for requesting loans	Criteria for loan approval	Maximum limit of personal loans (LE)	Maximum limit of project loans (LE)	Administration Fees
Assiut	Improve in irrigation efficiency and production; reduced quantity of inputs; lighter weight and soil texture.	20 years	Male & female farmers; either owners or tenants at the level of all categories.	To establish agricultural development projects	Providing collaterals (land holding document, either the land is owned or rented, proof of loan repayment credibility	4200	50 thousand	1‰ in case of agricultural loans; 1.5‰ in case of investment loans
Sharkia	Improve in irrigation efficiency and production; reduced quantities used of seeds, fertilizers and labor; lighter weight and soil texture.	22 years	Governmental employees, land holders, owners of saving accounts, small farmers (Renew Your Life Project)	To establish agricultural development projects	To be a governmental employee (salary); holder (land); loan personal collaterals in case of small loans	4200	100 thousand	1‰ in case of agricultural loans; 1.5‰ in case of investment loans

Fifth: Infrastructure

Providers of Agricultural Machinery

Governorate		Awareness regarding RBM	Benefits of RBM	Experience	Type of operation the machine is mostly rented for	Targeted Categories	Unit Cost
Assiut	Providers of Agricultural Machinery	Yes	Improve in irrigation efficiency and production; reduced quantities used of seeds, fertilizers and labor; lighter weight and soil texture.	20 years	Plowing and leveling	Male & female farmers; owners or tenants at the level of all categories.	Per *"Qerat*"
	Agricultural mechanization station and farms	No	-	20 years	Plowing and leveling	Male & female farmers; owners or tenants at the level of all categories.	Per hour, thus rent differs according to distance from main road
Sharkia	Tractor drivers	Yes	Improve in irrigation efficiency and production; reduced quantities used of seeds, fertilizers and labor; lighter weight and soil texture.	225 years	Plowing and leveling	Male & female farmers; owners or tenants at the level of all categories.	Per Qerat

Godeida Focus Group Discussion

Total population 9125

Number of farmers: 575

Number of holders: 275

Land holding category (less than one feddan) represents 90%. The remaining 10% are holders of 1-5 feddans.

The first time to use RBM was in 2011. Area planted is estimated at 30 feddans.

Between 2011 and 2015, number of MRB adopters reached 120 farmers, with total land area estimated at 80 feddans.

Around 120 farmers use RBM in wheat and maize planting. Adoption rate is about 20.8%.

The width of bed is 90 centimeters, with 7 rows for planting. Irrigation water is distributed evenly and penetrates the soil easily, providing seeds with proper irrigation requirements. So, it saves water and reduces crop losses.

First: FGD with Adopters

A. Results of FGD with 10 Males

FGD was conducted in Godiada village on Thursday 5/1/2016. Results reveal that:

1. All farmers knew about RBM from Dr. Atef who invented the machine and used it for the first time in his land.
2. All farmers are aware of using MRB farming package.
3. Farmers reported that MRB saves inputs like seeds, irrigation water, gasoline, labor and increases productivity.
4. They mentioned that it can be used in any type of soil and in all holding size categories.
5. RBM driver reported that he uses the machine in planting wheat and maize in Sharkia, and sugar beet in Kafr El-Sheikh.
6. Farmers reported that they do not pay fees for using the machine. Only LE 120-240 per Feddan is paid for the driver.

7. Planting cost in case of adopting MRB is LE 120-240 per Feddan, plus half of the cost of seeds against LE 480-720 per Feddan under traditional farming.
8. Farmers reported that the cost of using RBM is LE 200 per Feddan in case provided by private sector.
9. Private sector is the only source for obtaining seeds. For fertilizer, 30% is obtained from agric Coops and 70% from the private sector.
10. Planting time is very short, whereas demand for RBM is highly increasing. So, the number of available RBM is not sufficient to meet the increasing demand.

B. Results of FGD with 8 Females

FGD was conducted in Godiada village on Sunday 10/1/2016. Results reveal that:

1. All farmers knew the MRB from neighbors.
2. All farmers knew about MRB package.
3. Only 2 farmers, i.e., 25%, knew the technical conditions associated with MRB.
4. All farmers reported that MRB technology saves seeds, irrigation water, gasoline, and labor, and improves productivity.
5. They also reported that it can be used in any type of soils and in all sizes of land.
6. All farmers reported that RBM can be used in planting wheat in the winter and maize in the summer.
7. Fees of using RBM range between LE480 and 720 per Feddan.
8. All farmers have equal access to the machine and other services.

Second: FGD with Non-adopters

C. Results of FGD with 10 Males

FGD was conducted in Godiada village on Tuesday 7/1/2016. Results reveal that:

1. All farmers knew about RBM and wish to use it, but the number of available machines is not sufficient at the time of planting.
2. They reported that the potential area is 1300 feddans, while the machine is used in only 100 feddans.

3. Farmers mentioned that the machine is not available at agricultural cooperatives. By contrast, private sector has sufficient number of RBMs. However, fees paid to private sector are higher than those paid to agricultural coops, but available at any time.
4. All farmers asked to make the machines available at agricultural coops.
5. Private sector is the main source of seeds and other inputs. Agricultural coops are responsible for obtaining inputs and providing them to farmers to protect them.

D. Results of FGD with 10 Females

FGD was conducted in Godieda village on Sunday 10/1/2016. Results reveal that:

1. 6-8 of them knew about MRB, while the rest have no information about it.
2. Half of them knew about MRB package. The source of information is neighbors and agricultural engineers.
3. Half of the females are interested in using the machines.
4. All agree that the main reason for non adoption is the lack of sufficient number of machines during the very short time of planting.
5. The main source where RBMs are available is the private sector.
6. All reported knowing that fees paid to agricultural coops is less than that paid to the private sector. But they commented that services are available and accessible at the private without routine procedures.
7. All females have equal access to the machine and other services.

Meet Bashar Focus Group Discussion

Total population: 16750

Number of farmers: 340

The number of farmers who use RBM is 220. They use it in planting wheat and maize. Adoption rate is about 28.9%.

The width of bed is 90 cm, with 7 rows for planting. Irrigation water is distributed evenly and penetrates the soil easily, providing seeds with proper irrigation requirements. So, it saves water and reduces crop losses.

First: FGD with Adopters

A. Results of FGD with 10 Males

FGD was conducted in **Meet Bashar** village on Thursday 5/1/2016. Results reveal that:

1. All farmers knew about MRB from Dr. Atef.
2. All farmers knew that plowing and laser leveling is a must before using MRB.
3. Farmers strongly agree that MRB technology saves seeds, irrigation water, gasoline, and labor, and improves productivity.
4. All farmers use RBM in planting wheat and maize. Some tried to use it in planting sugar beet and succeeded. Some of them reported that a few tried to use it in planting rice.
5. Farmers reported that they do not pay fees for using the machine. Only LE 120-240 per Feddan is paid for the driver.
6. Private sector is the main source of seeds. Agricultural Coops are the only source of fertilizers.
7. The machine can be used to plant about 15 feddans per day if they are in one spot compared to 10 feddans per day if they are located in more than one spot.
8. The main problem confronted while using RBM is that it does not work efficiently in case soil is not perfectly leveled, and the harvester does not work efficiently because of planting spaces.

B. Results of FGD with 8 Females

FGD was conducted in **Meet Bashar** village on Sunday 10/1/2016. Results reveal that:

1. All farmers knew about RBM from neighbors.
2. All farmers knew the conditions for using MRB.
3. Farmers reported that MRB saves inputs like seeds, irrigation water, gasoline, labor and increases productivity.

4. All farmers agree that the machine can be used in any size of land, and can be used in plating other crops in addition to wheat and maize.
5. Farmers reported that RBM can be used in planting wheat in the winter and maize in the summer.
6. Fees to use RBM reach about LE 240 per Feddan, paid as a wage for the driver.
7. All farmers buy their needs of inputs from private sector.
8. All farmers reported that they have equal access to the machine and other services.

Second: FGD with Non-adopters

C. Results of FGD with 10 Males

FGD was conducted in **Meet Bashar** village on Tuesday 5/1/2016. Results reveal that:

1. All farmers knew everything about MRB and wish to use it, but the number of machines is not sufficient during the time of planting.
2. They mentioned that the machine can be used in planting wheat, maize and rice.
3. RBM is not available in agricultural coops or agricultural mechanization stations.
4. The main source of agricultural machinery is the private sector.
5. Agricultural coops only supply limited quantities of fertilizers.

D. Results of FGD with 8 Females

FGD was conducted in **Meet Bashar** village on Sunday 10/1/2016. Results reveal that:

1. All farmers knew about RBM.
2. 5 farmers are aware of practices associated with MRB package, while the rest are not aware about it.
3. Only half of the farmers are interested in using the machines.
4. 5 of farmers reported that the only source of inputs is the private sector.
5. All farmers said they know that the fees paid to agricultural coops are less than that paid to the private sector; however, they said that services in the private sector are available and accessible without routine procedures.
6. All farmers have equal access to the machine and other services.

Concluding Remarks and Policy Implications

Results implicate that promoting the adoption of raised bed farming requires formulating a set of policies and tools to activate the role of agricultural extension in providing farmers with information about MRB farming and associated benefits, in addition to organizing training programs to transfer to farmers the know-how on the introduced technology package. The set of policies should focus on availability of prober information about MRB package by increasing the number of extension officers and pilot plots, as most of the farmers knew about MRB farming from neighbors. It is also important to enhance farmers' accessibility to the machine by providing a sufficient number of raised bed machines in agricultural cooperative societies, where farmers mentioned that the cost of RBM in coop societies is reasonable but the number is not sufficient to meet the high demand during planting time, which will encourage more farmers to adopt and benefit from MRB farming. It is also important to activate the role of private sector in overcoming obstacles faced while using the machine to allow proper application of MRB technology package, which requires proper land preparation before using the machine, especially in old lands, in addition to solving the problem of clogging in seed tubes. Moreover, farmers' access to finance should be facilitated to allow them have access to the machine as well as essential inputs to increase their overall productivity thus income and livelihood. Enhancing the role of research is also highly important, where conducting a study to assess the economic efficiency of RBM use shall help in evaluating alternative uses of the machine, especially that farmers highlighted its use in planting maize and rice. Moreover, it is important to develop tools to coordinate the efforts of private sector, RBM industries, machinery traders and users; this will increase the opportunities, sustainability and economic efficiency of using the machine.

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Focus Group Discussion (FGD)
Farmers and Machinery Provides' Perceptions Regarding Mechanized Raised Bed (MRB) Technology in Egypt

1. Village Name

No	**Farmer's Name**	**Age**	**Type of Ownership 1-Owned 2-Rented**	**Frequency of using RBM**
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

2. Planted crops

No.	**Crop**	**Area Planted (Feddan)**	**User of MRB? 1. Yes 2. No**	**Cost of using MRB (L.E/Feddan)**	**Production (Ardab/Feddan)**
1					
2					
3					
4					

2.2. Production Inputs used for:……. (mention the crop at <u>the level of FGD</u>; Repeat for each crop)

	Item	Unit	Quantity	Price	Total
1	Land Preparation				
2	seeds				
3	N - fertilizer				
4	Phosphate fertilizer				
5	Potassium fertilizer				
6	Pesticides				
7	Labor				
8	Fuel				
9	Irrigation				
10	Harvesting				
11	**Total**				
12	**Revenue**				
13	Main product				
14	Byproduct				
15	**Total revenue**				

3. Source of Water

- What are your main water resources?
  1. River Nile ( ) 2. Well ( ) 3.Other, mention ……
- Cost of irrigation Water (for each source) in L.E/M3 ….,….…….

4. Using Raised Bed Machine (RBM) in crop planting:

- Are you well aware of using RBM? 1. Yes 2. No

- If yes, what is the main source of information? **<u>Please write the corresponding number of respondents</u>**

1. Extension 2. Neighbors 3. Media 4. Other, mention

- Have you ever used RBM? **<u>Please write the corresponding number of respondents</u>**

1. Yes 2. No

If yes, please mention the number of times for each crop:

Crop: Planted area: Cost:

- When was the first time you ever used RBM?

- Do you believe that using RBM is useful?

1. Yes 2. No 3. Neutral (no difference between MRB and traditional farming)

If yes, rate the following, **Please write the number of respondents**

Benefits	**1. Effective**	**2. Ineffective**	**3. Neutral**
Saving irrigation water			
Reducing crops Losses			
Reduced production cost			
Saving time and effort			
Increasing yield			

If No, please mention the problems faced and proposed solutions? **Please write the corresponding number of respondents in each case.**

Problem	**Proposed solution**
Do not know how to use RBM	
RBM is unsuitable for my land	
High Cost	
Other, mention	

8. Basic criteria for MRB technology adoption; Please write the corresponding number of respondents.

Criteria	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Refuse**	**Unsure/ inapplicable**
Can be used in small areas of land						
Available at all times						
Easy to use						
Maintenance is simple						
Improves Production						
Saves Cost						
Affordable						
Allows good distribution of seeds						
Makes weed removing easy						
Makes harvesting easy						

9. Challenges confronted while using RBM in performing agricultural practices

Please list the most important challenges that you are facing in agriculture.

1.

2.

3.