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Socio-economic aspects of buffalo production

Ibrahim Soliman and Ahmed F. Mashhour
Department of Agricultural Economics, Faculty of Agriculture, Zagazig University, Zagazig, Egypt

The Economic Reform and Structural Adjustment Programs (ERSAP) started in Egypt in November 1991 based on the agreement with the International Monetary Fund (IMF) and the World Bank. The ultimate goal for the program is to reinforce economic stability, growth, and efficiency. The economic liberalization policies were onset earlier in agricultural sector, than other sectors, i.e. in 1986/1987. The policy instruments were exemption of cropland allotment, phasing out of feed prices, to give allowance for importation of inputs and final products by the private sector, and gradually the crop prices have been freed (Soliman, 1994). Liberalization of prices, trade, and production impacted differentially upon the sectors of the food system. Impacts varied according to the proportional Increases of market prices following the reforms compared with increases in input costs following removal of subsidies (Soliman and Mashhour, 2000).

The major livestock production system is the traditional mixed agriculture farming system (buffaloes and native cows) which is characterized by very small herd sizes-typically just one or two animals (Soliman et al., 1982). Traditional mixed farms produce crops and livestock for both home consumption and sales. Livestock, under this system, is relatively intensive and concentrated on small subsistence-oriented farms in the irrigated cropping region. These intensive village-based systems predominate for cattle, buffalo, and small ruminants and produce 80 % of all beef, 80% of all milk and dairy products, and 60% of all mutton. Then, the success or failure of Egypt's livestock development programs depends upon their ability to influence traditional smaller farmer's decisions on investment in livestock.

The other principal production system is the commercial buffalo dairy herd. Up to mid of eighties these enterprises were known commonly as "Zaraba herds" or "flying herds", (Soliman and Abdul Zaher, 19884). They are located on the outskirts of major urban centers, such as Cairo and Alexandria. Normally, there is no breeding or production of replacement animals from within these herds themselves. Rather, lactating buffalo cows are purchased from outlying rural villages, thereafter; they are sold for slaughter once has completed lactation. Recently, another transaction system has been raised. The dairy buffalo operator replaces his buffalo cow during the year, through agents, in order to keep his milk supply stable over the entire year. The culled buffalo usually returns to traditional herd again, where the breeding system is found. This system composes of, relatively, small commercial dairy herds. Herds of 15 to 30 animals are common, while somewhat larger herds also exist. All feeds are purchased and consist of clover and crop residues from nearby farms as well as food processing wastes and feed concentrate mix. These herds account for an estimated 11 percent of milk animals and 13 percent of milk production.

The public sector, which had a very minor role in domestic milk and red meat supply, i.e. less than 2 percent in eighties (Soliman, 1984), has disappeared since nineties. The share of foreign cattle and crossbred cattle seems little. Recently, there has been substantial Expansion in foreign dairy cattle as private sector enterprising, including a few large as commercial dairies. Their share in total production has approached 6%.

This study focused upon dairy enterprise to evaluate the socio-economic aspects of buffalo production after economic reform program application in Egypt for several reasons. First, domestic production of milk (4% fat) has been increasing slowly over the last two decades (<1.5% a year), whereas, per capita consumption from domestic production has been increased by 5% a year, the imports of milk products (milk equivalent, 4% fat) have increased at 22% annually, to face the increasing deficit. However, total per capita consumption reached only 78 kilogram in 2000. On the other hand, milk prices have increased at an annual rate of more than 30 and the marketing margin between retail and wholesale stages has increased from 19% to more than 26%, as deducted from Soliman and Abdul-Zaher (1984); Soliman (1991) and Ministry of Agriculture and Land Reclamation, Economic Sector Affairs (2000).

Secondly, dairy buffalo is the main milk animal in Egypt. Buffaloes provide 50 percent of total milk supply (including imports), while native cattle produce about 11 percent. Therefore, it is safe to say that the buffalo improvement program has high potentiality to make significant impact on the livestock development in Egypt. Thirdly, there is a deficit in animal protein of the low-income households' diet rather than calories intake. The "vulnerable groups of those households" require highly digestible and highly biological value type of protein such as milk (not red meat) products (Soliman and Eid, 1992 and 1995). Furthermore, several economic studies in Egypt have shown that Egypt has comparative

advantage in milk production (Soliman, 1995; Soliman and Fitch, 1985). They cited that red meat production in Egypt has the highest comparative disadvantage.

Objectives of the present study

While the dairy buffalo in Egypt is the main source of milk production, particularly from small farming system, there have been few, if any, attempts to examine through a comparative study the economics feasibility of expanded buffalo production systems versus other systems, including domestic and exotic breeds. Furthermore, Egypt has, already passed an extensive economic reform program over the last two decades, which suppose to have a dramatic change upon livestock performances, particularly buffalo as the main livestock enterprise system in Egypt. Therefore, the present study has undertaken to examine the following economic questions: How have the buffalo productive and economic performances affected by the economic reform program? To how extend such impacts were positive? Which of the currently available production systems has the greatest economic advantages?

On the other hand, since most previous studies, up to mid of eighties, showed that the social factors are more significant than economic ones in deciding the investment in livestock on traditional farm, one of the main objectives of this study is to verify if this hypothesis after practicing the economic reform program and liberalization policies in the Egyptian market is still effective

Database

The study used input-output data of several successive sample surveys conducted, purposively, for livestock production systems in Egypt. All were designed and applied in the Eastern and middle Nile Delta Governorates, where the majority of livestock population, particularly, buffaloes is located. The first author of this article designed the questionnaire forms and the sample surveys and supervised the application of all those surveys. Accordingly, they were comparable, with respect to the samples and the sampling techniques. They were four representative samples, which covered the different cattle and buffalo production systems, including management systems. Two of them were conducted before the Era of economic reforms, i.e. within the mid of eighties. One covered the mixed farming system, of small livestock holdings with a sample size of 251 farms, representing the different farm sizes. The second survey covered the commercial systems (about 40 farms), which include; the dairy buffalo system and the exotic breed systems. The other two surveys were conducted during and after implementation of the economic reform program. One conducted at the mid of nineties (the sample size was 100 farms) and the other by the year 2001 (the sample was about 101 farms).

Two other purposive field samples for investigating the social aspects were utilized in this study, which have distinct characteristics. They were also designed by the first author of this paper and done under his supervision. The data for identification and investigation of social factors were collected and processed from the two questionnaire representing lower and Upper Egypt in 1981 and 1995. A stratified random sampling technique was applied to deal with the livestock investment decision-making of about 175 farms for each survey.

Methodology and analytical procedures

Using the survey data, a comparative analysis was made for the productive performance, costs of production, profitability. The analysis required estimates for the productivity, reproductive traits, costs, and income criteria for each production system. The return to investment was also calculated. The analysis required to adjust the yield per cow for lactation period length and the milk composition, particularly, the fat percent. The variability in fat percent requires adjusting the total milk yield per head to be 4% fat corrected milk, using "Jeans Equation" (Soliman and Abdul Zaher, 19884). Adjustment for the lactation period length required adjusting the total milk yield per lactation for an annual yield The study, also, generated an adjusted average costs per kilogram of milk, where the value of non-milk livestock outputs are deducted from the gross average costs. The value of non-milk livestock outputs is the sum of animal work –if any-, calf crop for sale, net inventory change of the entire herd value and manure production. Calf crop is the share per dairy cow of calves born (males and females) and raised for sale. Calf crop includes the value added of fed calves, after deduction of related costs of production. Net inventory change includes the growth value per dairy cow due to promotion from a lactating season to the successive one and net value added of replacement heifers. All calculations were made on per year basis as a share of a dairy cow per year. In the case of commercial non-breeding buffalo herds (Zaraba), the net inventory change per year is a negative value. This is because the replacement operation during a year of dairy buffaloes. This operation is required under this system in order to keep milk supply stable. It means to sell a less productive cow to purchase a higher productive one. Accordingly, there will be a loss between the sale price of a culled animal and purchase price of a new dairy one.

The study used in all tables the money unit of the Egyptian currency, which is the Egyptian pound (L.E.). For the year 1980, the used exchange rate was 1 E.L. = 1$, for the year 1993 the used exchange rate was 3.38 L.E. = 1$, for the year 2000 the exchange rate was 3.44L.E./1$. One Egyptian pound = 100 piasters. Profitability measures include both net farm income and normal profit. The net farm income is a criterion of the return to the farm own resources shared in production. They include family labor, equity and the farmer management share in the acquired income. The equity is the capital invested from the farm own assets. The final profitability criterion is the normal profit. It measures the share of manager and entrepreneur in the cross income, due to baring risk, creating ideas and management decisions. It is estimated. The return to investment was calculated, using the crude internal rate of return (Crude IRR 6 for the total investments, i.e. without deduction of the total liabilities (loans share in the capital invested), and for the equity, i.e. the return to the farm's capital shared in production, which is estimated by deduction of loans from the total investments.

With respect to social aspects, the study will attempt to relate the investment decision in cattle and buffalo with the following social and demographic features of the farm households: (1) farm endowments, represented by size of land holding, and size of farm machinery holding, (2) availability of family labor, (3) level of education of the family head, (4) age of the family head, and (5) occupation of the family head. Once the probability distribution of the investigated variables are not fully understood the Chi-square test, is applied: While, null hypothesis is that the concerned social and economic variables are independent of the decision to invest in livestock, the alternative hypothesis, is that they are not independent. Observed and expected joint frequencies of the farmers under each tested relation are calculated (Earl and Starr, 1983). Two-way contingency tables are presented for each relation. A contingency coefficient was derived for each relation to indicate the magnitude of the relation between livestock investment and each economic and social factor.

Results and Discussion

The results and discussion was classified into two major types of impacts. First the economic impacts and secondly, the social impacts

Economic impacts

Investment attractiveness and profitability

During Eighties, i.e. before the application of the economic reform program, when Egypt was applying an intensive governmental intervention regime of heavy subsidy policy for input prices, the buffalo dairy production under mixed small farm system provided the highest investment attractiveness, as shown from Table 1, i.e. 33% for total invested capital and 37.5% for equity. The two rates were closer because of the small share of loans (liability) in the total investment, low intensification of capital investment per head and almost complete self-reliance of feed supply and achieving the highest profitability as net farm income and normal profit- Table 1. The second order rate of return to investment was also generated by buffalo, but under commercial system, although it was much less, i.e. around 13%.

During the period of the dramatic changes of economic reform program, i.e. between 1987-1994, the return to investment of buffalo enterprise under the traditional system has not changed much (32% for total investment and 36% for equity), and stayed as the highest rate among all other competitive systems - Table 1. The closest rate was achieved by also buffalo, but under commercial system (26% for total investment and 36% for equity). The profitability estimated as net farm income and as normal profit has, significantly, increased to in nineties. Although the great increase in income generated by traditional buffalo enterprise, had surpassed the Holstein enterprises under free market economy. Table 1, even though the comparison would not be fair, because the exotic breeds commercial systems are specialized enterprises, while buffalo under traditional system is within a mix of livestock, poultry, and crop production system. These differences provided privileges to the traditional buffalo enterprise, it allocated the lowest capital investment share and relatively low feed costs among all other enterprises, as indicated by the outputs of the Tables 3, 4 and 5.

After stability of the economic reform transitional period, i.e. by the year 2001, the return to investment from buffalo enterprise under mixed small farming system has increased to be 35% for total investment and 39% for equity; and stayed the maximum rate among all other systems. The closest one to such rate was also the commercial buffalo, which reached 26%-28% for total investment and 30%-32% for the equity -Table 1. Also profitability from buffalo under traditional mixed system has slightly increased as net farm income and as normal profit per kilogram of milk, Table 1.

There is no doubt that economic liberalization has positive impacts upon exotic breeds enterprising. This could be recognized from the shift in return to investment from almost none for small-scale projects or negative for large-scale ones in eighties to about 8% and 12% return to equity, respectively, during the last decade of the 20th century. Surprisingly, the traditional cattle enterprise was the most negatively affected system by economic reform, return to investment dropped dramatically from 20% return to equity in eighties to less than 7% in the year 2001, Table 1. Therefore, crossbred cows have been, tremendously, expanded in rural Egypt.

Table (1). Economic efficiency under different production systems

Item	Buffalo enterprises		Native cows	Foreign cattle	
In 1981	Commercial dairy	Mixed farm	mixed farm	Small private	Large scale
Average Return on Total Investment (%)	12.68	32.99	15.10	2.27	-4.72
Average Return on Equity (%)	12.68	37.52	20.07	16.90	-2.79
Piasters per Kg. of milk					
Net Farm Income	3.60	11.14	5.63	4.93	-1.75
Normal Profit	2.14	7.97	5.42	2.55	-2.14
In 1993					
Average Return on Total investment (%)	26.26	32.68	5.36	7.20	10.26
Average Return on Equity (%)	29.93	36.14	6.00	7.77	11.46
Piasters per Kg. of milk					
Net Farm Income	31.36	37.00	4.17	12.08	19.93
Normal Profit	29.40	31.32	-30.16	6.30	13.27
In 2001					
Average Return on Total Investment (%)	28.26	34.99	5.62	7.71	10.89
Average Return on Equity (%)	32.47	39.00	6.35	8.36	12.25
Piasters per Kg. of milk					
Net Farm Income	35.12	40.70	4.48	13.41	22.02
Normal Profit	32.93	34.45	-32.42	6.99	14.66

Source: Calculated from the surveys data

Impacts of economic reform on the productive performance

The economic reform program and policies have associated with a noticed increase in daily milk yield of buffalo under commercial system. It increased from 7.8 Kg to 9.2 Kg. –Table, 2. The traditional buffalo herds have not shown any improvement. However, the length of the lactation season expanded from 201 days to 213 days for commercial buffalo and from 200 days to 229 days for traditional buffalo. Also, such improvements were associated with shorter dry period, before the successive calving, Table 2. It seems that these improvements were mainly due to better feeding regime and management of the holders. However, the reproduction policies, and breeding policies which stayed governmental, via free charge veterinary services and state research breeding institutes have not shown clear evidences towards improving the reproductive performance of buffalo under free market economy policies. The calving interval increased from 410 days to 417 days for commercial buffalo and from 432 days to 453 days for traditional buffalo. This was mainly due to longer service period, which extended from 95 days to 102 days for commercial buffalo and from 117 days to 138 days for traditional buffalo. Prolongation of service period of buffalo cows has been associated with deterioration in fertility, in terms of a decrease in the estimated calving rates, from 80.5% to 79% for commercial buffalo and from 76% to 73% for traditional buffalo. Accordingly, the degenerated reproductive performance limited the impacts of the noticed improvements in daily milk yield and expanded milk season. Therefore, the adjusted annual milk yield of the traditional system was not noticeable, and less expected increase has occurred in the annual adjusted yield of the commercial buffalo system.

Table (2). Productive and reproductive performance of buffalo & cattle in Egypt

Item	ID	Period	Buffalo enterprises		Native cattle on small mixed farms	Exotic Breeds	
			Commercial farms	Small mixed farms		Small Scale	Large Scale
Average milk yield	Kg/day	Mid eighties	7.8	6.0	4.9	10	15.7
		Mid nineties	9.2	6.0	4.2	14.2	15.9
Lactation period	Days	Mid eighties	201	200	154	240	290
		Mid nineties	213	229	179	247	304
Dry period	Days	Mid eighties	114	117	124	30	93
		Mid nineties	99	86	91	23	83
Service Period	Days	Mid eighties	95	115	104	120	113
		Mid nineties	102	138	112	108	117
Calving Interval	Days	Mid eighties	410	432	374	390	383
		Mid nineties	417	453	382	378	387
Calving Rate	%	Mid eighties	80.49	76.39	88.24	84.62	86.16
		Mid nineties	79.14	72.85	86.39	87.30	85.27
Total milk production	Kg/ lactation	Mid eighties	1568	1200	755	2400	4553
		Mid nineties	1960	1374	752	3507	4834
Average fat percent	%	Mid eighties	8.5	7.5	4.7	3.8	3.6
		Mid nineties	8.50	7.4	4.5	3.9	3.7
Total milk production Adjusted to 4% BF	Kg/ lactation	Mid eighties	2626	1830	834	2328	4280
		Mid nineties	3283	2075	808	3454	4616
Average annual yield	Kg 4% BF	Mid eighties	2338	1546	812	2179	4079
		Mid nineties	2874	15672	772	3335	4353
Percent of lactating Cows	%	Mid eighties	NA	80.6	45.9	n.a.	34
		Mid nineties	NA	63.13	45.65	66.28	69.15

NA = Not applicable because each type is a non-breeding system. n.a. = Not available / Missed data
Source: Calculated from the sample surveys data conducted in 1982, 1994 and 2002

Even though, it should be recognized that the reproductive performance of buffalo cows was not very far from cattle as the literatures used to cite. It reaches 80%for buffalo from field data in this study, while the academic work has cited a rate around 67% (Nigm, Soliman and Abdul Aziz, 1986). On the other hand, availability of funds, market incentives, and professional management for the commercial

buffalo enterprises could raise the calving rate from around 75% under traditional system to more than 80%, (Soliman, 1985).

Table (3): Cost of milk production per kg per year under different production systems, 1981

Cost Item	Buffalo Enterprises		Native Cows under Mixed Farm	Foreign Cattle	
	Commercial Dairy	Mixed Farm		Small Scale	Large Scale
	Egyptian Piasters				
Feeds	13.58	6.44	11.43	10.99	10.70
Hired labor	0.91	0.36	0.61	1.13	3.46
Veterinary service	0.07	0.05	0.13	0.10	0.16
Equipment and building depreciation	0.20	0.00	0.00	0.28	0.44
Interest for credits	0.00	0.00	0.00	2.70	2.48
Costs of replacement	3.14	0.00	0.00	4.28	6.45
Imputed costs due to death	0.00	0.21	0.27	0.00	0.00
Management costs	0.71	0.00	0.00	0.97	1.53
Imputed costs for family labor	1.49	5.72	9.67	2.04	3.23
other cost	1.47	2.55	3.24	2.01	2.80
Total	21.58	15.32	25.35	24.49	31.26
Net Cost	17.91	10.70	24.51	16.93	13.24

Table (4): Cost of milk production per kg per year under different production systems, 1993

Cost Item	Buffalo Enterprises		Native Cows under Mixed Farm	Foreign Cattle	
	Commercial Dairy	Mixed Farm		Small Scale	Large Scale
	Egyptian Piasters				
Feeds	26.77	17.27	31.16	29.04	37.89
Hired labor	1.23	0.68	0.74	2.35	3.93
Veterinary service	0.51	0.28	0.72	1.77	2.25
Equipment and building depreciation	0.20	0.10	0.21	0.25	0.27
Interest for credits	1.53	1.06	2.35	2.82	4.17
Costs of replacement	0.00	0.00	0.00	0.00	0.00
Imputed costs due to death	0.26	0.08	0.29	0.39	0.52
Management costs	0.09	0.00	0.00	0.13	0.24
Imputed costs for family labor	0.45	5.83	16.81	0.75	0.00
other cost	0.26	0.12	2.78	0.25	0.35
Total	31.31	25.42	55.06	37.75	49.61
Net Cost	25.83	24.34	52.34	27.17	38.40

Buffalo and the comparative advantage in milk production

The benefits of expanding the buffalo production in Egypt, particularly milk is obvious. It would reduce or eliminate the need to import and thus save scarce foreign currency, but also expanded buffalo milk supplies would provide a relatively inexpensive source of animal protein, particularly for lower income families in rural areas where the need for more animal protein is critical. Many studies demonstrated that Egypt's diet suffers from lack of protein rather than energy (Soliman and Shapouri, 1984; Mashhour, 1995; Soliman and Eid, 1995).

A recent study, (Soliman and Mashhour (2002), has compared the costs of producing 100 grams of animal protein at free prices among all types of protein production systems. That study made an index for relative comparison. The index assumed the least cost system as 100 and related the costs of producing 100 grams of protein by all other alternative systems to the least costs one. The results of that study ranked the animal products in ascending order of the costs as follows the least costs of producing 100 grams protein are from fish Farming systems, followed by table-eggs from large-scale commercial farming system (102), table-eggs from small scale battery system (104), milk from buffalo under traditional farming systems (105), milk from Exotic breeds (Holstein) commercial farms (114), rabbit meat under intensive commercial systems (126), broiler under commercial farm systems (135), milk from Native cattle under traditional farm system (160), milk from commercial non breeding system (190) and the highest costs' system is Red meat from feed lot systems (250).

Table (5): Cost of milk production per 1-kg per year under different production systems, 2001

Cost Item	Buffalo Enterprises		Native Cows under Mixed Farm	Foreign Cattle	
	Commercial Dairy	Mixed Farm		Small Scale	Large Scale
	Egyptian Piasters				
Feeds	30.79	21.37	40.51	37.75	49.26
Hired labor	1.28	0.71	0.77	2.44	4.08
Veterinary service	0.59	0.32	0.83	2.03	2.59
Equipment and building depreciation	0.21	0.11	0.22	0.27	0.28
Interest for credits	1.68	1.16	2.58	3.10	4.59
Costs of replacement	0.00	0.00	0.00	0.00	0.00
Imputed costs due to death	0.26	0.08	0.29	0.40	0.53
Management costs	0.10	0.00	0.00	0.14	0.24
Imputed costs for family labor	0.47	6.95	17.48	0.78	0.00
other cost	0.31	0.82	3.34	0.30	0.42
Total	35.69	31.52	66.02	47.20	61.99
Net Cost	29.39	30.27	62.89	36.11	46.66

Source: Calculated from sample surveys

Impacts of economic liberalization on costs structure

It should mention that, before economic liberalization, the main source of feed price subsidy was different among systems. It was mainly provided by the heavy subsidy of the concentrate feeds to commercial systems. In the case of traditional farming system, the main source of subsidy was derived from the artificially low opportunity cost of berseem, which resulted from keeping prices of alternative crops (wheat) below their international values. The equivalent international value for berseem (shadow price) was derived as the return to land at full international trade value of wheat, (Soliman and Fitch, 1985). After economic liberalization all prices were free, determined by market mechanism. Therefore, berseem price has significantly increased and its acreage has decreased for wheat expansion. Even though, the buffalo enterprises have resisted as the highest profitable one in Egypt (Soliman, 1994).

The feed costs, which the farms pay were influenced by various government subsidy polices (Soliman, 1984). Feed prices had been increased after elimination of such distortions caused by those polices.

These adjustments account for the impact of high increase in prices of growing berseem on farm, as well as the elimination of subsidies on feed concentrate mix and imported yellow corn. Based on these adjustments, it was noted that the highest increases of feed costs, after economic reform application, were for large-scale exotic breeds system. This showed that those farms that were up to early in eighties under state management were given the most support by government feed subsidies and price polices. After economic reform the state ownership was vanished and replaced by expansion in private sector projects. Accordingly, the share of feed costs in the production costs structure has, significantly, risen for buffalo under traditional system, i.e. from 42% in eighties to about 72% after phasing out the feed price subsidies, since mid of nineties. Surprisingly, such increase in feed costs of native cows under traditional system was much less, i.e. only from 45% in eighties to about 56% since mid of nineties. Such result provided additional evidence that the farmer with smallholding gives much attention to enrich the feed combination for dairy buffalo, than the native cow. He (or she) allocates the available concentrate feeds for the buffalo cow. Therefore, at free market prices, after economic liberalization, the feed costs, for dairy buffalo, has significantly, increased. The commercial production system of dairy buffalo, has shown apparent increase in the share of feed costs in total costs of production, however, it was much less than the traditional system

Not only feed costs but also the costs of production other than feed costs, at the Era before economic liberalization policies received subsidies. Under the umbrella of the food security program joint venture projects enjoyed credits at the low interest rate of 6 percent, per year. Imputed capital opportunity costs – at that time- were calculated at 12 percent interest per year as the market interest rate in 1981, (Soliman and Ragab, 1981) while it increased to 18 percent interest per year in the following two decades. The traditional herd was not under the livestock insurance program before the economic reform application because of very small holding size (1-2 heads). However, all systems after economic liberalization have the same opportunity to join the insurance program. Family labor represents most of the labor used for livestock on traditional farms (81.2% of total labor) and 51% of the work on the commercial buffalo farms.

Non-feed costs included hired labor and management, imputed costs of family labor, veterinary services, [illegible], depreciation of buildings and equipment, interest on loans, and imputed costs of capital investment, animal death loss, and land rent. The large scale exotic breed system, had the highest non-feed costs, reflecting not only heavy use of hired labor, but also high costs of interest on loans, capital investment and depreciation of expensive buildings and equipment. The small mixed farms with buffalo had very low non-feed costs, reflecting low use of hired labor and low interest and investment costs. The highest share of non-feed costs item for small mixed buffalo farms was the imputed cost of family labor.

The output other than milk includes the value of calves, which are sold, manure, and any changes in inventory due to herd's categories promotion. These items were deducted from costs of 1-kg of milk that shown as a credit to costs for non – milk products. Therefore the net costs per kg of milk were less than the aggregate one.

Net cost per Kilogram of milk

To obtain costs per 1 kg of milk, in the current study, each cost item per milking cow was divided over the annual adjusted milk of 4% butter fat yield. These adjustments were made to reflect both milk quality as well as differences in calving intervals among systems. Based on the surveys data, average costs were calculated per liter of milk produced, as shown in Tables 3, 4, and 5). These tables showed that, the net cost for a kilo of buffalo milk produced under the traditional system, in eighties, before application of the economic reform, in eighties was not only the lowest (less than 11 Piasters), but it was also much cheaper than the next cheapest source, the milk produced by the foreign breeds (14.25 piasters). Milk derived from native cattle was the most costly.

After implementation of economic liberalization policies, the adjusted costs of milk production from buffalo on traditional farms were still the lowest. However, costs of milk from buffalo on traditional farms and Holstein milk at small-scale farms, as well as, commercial buffalo milk now fall closer together during the transitional period of economic reform application, i.e. during the period 1987-1994, but the large-scale foreign breed farms were relatively higher. Costs of native cow milk have shown the highest costs of milk production along all periods. It should be pointed out; however, that milk production from native cows is really a by-product. The native cow is kept primarily as a source of meat animals (note the return to investment and normal profit per cow, Table1.

The large-scale exotic breed herds registered the highest costs per kilogram of milk after the stability of the economic reform program, i.e. by 2001. This reflected high use of purchased concentrate feeds at free prices (after phasing out subsidies) as well as berseem clover. In eighties, the large-scale farms were almost all state farms, which enjoyed abounded supply of concentrate feed mix at a highly

subsidized price. Therefore, they showed, apparently, low level of feed costs, at that time, which lowered the total costs of milk production of such system. Private small farm feed costs were all relatively low, reflecting less reliance on purchased concentrates and much dependence on farm produced feeds. Even though, the costs of one diary buffalo milk is just equal to the costs, which the study, calculated for reconstituted imported powdered milk at processing plant in Cairo, there are differences in quality and location to be taken into account. The buffalo milk is fresh and therefore preferable for the consumer taste, but it needs better handing such as pasteurization or production of (UHD) and proper packaging. The fact that the buffalo milk is priced at the farm gate, not delivered to Cairo, indicates that the reconstituted powder may be a cheaper source of milk for urban consumers.
So far, Egypt's efforts to improve milk production have been centered on importing Friesian and Holstein replacement heifers. This study shows that, in economic terms these animals don't seem to compete well with the buffalo. The relatively, small private exotic breed herds (less than 50 milking cows) may have promising economic efficiency, rather than large scale herds. Although the study has not been able to obtain any significant body of information on cross breeds, presumably, these would out-perform the native cow. In fact, Egypt has several herds of improved water buffaloes on its research farms. There are A.I. programs to spread these genes effectively spread among the national herd. However, it requires assessment.

Social and demographic impacts

The success or failure of Egypt's livestock development programs depends upon their ability to influence traditional small farmers' decisions on investment in livestock (Soliman, 1985). Conventionally, farmer's investment decisions in agriculture are influenced by profitability, equipment requirements, and length of investment period, crop rotation, subjective time preference factors (Nadal, 1972; Kahlor and Karajkar 1972; Soliman and Zaki 1982), and to increase the farm household income or to provide opportunities for the family labors, particularly women (Soliman, 1985). However, the traditional farm households may hold cattle and buffalo, also for social objectives. The social factors are also identified as possible influences on farmer's choices (Soliman and Zaki 1982; Soliman 1985).
Investment in livestock enterprise is defined in this study as holdings in heads of cattle and buffalo. The holding size of these two types of animals represents the bulk of dairy and fattening activities within the traditional farming household. While 5% of the households with livestock holding were landless, 51% of the households were with less than 3 feddans. Cattle and buffalo distribution of the sample is 10% with one head; 16% with two heads; 18% with three heads; 16% with four heads, 40% with five heads and above.
Results are presented according to the concerned socio-economic and demographic factors that may affect the household decision on investment in cattle and buffalo. The households with no cattle and buffalo were excluded.

Effect of education level of the head of household

Either before economic liberalization (Soliman, and Zaki 1982) or after it was found that the holding size increases with the holder's educational level (Soliman & Mashhour, 2000), which implies that the farmers with higher education level tend to keep larger number of buffalo. The associated, relatively, high education level with 1 head holding size reflects the holders of a bull or exotic breed dairy Cow. The Chi-square analysis indicated that the educational level of the head of household and the number of buffalo are significantly related. The estimated Contingency coefficient is relatively high, i.e. 0.447. This result indicated that development of buffalo on farm is an intensive capital technology (biotechnology), which requires a considerable level of the manager's education.

Effect of household size

Keeping cattle and buffalo as opportunities for family labor employment, regardless their opportunity income as recognized in eighties by Soliman and Zaki (1982); and Soliman (1985) has no longer been valid. Tracing the trend of household size with buffalo holding size on farm, after economic liberalization, did not show any considerable direction of the relationship. Chi-square test showed that family size has not significant relationship with buffalo holding size on farm, (Soliman and Mashhour, 2000).

Effect of the age of the head of household

The Chi-square test provided evidence that the age of household's head was independent of the number of buffalo on farm, (Soliman and Mashhour, 2000). The same result found before economic liberalization Era (Soliman and Zaki 1982).

Effect of the occupation of the household's head

After economic liberalization, there was a positive relationship between households head members with other non-agricultural jobs, and buffalo holding size in Lower Egypt region, while, in Upper Egypt region; such relation was not observed, at confidence level of about 95% (Soliman and Mashhour, 2000). However, before economic liberalization such relation was absent, (Soliman and Zaki 1982). The off-farm additional job could be considered as an indicator to off farm income. Therefore, it could be concluded that, after free market system application, the higher the household aggregate income, the higher is the potentiality to save and consequently to invest in more dairy or fattening buffalo enterprises.

Effect of the number of children of the household

The number of children is an indicator of the vulnerability of the farm-household towards animal protein food (Soliman and Eid, 1995) in addition to being a source of family labor for farming. Before economic liberalization there was a relatively significant relation between children's' number with the household, (Soliman and Zaki 1982) indicating that investment in buffalo on farm was controlled by subsistence needs. In The nineties sample did not show any observed trend with the number of cattle or buffalo, (Soliman and Mashhour, 2000). The Chi-square test provided evidence that the number of children of the household was independent of the number of buffalo. Therefore, after free economy policy implementation milk and meat production activities on traditional farm has become a market oriented enterprise rather than subsistence one.

Effect of the number of adult females of the household

Studies made in eighties (Soliman and Zaki 1982; and Soliman and Ragab 1985) showed that the adult females of the household serve most of the labor required for livestock activities on farm. That was because their opportunity to work off farm was very little. Therefore, the farmer's decision to invest in cattle and buffalo was associated with the number of adult females of the household. After economic reform application in Egypt the results showed that (Soliman and Mashhour, 2000), it dose not appear that there is a relationship between number of animals and the number of adult females in Lower Egypt region. However, such relation exists in Upper Egypt at confidence level about 95%. Consequently, while the distribution of cattle and buffalo is independent of the number of adult females of the household in the Lower Egypt, they are associated in Upper Egypt. It seems that the structural economic changes in labor market in Egypt, particularly in rural areas of Nile's Delta have changed this relation, because the rapid increase in women education and opportunities of their off farm work. However, the traditions in Upper Egypt has not fully changed, therefore cattle and buffalo herd management is still a major women's' activity on farm.

Effect of the number of family members sharing in farm operations

Aside from the farmer, whereas 42% of the sample households have 1-2 members that share in farm work, 52% of the households have no members sharing in farm work. The Chi-square test provided evidence that the number of persons of household that share in farm work was independent of the number of the cattle and buffalo on farm, (Soliman and Mashhour, 2000).

Effect of the landholding size

Under free market economy, there is a significant strong positive relation between landholding size and livestock holdings. The Chi-square test supports the hypothesis that landholding and livestock holding are associated at significance level less than 1%, (Soliman and Mashhour, 2000). This result coincides with the conclusion of the studies before economic liberalization era, (Soliman and Zaki 1982; Soliman 1985). The reasons of such relation are mainly that the landholding size is a good indictor of farm wealth, as well as, a potentiality of expansion in fodder cropped area on farm, which determine the availability of funds and resources required for investment in livestock on farm.

Effect of the volume of farm machinery holding

The volume of farm machinery reflects, on one hand, the level of mechanization of farm operations, and could also be a measure of the farmer's Wealth. A strongly positive relation was found between machinery holding size and livestock holdings after economic liberalization, (Soliman and Mashhour, 2000). Therefore, more Machinery owned on farm, means richer farmer, accordingly, he is able to invest more in cattle and buffalo as meat and milk producer and not, any more for farm work.

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