Animal Production (Group Scarabaeus)

Possibilities to Expand Sheep Production by Crossbreeding

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Introduction and Background

Population in the developing regions is expected to grow from about 4 billion at present to 7 billion by 2025 with the majority (4.4 billion) in Asia (United Nations, 1988). By 2025 the majority of people in the developing regions will be urban dwellers (Sub Sahara Africa 54%; Asia 56%; West Asia and North Africa 75%; Latin America and the Caribbean 84%). The projected average annual growth rate for per capital income in the developing countries is about 3.5%. Based on these projections for population, urbanisation and income, it has been predicted that in most developing countries, food consumption will increase and there will be a shift in diets from staple grain to livestock.
Small ruminants form an integral and important component of the pattern of animal production in many parts of the Tropics and Subtropics. Sheep are widespread and a characteristic feature of their production is that they are essentially reared in a complex of production systems on small farms.
In terms of food supply, many countries are very dependent on imports. The imbalance between demand and local supply is especially evident in parts of the livestock sector.

It is possible to increase local sheep production by
a) increasing the size of the national flock,
b) increasing productivity by crossing local sheep with imported breeds, especially for certain production systems,
c) improving the feedstuff, and
d) control of diseases.
The first part of the study consists of an overview of the world sheep population describing the development of the sheep population.

World Sheep Population

In the last forty years, as reported by FAO (2000) in Table 1, the sheep population in Africa has increased continuously from 135 million to 240 million and in Asia has from 232 million (1961) to 413 million (1999). In a comparison of Asia with Africa in the last twenty years, the sheep population in Africa increased by 31%, and in Asia by 25%. North America, South America and Oceania have had a negative development of sheep population over the last twenty years. Europe has had a slight increase by 12%.

Table 1:Sheep stocks according to Continents and selected Countries (FAO 1961-2000)

	1961	1981	1999	Development 1999:1961	% in World stocks in 1999
		in 1000 pces		%	%
World	**994072**	**1110355**	**1068669**	**107,50**	**100**
Africa	**135126**	**183780**	**240342**	**177,87**	**22,49**
Egypt	1552	2100	4400	283,51	0,41
Jordan	528	1073	2000	378,79	0,19
Sudan	7848	18107	42500	541,54	3,98
Tanzania	2986	3772	4150	138,98	0,39
Tunisia	5116	4734	6600	129,01	0,62
Asia	**232092**	**329605**	**412608**	**177,78**	**38,61**
China	61640	106627	127163	206,30	11,90
India	40223	46420	57600	143,02	5,39
Syria	2901	10504	15000	517,06	1,40
Palestine: Gaza Strip & West Bank		248	376		0,04
Europe	**133973**	**137109**	**154256**	**115,40**	**14,43**
EU:15 Countries	90733	78420	115187	126,95	10,78
Germany	3052	3217	2298	75,29	0,22
Greece	9353	8048	9290	99,33	0,87
UK	29070	21604	44656	153,62	4,18
North & Central America	**39335**	**20044**	**15150**	**38,52**	**1,42**
USA	32725	12947	7238	22,12	0,68
Mexico	5853	6567	5900	100,80	0,55
South America	**118441**	**105284**	**80594**	**68,05**	**7,54**
Argentina	50150	31418	14000	27,92	1,31
Brazil	14000	19054	18300	130,71	1,71
Oceania	**201150**	**204298**	**165718**	**82,39**	**15,51**
Australia	152678	134407	119600	78,33	11,19
New Zealand	48462	69884	46100	95,13	4,31

Table 1 shows that in 1999 high proportion of 38.61% of world sheep population is concentrated in Asia. The other continents are Africa 22.49%, Europe 12.52%, North & Central America 1.42%, South America 7.54% and Oceania 15.51%. The population of small ruminants in the developing countries accounts about 56% of the world total compared to about 38% in developed countries, again this implies the important role of small ruminants in developing countries.

Constraints to Small Ruminant Production

Small ruminant production systems in the developing countries have not reached their full potential, therefore, there is a lot of opportunity for improvement of small ruminant production systems. The establishment of more intensive production systems can lead to increased production. However, before the systems are expanded, it is important to discuss the constraints, possibilities and implications.

Small ruminant production systems are complex. These systems are affected by inter-related biological and non-biological environment factors. The biological factors include genetic potential and resources, nutrition and animal health. Non-biological factors are:

- the economic factors of capital, price, labour, land tenure and demand,
- institutional factors such as education, research and extension services and
- social factors such as attitudes, beliefs and norms.

The relative importance of these constraints for small ruminant production systems varies. A full understanding of the complexity of small ruminant production systems is necessary in order to predict the consequences of change. Intensification with higher inputs is not always economical, if the small ruminants cannot respond with higher outputs. However, most small ruminants in developing countries survive in harsh climate, endemic diseases and poor feeding by a process of adaptation that combines tolerance with lower productivity.

The establishment of more intensive production systems needs to improve the genetic resources. There are three possible solutions to the problem of breeding small ruminants with improved genetic resources for productivity:

- selection of the most productive animals from indigenous animals,
- introduction of exotic breeds and
- cross breeding between indigenous and exotic breeds (up-grading).

In the following part examples of crossbreeding programmes for sheep for improving the genetic resources are introduced:

- crossbreeding object in Malaysia
- crossbreeding object in Germany
- possibilities for a crossbreeding programme for intensive production systems

Crossbreeding Object in Malaysia[1]

Many tropical countries have tried to import a large number of temperate sheep to crossbreed with their local breeds in order to increase the body size and possibly improve the reproductive capabilities.
Even in Malaysia, since 1955 genetic improvement by crossbreeding with more productive imported temperate and other tropical breeds has been attempted. Crossbreeding of local sheep with highly productive exotic breeds of temperate climates did not produce the initially expected high rates of productivity. The imported wool breeds has been hit by high rates of mortality and by low reproductive performance among the surviving adults. The poor adaptability of animals to the Tropics is due to the heat stress. Additionally, there is the typical low quality of the local forage resources and extreme levels of ecto- and endoparasitic burdens. Most of the local sheep breeds were originally not indigenous to the region and are characterised by a low level of productivity under the given conditions of breeding in the humid tropics.
Therefore, the University of Malaysia has imported hair sheep and also Thai Long-tail. As hair sheep are indigenous mainly to the humid tropics of West Africa since early domestication, they show high productive adaptability under the constraints of tropical animal breeding. Thai Long-tail is believed to originate from Myanmar, previously known as Burma (Mukherjee 1999). The Thai Long-tail is a large sheep with low incidence of twinning. This breed has been introduced into Malaysia and used for crossbreeding to increase body weight.

The Malaysia Peninsula stretches from NW to SE over 700km ranging from $6^{o}30'$ N to $1^{o}20'$N and is 300 km at its widest. The core of the country is mountainous with steep, heavily forested slopes rising from very flat coastal and ravine lowlands. Two thirds of the land lie above 200m altitude with a maximum of 2,100m. Its typical hot and wet

[1] Afewerki, A. 1999: The role of sheep keeping in Malaysia. Thesis, Dept. of International Animal Husbandry, University of Kassel

equatorial climate has an annual range of temperature that does not exceed 15°C with the diurnal ranges typically greater than that, i.e. the mean daily temperature variations are greater than the difference between the temperature means of the warmest and coolest months of the year. The mean daily range of temperature is less than 11°C and the absolute minimum and maximum temperatures observed are 17.8°C and 36.7°C respectively.

Breeding Object Cameroon with Thai Long-tail

The aim of this investigation was to develop a synthetic hair sheep, which adapted well in the humid tropics, by crossbreeding imported hair sheep (Cameroon) and wool sheep (Thai Long-tail from Thailand):

Hair sheep (Cameroon) x Thai long-tail sheep (Thailand)

The breeding work carried out had two objectives:

- to introduce a nucleus flock of hair sheep crosses as a basis for the foundation of a synthetic breed
- The scheduled production of animals arranged in groups of genotypes differing in their hair sheep blood percentage as needed for the experiments of the various sub-projects.

The breeding plan was based on the assumption that the inheritance of the hair coat follows a dominant mode. The dominant mode is based on the effect of a major gene (N) whose expression is altered in the presence of modifying factors. As a result, the production of F_1 by crossing Thai Long-tail with Cameroon and their subsequent interse-mating was the premise for a large F_2 generation. The identification of the homozygotes and selection for growth performance above the average from the second generation onwards represented the initial steps for the foundation of the synthetic breed with combined improved growth performance and desirable coat characteristics.
As soon as the first male F_1 rams had reached breeding maturity, the University of Malaysia arranged for extension workers who gave the rams to the village farmers. In the district of Kuala Langat were those identified who were able to guarantee that the hair sheep crosses produced in their farms would be managed separately.

Results

The hair sheep F_1-crosses produced, as this project shows, terms of weight and body conformation which were comparable to that of wool breeds. Although this level of performance is partly due to hybrid effect, which will eventually be lost with further crossing, it can be assumed that such losses will be compensated by selection and other advantages which hair sheep crosses seem to possess (Mukherjee, 1994). All in all, the small body size Cameroon crosses show compact body conformation and hence possess meat type characteristics that are desirable for a meat sheep. Furthermore the small body size is produced by males and females which do not differ much in their performance and therefore masks an outstanding performance of crossbred females compared to pure-bred ewes. As the same time, the crosses show an advantage expressed in high daily weight gains if subjected to adverse environments such as grazing under tropical climate and forage conditions. Best performance under such conditions shows an improved productive adaptability of crosses compared to wool sheep.
The superior performance of the ewes was well recognised by local farmers who showed interest in purchasing crossbred ewes. Mating them to Dorset Malin or Long-

tail rams would produce back cross offspring forming a pool from which the farmers could select their replacement stock with combination of desired characteristics (Sivaraj, 1994).
Nutritional and parasitological studies imply that the performance of hair sheep crosses is based on the ability to produce better growth rates than wool sheep subjected to low quality forage, especially under grazing management. Secondly, the hair sheep crosses seem to show obvious lower infection rates than wool sheep under a given endoparasite burden as typical for the humid tropics (Pendey, 1993).
Therefore, the results of this study indicated that the attention that hair sheep have recently gained in breed evaluation programmes for the Tropics is fully justified. The genetic potential which hair sheep hold, has to be recognised and their importance for the improvement of sheep production and imminently for the protein supply of the increasing population has to be acknowledged.

Crossbreeding Object for Hair Sheep in Germany

Problems of the international wool market

The number of sheep in the EU has remained the same since 1987. The number of sheep in Germany has declined for years, since 1995/96 annually up to 10%. Supply of mutton and lamb from home reserves has fallen accordingly from 77,1% in 1990 to 47.9% in 1999. The reasons for the decline in sheep keeping are the unsatisfactory price development (currently 6,50 - 7,00 DM/kg warm slaughter weight), especially (Fig. 1) due to the heavy fall in wool prices (0,50 DM/kg raw wool in 1998). During the same time the market influction of the high grade, synthetic textiles are rising steadily. It is only fine wool (fibre <20µ) that can still be marketed. Wool of this quality cannot, however, be produced by the most sheep breeds for known reasons.

Fig. 1: Wool price development in Germany[2]

The majority of sheep keepers only produce crossbred wools of inferior quality or coarser wools which cannot be marketed. Wool has therefore now turned from being a desired by-product to being an unwanted waste product. The increasing expenses for care of wool, its shearing and the sale cause a considerable decrease in profit margin. On the basis of a long well known development there has been intensive research for other uses for wool such as insulation. However, the wool must be processed for this purpose with chemicals to hinder the natural process of rotting and especially as a protection against parasites (insects and mice), which is very costly. Scepsis is justified as far as costs are concerned when a comparison of insulating and sound-proofing materials is made with commonly used materials with regard to its durability and insulating efficiency.

Wool does not only give the sheep an advantage

Shepherds in the past have known for a long time that the fleece only has two advantages; firstly this could be sold and secondly it protects the sheep against the extreme cold. These two advantages, the first of which has already disappeared over the last few years, face disadvantages. The change due to the selection of breeding in the natural conditions of the secondary to the primary hair follicles from 2:1 in the direction of 20:1 is unnatural and affects the welfare of the sheep, not only in hot summers. Ewes feel better without wool and move around more. Should the sheep be exposed

[2] The figure is only available in the print copy (Beihefte zu Der Tropenlandwirt Nr. 71)

to continual rain, the fleece soaks up the water and becomes full of algae. The consequences are pneumonia and parasites. The wet and cold fleece is often the reason for the ewes not becoming pregnant. This really points to wool being rather a hindrance to the sheep.

Efficient hair sheep can solve the problem

Sheep breeders in Germany are to reach a decision in the coming years whether it should keep the dual-purpose type (meat and wool) or cross bred part of the simple and coarse wool sheep stocks (fibre thickness >25 µ) to the single-purpose sheep type (meat). Hair sheep serve the purpose of meat production only as compared to wool sheep. They do not grow a wool fleece, but show a short hair coverage like wild sheep with a ratio of secondary to primary follicles of 2:1 (wool sheep up to 25:1). Similar to wild sheep they carry a pelt in the summer of smooth upper hair and grow a winter pelt in late autumn with sufficient undergrowth wool. Hair sheep change their hair each spring. The costs for shearing and the expenses for the wool care are therefore nil.

The argument that the wool fleece puts the sheep into a position to be kept outdoors all the year with a minimum of indoor care, is to be invalidated in this connection because hair sheep grow a short thick fleece in cold winters as do primitive domesticated sheep and wild sheep. This coat is shed during the spring change of hair.

Today hair sheep number about 10% of the world sheep stocks; population is growing. Most hair sheep are in the Tropics but there are some hair sheep breeds in Europe and Euro-Asia which are adapted to moderate climate and local conditions. In the USA there have been, for a few years now, genetically consolidated and recognised hair sheep breeds.

The Nolana Sheep Breeding Project

The project became realistic on a broad and solid basis in the Spring, 1998. In co-operation with the Department of International Animal Husbandry of the University of Kassel with the Faculty of Agriculture in Osnabrück, the Chamber of Agriculture in Hanover, the University of Göttingen, the College of Veterinary Science in Hanover, the Federal Institute for Agriculture in Köllitisch in Saxony and the State Education and Research Institute for Cattle Husbandry and Forage Farming Aulendorf as well as with many private sheep keepers, the building up of a nucleus herd of Nolana sheep has began. With the Nolana sheep, a sheep for meat production and landscape management as well as a sheep which is suitable, robust, efficient and fertile is to be bred. High grade material from the breeds Wiltshire Horn, Dorper, Barbados and other suitable hair sheep breeds are to be crossbred into wool sheep herds under a controlled method. The genetic variety in the sheep breeds will be used today in the best economic way with Nolana hair sheep for meat production and in landscape management. Due to the prices for meat and wool Nolana sheep extend the current breeding spectrum, offer sheep keepers an additional alternative and can give new impulses to sheep breeding in Germany and neighbouring countries.

The Department of International Animal Husbandry in Witzenhausen has already started co-operating with sheep keepers in the region on a crossbreeding programme. A hair buck of the robust Wiltshire Horn breed from England has been crossed with German Black Head herds (Schwarzkopf). The lambs of the first generation are under investigation for quality control.

Wiltshire Horn (England) x Black Head (Germany)

Summary of goals of the Nolana hair sheep project

- New positive impulses for improving the decline in sheep keeping in Germany
- Provision of breeding animals of the robust and fertile Nolana hair sheep breed for meat production and landscape management
- Extension of crossbreeding to the existing flocks of the interested sheep breeders
- Development of sheep breeding and keeping under economic viewpoints
- Conservation and promotion of sheep in landscape management and protection of the agro-ecological environment

Crossbreeding plan (Fig. 2):

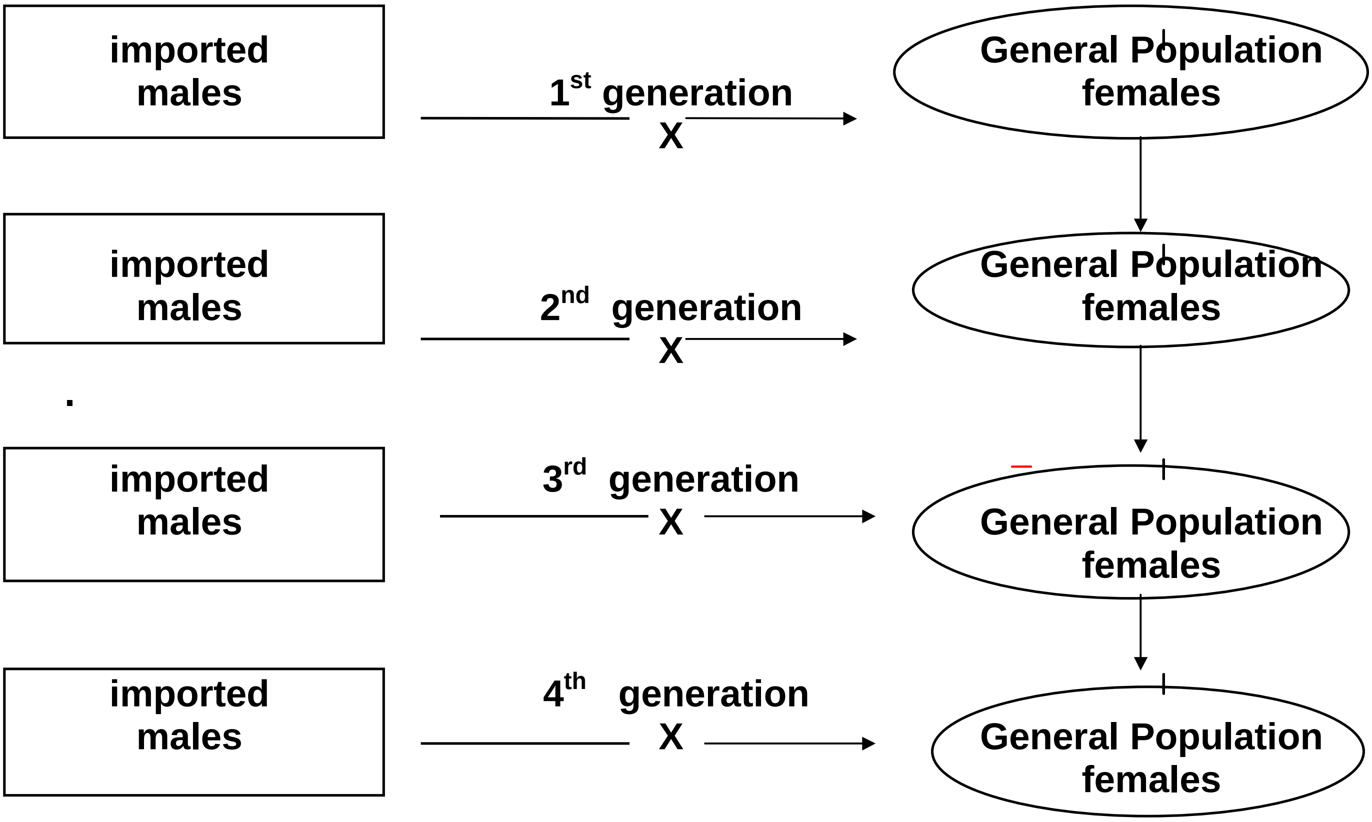
- Hair-meat-sheep breed as male line:
  Wiltshire Horn, Dorper, Barbados
- Wool-meat-sheep breed (local sheep) as female line:
  Black Head meat sheep, White Head sheep, Merino-sheep

Table 2 : A comparison of wool and hair sheep (Minhorst, 1999)

Wool sheep	**Hair sheep**
Wool fleece	Short hair cover, no wool
Shearing 1x/annually (Animal Protection Laws)	No shearing necessary for short hair, no woollen fleece
Very good meat production performance	Meat performance is lower
Satisfactory good meat quality	Very good meat quality, often dark meat with game character
Fat coverage mainly in acceptable areas	Only small, often no fat coverage
Good fertility	Very high fertility
Dark skin pigmentation only in certain breeds	Dark skin pigmentation in nearly all breeds
Very often foot problems	Few foot problems

Comparative performances of the wool and hair type sheep is shown in table 2.

Fig. 2: Crossbreeding Plan



Possibilities for Crossbreeding Programmes for Intensive Sheep Systems

In countries, where the sheep has significant value for meat production, such as the Near East, where the sheep are wool-type and fat tailed-type the questions are:

- What value has the wool production for the animal keeper and for the consumer?
- What value has the fat in the tail region of the animal and for the animal keeper and for the consumer?

For the small holder and direct live market to the consumer the wool sheep with the fat tail has traditional value. The existing husbandry management systems in many countries are normally the result of hundreds of years of traditional husbandry. On the large intensive farms near large cities, especially where the sale of meat is through the butcher, the above mentioned questions are very important. Sheep are intensively indoor-fed and the costs of feeding are significant factors for profitability of the production. Sheep production plays an important role as an income generating activity. The major local breeds in many parts in Africa and Asia are wool-fat-tail sheep, which are widely distributed in the Subtropics.

The following factors are prerequisite for economic improvement of sheep production systems:

- Increase in average production by improving the management systems so that the genetic potential of the animals may be expressed as fully as possible.
- Improve the genetic potential of the stock population by the introduction of new genotypes by crossbreeding.

Consequently, it will of a great interest in introduction of crossbreeding programme with new genotypes, for example

- meat hair sheep or
- meat sheep with thin tail or
- meat hair sheep with thin tail.

Such genetic improvement programmes must be based on crossbreeding between available local breeds as female breeding stock and imported breeds as the male breeding line. The introduction of specialised breeds with good production and reproduction performance with thin tail and also if needed, as hair sheep, may be a rapid solution for increasing the performance of the animals.

The most important factors responsible for economic return in performance include:

- litter size
- survival rate
- growth rate of lamb
- kidding interval.

It means that the selection programme need to be concentrated on the ability of ewe to produce meat per year under the local environment. These last points are to start the discussion in the group: "The Value of the wool and the fat tail for intensive sheep farm systems".

Use of Biotechnology in Milk Production in Egypt

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Biotechnology applications in livestock production cover a wide range and vary in their nature and objectives. Biotechnology in its broad terms refers to the technology used to control or manipulate certain biological function(s) of animal as a whole or in part, applied either in vivo or in vitro. Recombinant bovine somatotropin (BST) is one of the modern technologies used to improve milk production. Bovine somatotropin, or BST, which is produced by the recombinant DNA biotechnology, has been recognized for its ability to increase milk production from dairy cows in many countries over the last decade. There is no question that BST use increase milk yield and production response, and the results obtained are varied widely.

In Egypt, some large dairy farms have used BST to increase milk yield as well as to increase their income. It is argued that large commercial dairy operations can begin using new technologies such as BST more easily, rapidly, and efficiently than smaller ones.

This brief paper addresses some of the issues that surround BST use in Egyptian dairy farms after its commercial availability. Specifically, the focus of our inquiry is on, has this technology been profitable and productive at the farm level? Is the BST an economically feasible technology?

Keywords: recombinant bovine somatotropin, adoption, profitability, economic feasibility, Egypt

Bovine somatotropin is a naturally occurring (protein) hormone produced in cattle and all species of animals, by the pituitary gland. This hormone is important for growth, development, and other body functions of animals (Butler, 1999). In the 1930's, it was discovered that injecting extracted BST into lactating cows could increase milk production. In the late of 1970's, Bauman, successfully transferred the gene responsible for BST production to a bacterium. The resulting product was called recombinant bovine somatotropin, BST. Simple multiplication of the bacterium meant that BST could easily be produced in commercial quantities at reasonable cost Though BST is a peptide hormone and not a (much-maligned) steroid hormone (Butler, 1999). The basic findings of BST were as follows:

- Using recombinant bovine somatotropin, could cause a 10-20% increase in milk yield and accordingly increases milk efficiency. It also decreases the feed costs per unit of milk produced by reducing the needed maintenance feed (Butler, 1999).
- Using recombinant bovine somatotropin, seems to be safe for both human milk consumption and cows because of its nature as a protein

It took until November of 1993 to gain Food and Drug Administration (FDA) approval, and it was not released commercially until February of 1994.

Use of BST in Developing Countries:

The first trial with BST in the tropics was carried out by Ludri and his colleagues in 1989 in India with milking Buffalo. In Africa, Phipps et al (1997) suggested that BST increased total milk production in Zimbabwe (Fig.1). Further trails have been carried in Gambia (Fig. 2) and Kenya (Fig. 3)[3].

Use of BST in Egypt:

In Egypt, BST was approved in 1996 and was used commercially in two large private dairy farms at the end of the same year. Starting from the year of 1997, the number of dairy farms that adopted BST technology has linearly increased being nine dairy farms and accordingly the number of cows injected with BST which also increased to be 2000 lactating cows by the year 1998.

Thereafter, the treated cows with BST, in Egypt, has dramatically decreased reaching to the lowest number being 500 cows (Fig.4). Seven farms were stopped to use BST which may be due to the following reasons

- 57% of the dairy farms claims from its negative effect on reproduction, including increase of the days open, increase number of services per conception and lowering the conception rate.
- 29% suggested that there is no significant economical return with using BST as a result of low production response to the BST and low milk price.
- 14% observed that using BST did not increase milk production compared with the untreated cows.

Figure 4: Number of BST treated cows from 1996 to 2000 in Egypt

Nowadays, the controversy surrounding the use of BST in Egypt that has existed since 1996, health of animals treated with BST. Therefore, the researchers in Egypt, conducted the first trail about the using of BST in commercial herds under the Egyptian condition and its effects an milk yield, reproduction and animal health (El-Ghandour, 2000).

The main results of this study could be summarized as follows:

The overall average percentage increase in milk yield that resulted from BST treatment found in this study is in line with the average increase of 10-20 % reported in many trials such as the study conducted in Egypt by El-Harairy (2000) on Holstein cows. The magnitude of increase in milk yield in this study was, however, significantly larger in early treated (starting on day 65 postpartum) than in later treated cows (starting on day 105 postpartum). Such difference would be mainly a function of the length of time during which cows were subjected to treatment.

The finding that multiparous cows had significantly higher response to BST (percentage increase in milk yield) than primiparous cows is of great interest. Part of this difference may be related to the relatively limited udder capacity for milk synthesis in primiparous than multiparous cows. Primiparous cows also have less available nutrients for increased milk synthesis, with a significant part of the available nutrients being directed to continue growth, as compared to the situation in the more mature multiparous cows. This finding is of practical importance, as it may be recommended, accordingly, to limit the use of BST to multiparous cows in order to achieve higher economic efficiency of the treatment.

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[3] The figures and tables are only available in the print copy (Beihefte zu Der Tropenlandwirt Nr. 71)

One of the most interesting results in the study conducted by El-Ghandour (2000) is the discrepancy in the response to BST treatment due to the level of milk yield, with the high yielders showing higher response to treatment, being almost three times higher than the response obtained in low producers (22 v. 6%). Such finding which, to our knowledge, has not been reported elsewhere, has serious practical impact, with the recommendation to limit the use of BST to high and medium-producing animals only, to achieve highest economic efficiency of the treatment. This was illustrated clearly in the economic analysis conducted (Table 1), where the treatment of low producing cows did not seem to be profitable, since the small increase in milk yield obtained did not cover the cost of treatment itself. This finding also raises an important question, whether BST treatment would be biologically and economically effective in other circumstances with low producing cattle genotypes of buffaloes? Such a question deserves an answer through future detailed studies an our local cattle breed and buffaloes.

Another interesting result that emerged from this study is the significantly higher response to BST in open cows than in those that conceived during the first eight months of lactation. This is likely to be due to the effect of gestation and the diversion of part of the available nutrients to meet the demands of the conceptus. This, however, opens the debate on “to what extent we can extend the calving interval to achieve maximum profitability in high yielding dairy cows". This question is of practical importance for commercial dairy herds. It's answer can only be achieved through future studies that should also take into account the changes in total production of a cow over its herd life time, both from milk and calves born, the possible implications of long lactation periods on cows body condition score (BCS) and health, and in turn its productivity in subsequent lactations (Aboul-Ela et al., 2000).

Unfortunately, the effect of BST on cows reproductive performance could not be studied thoroughly, mainly due to the rather poor reproductive management system applied in the herd, as indicated from the performance of all groups including the control, where about half of the cows did not get in calf for over eight months (El-Ghandour, 2000).

The lack of monensin (RM) effect on milk yield is consistent with the results of other investigations, as discussed by Aboul-Ela et al.,(2000). This, however, should be taken care of in future studies to elucidate the mechanism through which RM treatment could alleviate the negative effect of BST treatment on BCS.

Profitability of using BST in Egypt:

There is no doubt that the major contributing factor for profitability with BST is the magnitude of response which is directly related to management, including cow health, feed quality and intake, water intake, cows comfort. Therefore, providing a high quality of management can optimize the profitability of BST. The other contributing factors to BST profitability are milk price, feed price, BST price, and labor costs. Since milk price is the most changeable factor, the profitability of BST was calculated as a function of milk price (ranging from 0.55 to 1.25 LE/kg) and the magnitude of response to BST. This index (Table 1) is suggested as a guide for profitability of BST under these conditions (El-Ghandour, 2000). Furthermore, milk price up to LE 0.65/kg makes it not profitable under similar conditions of response, feed, and labor costs. In addition, using BST was more profitable in high and medium producers compared with in low producers, which was not profitable.

As shown in Table 1, return on investment and, of course, profitability of BST is increased with increasing in milk price and the magnitude of lactation response to BST treatment. Under the conditions of the study by El-Ghandour (2000), one may recommend the use of BST as a treatment to increase milk production in multiparous and in both high and medium producers cows, and to exclude primiparous and low producing cows from the treatment, in order to achieve maximum profitability. However, it should be stressed that an economic analysis should be made for each given condition, taken into account various aspects of the production process, particularly the level of milk production, the magnitude of milk yield response to treatment, and the milk price along with the cost of treatment.

Table 1: Profitability of using BST as a function of milk response and price (El-Ghandour, 2000)*

Conclusion

On the light of the results under Egyptian conditions, there are beneficial effects of using BST in improving milk production, however, these depend to large extant on the management system applied in the farms including nutrition, reproduction, and body condition score. Additionally, large commercial dairy operations can using modern technologies (BST) more easily, efficiently, and economically than smaller ones.

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