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FEASIBILITY OF INTRODUCING BUFFALOES INTO SOME AFRICAN COUNTRIES

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SUMMARY

This paper discusses the opportunities of developing river buffalo production in Africa. Only in Egypt, in fact, Bubalus bubalis is reared as milk and meat producer.

Problems relating to climatic adaptation, feeding and nutrition, pathologies and management are discussed.

The potential African areas where buffalo production is likely to be succesful are identified on the basis of the following parameters: percentage of dairy cows out of total cattle; average annual milk production; increase or decrease in cattle number in the past 10 years.

North and East African countries look more vocated to eventual buffalo introduction because of their tradition in dairy production and consumption. However, a blind import of buffalo to countries with no buffalo tradition is a nonsense if all aspect relevant to general physiology, reproduction, health, feeding, management, performance recording and marketing are not carefully taken into account. It is suggested that a local organization cooperates in planning and super-vising all necessary actions for a successful buffalo production system.

Keywords: buffalo, African countries, livestock production.

INTRODUCTION

This paper will discuss the opportunities of developing river buffalo production in Africa. Therefore, the indigenous wild African buffalo (Syncerus caffer) will not be here considered. However, a short mention of this indigenous African species, which is very little known to most animal production scientists, is here necessary. The African buffalo is referred to be a large, suspicious and ferocious animal (Mason, 1974) and has never been domesticated. In the classification of the "Bovini" tribe, three groups are distinguished: Cattle, Asian buffalo and African buffalo. African buffalo therefore belongs not only to a different species as respect to Asian buffalo, but also to a different group and a different genus (genus Syncerus) respect genus Bubalus of Asian and Europe, with a number of chromosomes= 52 in Syncerus respect 50 of Bubalus bubalis group River and 48 of Bubalus bubalis group Swamp: therefore interbreeding between Syncerus caffer and Bubalus bubalis appears impossible.

Very few studies exist on African buffalo, which is found in the forest and savannah regions of Africa, south of the Sahara: Ethiopia, Sudan, Zaire, Congo, Chad, South Africa. The number was referrend to be 2-3 million (Mammerick, 1961). In view of its tolerance to tsetse fly and trypanosomiasis as well as to sustainability to the environment, the possibility of producing fertile hybrids with the Asian river buffalo appeared attractive to the extent that experiments of crossbreeding with Indian buffalo were done. Unfortunately, such experiments were unsuccesful (Bigalke and Neitz, 1954).

Further trials to introduce in Africa the river buffalo for purebreeding were performed in Madagascar (1957), Mozambique (1962), South Africa (1904), Tanzania (1923), Tunisia (1958), Uganda (1971), Zaire and Congo (1914). Such trials were all unsucessful (W. Ross Cockrill, 1974) and there are no buffalo herd now except for one only herd in Mozambique.

It appears that lack of appropriate management skills made all these trials to fail.

Some animals were imported also in Madagascar, Uganda, Zaire and Congo (Alexiev, 1998).

The river buffalo is bred with good results in terms of milk and milk products, meat and work in Egypt only, along Nilus river valley and Fayum oasis. In fact the expansion of buffalo from the Indo valley towards both East and West occured in the first centuries a.D. and was developed in the civilizations of the rivers: to Mekong and Yellow River (Far East), to Tigris and Eufrates (Near East), to Nilus (Africa) and Sele and Volturno (Italy).

For this reason, the diffusion of Buffalo in Africa depends on the availability of water, to the extent that Bubalus bubalis is commonly called "water buffalo".

Climatic adaptation

Buffaloes are more sensitive than cattle to direct solar radiation and ambient temperature. However, buffalo has a peculiar ability to seek water as a means to reduce the heat load. In case there is no access to water Sastry (1983) refers that shade serves equally well because evaporation along the respiratory tract is an important mechanism of heat loss in buffalo.

Buffaloes are a less efficient water users, as evidenced by their higher intake of water per unit dry matter intake, higher urine outputs and lower percentage kidney reabsorption of filtered water (Moran *et al.*, 1979). Suitable protection against thermal stress is thus an essential requirement for buffalo husbandry. Karam Shah (1979) has demonstrated that shade is the most important protective measure and that loose housing, in the form of simple shelters with grass thatch or bamboo are the most suitable and less expensive structures.

In hot climates, water availability increases in importance. The provision of wallows is not considered optimal, unless there is a continuos change of water, because of the dirt that accumulates in the wallow; on the contrary, splashing water during the hottest parts of the day and the provision of cooled drinking water alleviate the thermal stress. These practices are regularly followed in most villages in India.

Buffalo calves under one year of age are more sensitive to heat stress. However, high mortality of buffalo calves is a universal problem. Well ventilated housing is therefore essential for them and particular care should be taken during the short critical period after birth to assure that the calf consumes enough colostrum.

Heat stress produces also a lowered feed consumption and utilization; however it was demostrated (Singh, 1983) that the same animals, at night, under field conditions, have a higher dry matter intake. Therefore is important to make deeper researches on the effect of temperature on nutrition intake and on milk production (Chauhan *et al.*, 1998) on nutrient utilization and on biochemical and physiological parameters in growing calves (Chauhan *et al.*, 1999), during transport (Kanchev *et al.*, 1997), and the possibility to reduce the hot stress with the availability of wallows (Terzano *et al.*, 2000) or showers.

Feeding and nutrition

Average daily milk yield registers a huge variability in river buffalo, depending on the breed, the country and especially the management and feeding system. It can range from 3-4 kg milk/day for poorly fed animals (grazing and by products) to even 15 kg/day in intensive management systems.

In the countries of Europe and the Near-East, except Italy, extensive management systems are employed, allowing to obtain a yearly milk production in about 270 days lactation of 900-1000 kg milk. Such extensive systems include grazing in the favourable seasons. In all cases, green forage 'cut-and-carry' - composed of leguminous varying from country to country - concentrates and byproducts are the basic foodstuff. Green forage and hay are made mainly of alfalfa in Italy, Bulgaria, Romania and Turkey and *Trifoliulm alexandrinum* in Egypt. Most common by products given to buffaloes are brewer grain residuals in Italy and Bulgaria, sugarbeet-pulp in Italy, Bulgaria and Iran, cotton residuals in Egypt and Azerbaijan, tomato peel in Italy, apple juice residuals in Iran, sugarcane residuals in Egypt and Iran, stalk and cobs in Iran, Egypt and Romania and straw everywhere.

In India and Pakistan most common type of feeding for buffaloes yielding 10 kg milk/day is composed of green forages (*Trifoliulm alexandrinum, alfalfa,* green oats) with the addition of a concentrate mixture and straw (Ranjhan and Pathak, 1983, table 1).

Table 1. Feeding schedule for lactating buffaloes yielding 10 liters/day. (Ranjhan and Pathak,1983)

Feed	Quantity (kg)
Ration 1	
Green berseem (15% D.M., 1.5% D.C.P., 10% T.D.N., 0.360 Mcal M.E. on fresh basis)	85
Ration 2	
Green berseen/alfalfa/cowpea	60
Wheat straw	5.5
Ration 3	
Green oats (25% D.M., 1.6% D.C.P., 16.7% T.D.N., 0.61 Mcal M.E. on fresh basis)	20
Concentrate mixture (15% D.C.P., 73% T.D.N., 26 Mcal M.E.)	4
Wheat straw (0% D.C.P., 40% T.D.N., 1.4% Mcal M.E.)	5
Ration 4	
Chaffed wheat straw (0% D.C.P., 40% T.D.N., Mcal M.E.)	8
Concentrate mixture	7

In Iraqi marshes, buffaloes swim half-submerged on the aquatic vegetation all day long, where they get the major bulk of feed. During the night, when they return to the floating islands where they live, they fed the green forage cut by the farmer during the day; this forage is composed of reeds, papyrus, various water plants, and rice hulls when available.

In Italy, dairy buffaloes are managed in the same intensive way as dairy cows, maintained in loose housing paddocks all over the year. Maize silage and grass silage are the main feeding source. Average yearly milk production registered for buffaloes in Italy is 2000 kg although five percent of the recorded buffalo overtake 3000 kg.

An example of feeding schedules for high yielding buffaloes is reported in table 2.

Table 2. Example of daily feeding schedule for a 10 kg milk producing buffalo in Italy

Component	kg	kg dry matter	UFL	Crude protein (g)	Fibre (g)
Alfalfa hay	7.5	6.45	3.87	650	2220
Maize silage	16.0	5.12	4.56	385	950
Concentrate (3.8% protein)	3.0	2.64	2.90	1000	320
Maize grains	1.3	1.14	1.45	115	25
Total	27.8	15.35	12.78	2150	3515

But similar very energetic diets (0,80-0,85 UFL (kg s.s.) are used in Italy only in particular selected genotypes where highest milk productions are requested for the very convenient price of milk (3 times cow milk) and because the employment of concentrates increases milk protein (4.5-5.0%) and fat (8-9%) content (Bertoni *et al.*, 1991; Tripaldi 1993, Verna *et al.*, 1994) These characteristics are necessary for the quality of mozzarella cheese, the luxurious, expensive cheese produced by buffalo milk in Italy. The demand of high quality mozzarella in Italy and in the World has stimulated the development of selection, husbandry, reproduction and nutrition techniques and the increasing of buffalo farming in Italy.

In African Countries it is possible to exploits buffaloes better than other ruminants for the higher ruminal microbial number vs bovines (Puppo *et al.*, 1998) and their better nitrogen digestibility and degradability with very fibrous diets (Puppo e Grandoni, 1994; Puppo *et al*, 1998). In fact buffaloes showed better digestion capacity than other ruminants with higher forages/concentrates ratio and low energetic concentration diets (Settineri *et al.*, 1993; 1995; Bartocci and Di Lella, 1994) that are common in extensive conditions of Africa.

Therefore the possibility of buffalo adaption to African environments includes also the ability to utilize effectively the poor resources.

Pathology

Buffalo pathologies are similar to that described in cattle even if few deseases are peculiar of buffalo that show more resistance to other deseases than cattle, for higher adaptation capacity to hot-humid climates.

1 - Parassites infections

It is very easy, particularly in developing countries, (Borghese *et al.*, 1997) to find parassites infections as gastrointestinal helminths (Strongiloides, Toxocara, Moniezia, Mammonogamus) and coccidia (Eimeria, Giardia, Cryptosporidium), liver parassites (Fasciola), tick parassites (Hyalomma, Sarcoptes) blood parassites (Theileria), that produce the most important economic losses in buffalo breeding.

2 - Bacterial infections

Escherichia coli is a Gram negative bacillus, that can cause gastroenteric pathologies, particolarly in calves, associated with other bacteria (Enterobacter, Pseudomonas, Klebsiella) or coccidia or erminosis or virosis. The respiratory deseases are caused by Pasteurella, Staphylococcus, Streptococcus, Escherichia coli, that can cause high mortality, if the animals are non treated by antibiotics.

Pasteurella multicida is responsible of Haemorragic septicaemia, the most serious desease in buffalo because of high mortality particularly in tropical Asian countries, but it could be controlled by antibiotics and vaccines.

Tubercolosis, produced by Mycobacterium, is a serious zoonosis, that could be eradicated after tubercolin diagnosis.

Brucellosis, by Brucella, is another zoonosis, that need to be eradicated after sierological diagnosis, because could causes serious desease in population and reproductive disorders and infertility in buffalo. Vaccination could be applied only in developing countries.

Leptospirosis is another zoonosis, produced by Leptospira linked to water sources contaminated by rodents.

Listeriosis, by Listeria, produces meningoencephalitis, abortion and septicaemia: the listeria could be found in silages.

Chlamidia, Rickctsia, Paratuberculosis are present in developed countries also, as mastitis incidence is linked to dairy buffaloes.

3 - Viral infections

Prophylaxis is very important to control some viral infections that could cause neonatal diarrhoea (Rotavirus Coronavirus) particularly in intensive systems. IBR (bovine Rhinotracheitis) BVD (bovine diarrhoea) BHV (bovine Herpesvirus) have been diffused by cattle in buffalo intensive farms.

In developing countries is present the foot and mouth disease by Aphthovirus.

4 - Other pathologies

Buffaloes could be affected by Mycotic infections, tumors, reproduction disorders and huterus prolaxe.

Buffalo sustainability in the world

Buffalo has proved to be, in several countries, an important source of works, animal proteins from milk and meat, and for the smallholders it gives additional farm income with the manure, a worldwide recognized cheap and good fertilizer. In Nepal, Thailand, China and India many smallholders depend on buffalo for fertilizing their crops (Keshary, 1978, Pilla, 1995).

But buffalo sustainability all over the world can be increased (Borghese and Moioli, 1999) through the implementation of appropriate key actions which exploit the results obtained during the ongoing development projects as well as by research institutions. In particular the research has contributed to achieve a high production level in the breeding stock, thanks to the application of milk recording systems, progeny testint and targeted breeding strategies. If these systems will be applied at regional or national level, coordinated by appropriate organizations, successful genetic improvement will be achieved.

Research in dairy technology has been widely carried out in Italy and has demonstrated the buffalo milk is suitable to processing into various dairy products which might be exported all over the world through an appropriate marketing organization. The same could apply to meat production, which should take into account the results obtained by Italian and Bulgarian researchers in the identification of the best fattening systems as well as of alternative meat products, like cured meats, "salami" and sausages, which better satisfy the consumer's taste and that could be exported as delicatessen, if properly promoted.

The belief that buffalo has a poor reproductive efficiency was demonstrated to be wrong by several research institutions, in particular italian (Borghese *et al.*, 1996). In fact with appropriate rearing systems for female calves and heifers, puberty can be anticipated and age at first calving decreased by several months. The use of artificial insemination can be increased through estrus synchronization obtained with intravaginal implant of silicon coils (PRID + PMSG+$PGF2\alpha$) for 10 days followed by an injection of 1000 UI PMSG and 15 mg Luprostiol on the 7^{th} day. The insemination offered after synchronization turned out into a very satisfying pregnancy rate.

By intensifying international cooperation and exchange of expertise among research institutions, governments and development organizations, buffalo will have many chances to survice and expand in the framework of a sustainable agriculture.

Introduction of buffaloes in the African countries

In order to promote the introduction of river buffalo in African countries, several economic aspects, on top of the mentioned biological ones, must be taken into account. Although the above mentioned trials were unsuccessful, it believed that they fail because of lack of adequate knowledge of buffalo physiology and non-appropriate management.

Two main issues are in favour of the introduction of dairy buffaloes in Africa:

The first is the poor milk productivity of dairy cows in Africa: 450 kg milk yearly, while the world average is 2061 kg. Such low productivity is due not only to poor feeding and management resources, but mainly to the employed indigenous breeds. African countries, generally, have not experienced the progressive move registered all over the world towards high yielding breeds of Holstein-Brown type, because such high selected breeds cannot fit in the local environments and easily go under health and reproductive problems which reduce their productivity.

The second, is the sustainability of buffalo production. In fact, the intensive management systems requested by the high productive cattle breeds have a damaging impact on the environment and disagree with the promotion of a sustainable agriculture. Buffalo, on the contrary, is reared in a large variety of sustainable production systems in the developing countries, producing milk of higher nutrition quality: buffalo milk is much richer in total solids than cow milk (protein content is twice higher, and fat content three times higher), therefore it is especially suitable for butterfat production and cheese production (Borghese *et al.*, 2000); moreover, the skimmed milk obtained after the removal of the cream, is a precious protein source for human consumption.

In order to evaluate which countries could be more suitable for introducing buffaloes, the following methodology has been used. We assumed that the potential areas are the same where dairy cattle production has the major importance, for two reasons: first for the similarities between dairy cattle and dairy buffalo production and the need of existing traditions for the practices of milking and milk processing; second, because the presence of dairy cattle indicates the human attitude to use milk and dairy products, therefore a potential market demand for buffalo milk can be hypotized. We emphasize the second point because we should be aware that in most East-Asian countries, like Thailand, the Philippines and Vietnam, human population in general is not used to consume milk, and despite of the large presence in those areas of swamp buffalo, animals are rarely milked and have been improved only to a very little extent through crossbreeding with river buffalo.

The considered data were the number of total cattle, number of dairy cows and average milk production in each African country (FAO Yearbook Production, 1995). Only African countries having at least a total cattle population of 200,000 heads were here considered.

The following parameters were identified to define the potential African areas:

1. Percentage of dairy cows out of total cattle heads;
2. Average annual milk production;
3. Increase or decrease in cattle number in the past 10 years.

In table 3 total cattle number, total dairy cows, percentage of dairy cows out of total cattle heads and yearly milk production are reported.

As regards to the proportion of dairy cows, as expected, the countries showing the highest proportion (from 40 to 60%) are the North-African (Morocco, Tunisia, Egypt and Algeria). This confirms the renown that milk is a fundamental food in the Mediterranean, confirmed also by the utilization of milk from all species (sheep, goat, camel) in this countries and in particular in Morocco. North-Africa is followed by East-African countries (Somalia, Kenya, Mozambique, Tanzania) plus a few more countries bordering the previous mentioned (Mauritania, Niger, Sudan, Uganda and Zimbabwe); these countries have a proportion of 20% dairy cows out of total cattle. In the remaining countries the percentage is lower than 20%.

As regards to the average yearly milk production, an immense variability is evident. Only in three countries (South Africa, Tunisia and Algeria) milk productivity reaches 1,000 kg. In a second group (Egypt, Morocco, Camerun, Kenya, Angola, Sudan, Somalia, Niger and Zimbabwe) milk productivity ranges from 400 to 670 kg milk (the average for all Africa). The remaining countries lie below 360 kg/year. It must be noted that some of these poor milk producing countries have not only a high number of cattle but also a high proportion of dairy cattle out of total cattle, like Mauritania, Uganda, Tanzania and Mozambique.

As regards to the trend in cattle population, no big changes in numbers were registered in the past decade, with a few exception, such as a consistent decrease in both total cattle and dairy cows in Morocco and Zimbabwe, a consistent increase of the same in Sudan and Nigeria; a moderate increase of dairy cows in Mauritania, Angola, Tunisia, Niger and Uganda.

Table 3. Total cattle, dairy cows, increasing trend and average milk productivity in Africa. Source FAO, 1995

Country	Total cattle 1000/heads	Trend total cattle (*)	Dairy cows 1000/heads	Trend dairy Cows (*)	% dairy cows/ total cattle	Average year milk production (kg)
Algeria	1300	s	560	d	43	946
Angola	3280	s	328	i	10	488
Benin	1223	i	125	s	10	130
Botswana	2800	i	335	s	12	350
Burkina F.	4350	i	690	s	16	175
Cameron	4900	s	250	s	5	500
Rep. Centr Africa	2797	s	218	s	8	483
Chad	4539	i	455	s	10	270
Egypt	3100	i	1475	s	47	679
Ethiopia	29825	s	3534	s	12	209
Guinea	1780	i	250	s	14	185
Kenya	13000	s	4420	s	34	489
Madagascar	10309	s	1753	s	17	276
Mali	5542	s	555	s	10	245
Mauritania	1125	d	303	i	27	350
Marocco	2490	d	1500	d	60	553
Mozambique	1280	d	346	s	27	170
Niger	2008	i	410	i	20	400
Nigeria	17791	i	1630	i	9	233
Senegal	2850	i	287	s	10	360
Somalia	5200	d	1360	s	26	412
South Africa	13015	i	930	s	7	2663
Sudan	22000	i	5400	i	24	480
Tanzania	13376	s	3250	s	24	182
Tunisia	735	i	390	i	53	1823
Uganda	5200	s	1300	i	25	350
Zambia	3300	i	297	s	9	300
Zimbabwe	4500	d	990	d	22	424

(*) i= increasing; d= decreasing; s= steady.

Considering the previous assumptions, the countries with the best potential for introducing buffalo could be the following:

1. For their dairy tradition (parameter 1): Morocco, Tunisia, Algeria, Kenya, Sudan, Somalia, Mauritania, Mozambique, Uganda;
2. Because they have registered a trend to increase (parameter 3) cattle and/or dairy cow number: Sudan, Mauritania, Angola, Tunisia.
3. Because their milk productivity could be highly increased (parameter 2): Tanzania (actually 182 kg/year), Mozambique (170 kg/year), Uganda (350 kg/year), Niger (400 kg/year);

Several steps for introduction of buffalo in African targeted countries.

1. Economy is the most important aspect, as regards to the expected marked demand of buffalo milk. Surveys must be performed to verify how buffalo milk will be marketed and who will be marketing milk. It is renown that buffalo milk can be processed in a huge number (Borghese *et al.*, 2000) of dairy products, both fat-based products (cream, butter) and protein products (cheese, curd, yoghurt) and that in India mainly it is used for liquid consumption after dilution. It must be noted that in every country buffalo milk has its own specific outlet, depending on the tradition and the request of human population. It is rare to find that in the same area buffalo milk is used for different purposes: in Italy nothing else but "mozzarella cheese" is produced, in Bulgaria yoghurt, in Iraq mostly cream, in Azerbaijan butter, in Iran cheese, in most Asian countries home-made fatty products. It is important also to define how the production will be marketed. In Asia, most buffalo milk is home-

processed; in Italy it is rarely processed at the farm, but it is sold to dairies; in other Eastern-European countries it is mostly home-processed, while in Iraq it is all sold to dairy plants.

2. Therefore, before introducing buffalo, it is important to know where and how milk will be marketed, that means to create a marketing structure where it does not exist yet.
3. All aspects relevant to buffalo phisiology and health mentioned in this paper must be taken into account: water availability and shelters to cope with thermal stress are a must.
4. A feeding programme based on the available feeding resources must be drafted. The feeding programme should carefully evaluate the cost/benefit ratio. but should aim to have animals producing at least 4-5 kg milk daily. Marketing opportunities for small amounts of milk are null.
5. It is suggested that a local organization supervises the introductory trial. It is well known how clever livestock exporters can take advantage of the lack of knowledge of local farmers by promising high profits. Such local organizations might be composed of technicians and animal production experts from the Governments or also Research Institutions that might help in planning and supervising all necessary actions for a succesful livestock system: housing, management, feeding reproduction, health control, animal registration and milk recording.

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