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BULLETIN OF THE FAO INTER-REGIONAL COOPERATIVE RESEARCH NETWORK ON BUFFALO

INCLUDES SHORT COMMUNICATIONS, RESEARCH PAPERS, TECHNICAL NOTES, ONGOING RESEARCHES

From the editor

It has taken some time to prepare this issue of the Buffalo Newsletter, because various events relevant to buffalo took place, and we will use again this magazine as the appropriate means to communicate with different countries what is going on all over the world.

From 20 to 23 May 2001, in Maracaibo (Venezuela), the VI World Buffalo Congress was organized by the International Buffalo Federation, the President of which is Pablo Moser.

This Congress was called "The buffalo, an alternative for animal agriculture in the third Millennium"; this statement is especially true in the countries of southern

Prof.AntonioBorghese

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BUFFALO GENETIC RESOURCES IN CHINA

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China has a huge varieties of buffalo genetic resources, unknown to most buffalo experts but the Chinese. They are all of the swamp type, with a long history of domestic livestock, and provide a good deal of products to the farmers.

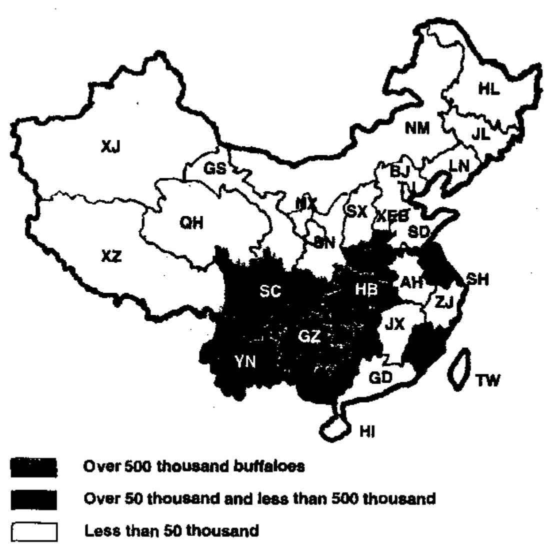
A brief outlook of the Chinese buffalo was presented in issue no. 3 of the Buffalo newsletter (July, 1995). In that paper, buffalo was presented as the multi-purpose helper in the agricultural economy of South Eastern China.

In this paper, we will concentrate on the different breeds, attitudes, adaptation to the environment and distribution.

In fact, every Chinese province of the south east, and sometimes even every typical area within the province, has its own local swamp buffalo breed, which carries the name of that geographical area. It means that each breed evolved separately, by adapting itself to the peculiar environmental conditions of each area. Eighteen different breeds of local swamp buffaloes are here referred, altogether 17 million animals.

For making the reader more accustomed to these genetic resources, the various breeds will be examined step by step, at each step considering a different point of view, such as geographical distribution and numbers; climate and environment; morphology, i.e. colour, size and weight; productivity. (follows page 2)

Buffalo distribution in China in the different provinces



MAP LEGEND

AH - Anhui
BJ - Beijing
FJ - Fujian
GD - Guangdong
GS - Gansu
GZ - Guizhoiu
HB - Hubei
HEB - Hebei
HEN - Henan
Hi - Hainan
HL - Heilongjiang
HN - Hunan
JL - Jilin
JS - Jiangsu
JX - Jiangxi
LN - Liaoning
NM - Inner Mongolia
NX - Ningxia
QH - Qinghai
SC - Sichuan
SD - Shandong
Sh - Shanghai
SN - Shaanxi
SX - Shanxi
TJ - Tianjin
TW - Taiwan
XJ - Xinjiang
XZ - Tibet
YN - Yunnan
ZJ - Zhejiang

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America, where buffalo can be reared more easily, being a less demanding livestock than others, but producing at the same time work, meat, milk, and processed products, utilising poor feed resources and surviving in difficult climate conditions.
The actuality and the future prospect of water buffalo production systems in the various parts of the world were presented, as main lectures, in the plenary session: by S.K.Ranjhan from India, President of Asian Buffalo Association and by Libertado Cruz, from Philippines, for Asia; by Aleko Alexiev, from Bulgaria for Europe; by Luigi Zicarelli and Luigi Infascelli for Italy; by Barry Lemcke, for Australia; by Rocha Loures, for Americas.
A symposium on "Global demand for red meats and buffalo milk" was coordinated by Sergio Gigli and Rafael Rogrigues.
A book of proceedings was edited, including the main lectures, while the scientific papers, that were exposed in poster sessions, were included in a CD Rom, and covered all different fields of buffalo research and production: Physiology, Reproduction, Genetics, Social-Economics, Animal Behavior, Meat and Milk Science and Technology, Nutrition and Animal Health.
Many breeders partecipated to the Congress and were interested to the selection schemes adopted in Italy and managed by the Buffalo National Breeders Association (ANASB) that produced a genetic type of buffalo which is very appreciated in southern America.
During the Congress, three meetings of the standing Commitee of the International Buffalo Federation (IBF) were held, and were partecipated by people from 20 countries. Libertado Cruz was nominated President of IBF for the period 2001-2004; he will organize the VII World Buffalo Congress in the Philippines in 2004.
Antonio Borghese was nominated General Secretary of IBF, and while it was decided to change the President every 3 years, the General Secretary will be maintained in Rome, in order to be closer to FAO, and to favour a continous link between the FAO Inter-regional Co-operative Research Network on Buffalo and the International Buffalo Federation.

Prof. Antonio Borghese

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DISTRIBUTION

In the map, numbers of buffaloes are reported for each province. Different colours indicate the different class of numbers.

In red the provinces with more than half million buffaloes:
Guizhou 1.4 million
Hubei 777 thousand
Yunnan 655 thousand
Sichuan 605 thousand.

The provinces with more than 50 thousand and less than half million are indicated in green:
Hunan 461 thousand
Henan 290 thousand
Guanxi 116 thousand
Fujian 70 thousand
Jiangsu 65 thousand.

The provinces with less than 50 thousand are indicated in yellow:

Shanghai 36 thousand
Anhui 27 thousand
Hainan 24 million
Zhejiang 10 thousand.

Each region has different types of buffaloes, to the extent that it is possible to say that in China, buffaloes, have adapted themselves to a range of climates, heights and temperatures as wide as the different cattle breeds fit the various continents and countries. Therefore, there exists in China buffalo breeds that can be found only in the lowlands, while other breeds live only in the mountains.
The breeds of the lowland are raised on fertile soils and paddy fields where intense agricultural activities are carried out. This is the case of the the Jianghan breed (700 thousand) in the Hubei province, the Binhu breed (461 thousand) in the Hunan province, the Xinyang breed (290 thousand) in the Henan province, the Enshi breed (77 thousand) in Hubei, the Fuan breed (70 thousand) in the Fujian province, the Yanjin breed (45 thousand) in Yunnan, the Xinglong breed (24 thousand) in Hainan and the Wenzhou breed (10 thousand) in Zhejiang.
Two more breeds take advantage of the lowland and fit also in the saline seaside shores of the East sea: it is the case of the Haizi breed (65 thousand) in Jiangshu and Shanghai breed (36 thousand) around the city of Shanghai. A similar adaptability to saline sandy field was already referred for another buffalo population in Bangladesh, in the bay of Bengal (see Buffalo newsletter no. 15).
The highly most represented breed in China is the Guizhou (1.46 million), a mountain breed of the Guizhou province: raised on natural pasture and of various body size according to the environment conditions.
As regards to the other breeds of the mountains, we find the Fuling (415 thousand) in Sichuan, the Dehong (390 thousand) and the Diandong (220 thousand) in Yunnan, the Dechang (190 thousand) in Sichuan, the Xilin (59 thousand) and the Fuzhong (57 thousand) in Guanxi and the Dongliu (27 thousand) in the Anhui province.
Most buffalo breeds tolerate all ranges of temperature, from the zero degrees centigrades in winter to the 30 and over degrees in summer.
Size and weight is variable; in general, breeds of the lowland are slightly heavier:

follows page 3 ☞

in fact weight of adult females ranges between 406 to 600 kg. On the contrary, the weight of adult females in the mountain ranges between 358 and 571 kg. The biggest in size is the Shanghai breed (average weight of the adult female is 600 kg), followed by the Haizi breed (580 kg). Both these breeds are the ones reared in the lowland sea coastal areas. The two smallest breeds are the Diandong (358 kg) and the Yanjin (406 kg) of the Yunnan. In table 1, breeds, numbers, provinces, coat colour and average adult weight of the females are reported.
All buffaloes have long horns, typical trait of the swamp buffalo. The colour of the coat is grey, with various intensity: from deep grey and blackish grey to brown, hoar, caesius and light grey. The majority of the breeds have also white spots either in form of stripes on the breast or in form of rings on the neck.
As for all swamp buffaloes, also all Chinese buffaloes are used for draught, often as the only purpose. Exceptions are given by the Wenzhou breed, which is is regularly milked and produces 1020 kg milk in 278 days and by the Jianghan (800 kg milk in 8-12 months). Also the Fuan breed is sometimes milked, producing averagely 2.6 kg milk/day, in a lactation of extremely variable length: 150 to 300 days.

MILK PRODUCTION

In order to improve milk productivity, a group of river type buffaloes were imported from India (Murrah breed) and Pakistan (Nili Ravi breed) respectively in 1957 and 1974. They included both males and females and they are maintained purebred at the farm of the Buffalo Research Institute, Nanning, Guanxi, for producing

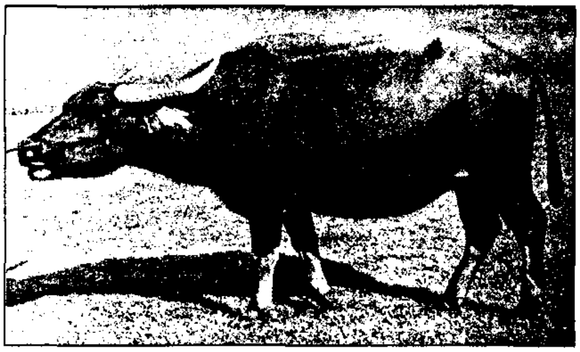
follows page 4 ☞

Table 1. Major patterns of buffalo genetic resources in China

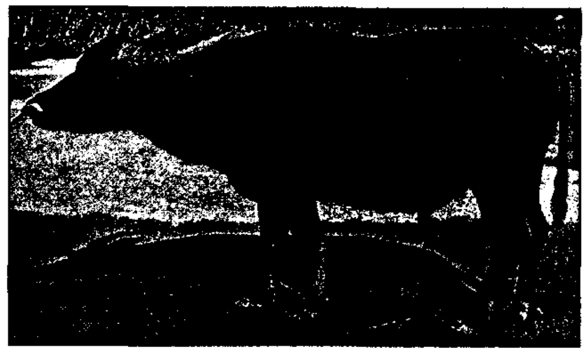
Breed	Numbers (x 1000)	Province	Coat and spots	Average adult weight of female (kg)	Environment
Guizhou	1,461	Guizhou	Grey, white band in fore breast	487	plateau
Jianghan	700	Hubei	Livid and caesious, white band in fore breast	519	lowland
Binhu	461	Hunan	Grey and black, a white band under neck	547	lowland
Fuling	415	Sichuan	Brown and black	491	mountain
Dehong	390	Yunnan	Black and hoar, white band in parts of neck and breast	571	mountain
Xinyang	290	Henan	Grey	533	any
Diandong	220	Yunnan	Hoar, white band on fore breast	358	mountain
Dechang	190	Sichuan	Hoar	527	mountain
Enshi	77	Hubei	Caesious, striation on neck	524	any
Fuan	70	Fujian	Grey and black	523	lowland
Haizi	65	Jiangshu	Brown, a yellow and white striation	580	lowland
Xilin	59	Guanxi	Grey and black, white band under neck	485	plateau
Fuzhong	57	Guanxi	Grey and black, white band on fore breast	419	mountain
Yanjin	45	Yunnan	Green and grey, a grey and white striation in fore breast	406	lowland
Shanghai	36	Shanghai	Deep grey, white ring under neck	600	lowland
Dongliu	27	Anhui	Caesious, white ring on breast	534	hill
Xinglong	24	Hainan	Grey and black, white band under neck	503	lowland
Wenzhou	10	Zhejiang	Deep grey, white ring under neck	505	lowland

Binhu buffalo (male)

Dongliu buffalo (female)



Enshi buffalo (female)



Enshi buffalo (male)

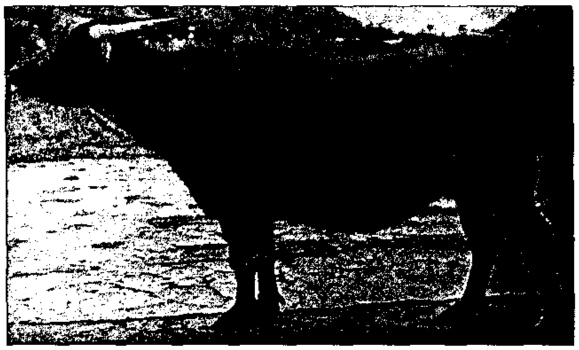
crossbred (75% Nili Ravi, 25% local swamp) as well as triple crossbred (25% Murrah, 50% Nili Ravi, 25% local swamp).The crossbred are kept at the Institute for research, but are also distributed to private farmers that use them on local buffaloes. Unfortunately, no statistics are available either on the numbers of the crossbred buffaloes that are raised by local farmers, or on their production.
Milk productivity of the imported breeds and crossbred compared with one local breed (Wenzhou) is higher, as indicated in the following table down below.
In the research farm, milking technique has been moved from hand milking to milking machine. In the big production farms, and in the small village herds, hand milking is used. The Buffalo Research Institute in Guangxi produces several dairy products, as follows: sterilized milk, AD Calcium milk, yoghurt and strawberry flavor yoghurt, and others.
At villages in Guangdong province buffalo milk is used to produce some folk traditional dairy products such as milk cake, ginger juice milk and milk bean curd.

MEAT PRODUCTION

Meat productivity of buffaloes of

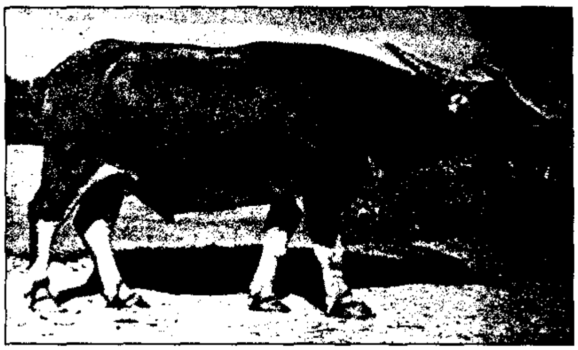
follows page 5 ☞

	Murrah	Nili-Ravi	Triple crossbred	Nili Ravi crossbred F1	Nili Ravi crossbred F2	Crossbred at the village	Wenzhou breed
Lactation length (days)	324	317	318	327	325	280	278
Milk (kg)	2133	2262	2296	2041	2268	1093	1020
Fat %	6.73	6.35	7.43	8.17	-	11.04	9.5
Fat kg	143.5	143.6	170.5	166.8	-	120.7	96.9
Protein %	4.05	4.11	4.47	4.61	-	5.86	4.5
Protein kg	86.4	93.0	102.6	94.1	-	64.0	45.9
Milking rate (l/min)	0.292	0.311	0.275	-	-	-	-



Fuling buffalo (female)

Fuzhong buffalo (female)



Fuzhong buffalo (male)

the imported breeds compared to the local breeds is reported in table 2, page 6.

HUSBANDRY

In research farms and big breeding farms, house-feeding management is conducted. Wastes are drawn in pool and fermented for use in fodder land. The transport is mechanized.
In average production farms, half house-feeding and half-grazing management is conducted.
For the small local farmers, grazing is the main feeding system for buffaloes.
The ideal carrying capacity of the grazing land is 1 ha per buffalo. Nutritional disorders might occur due to verminosis, such as liver fluke, with 70-80% of infection rate.

HEALTH AND PHISIOLOGY

Buffalo in China has good adaptability and disease resistance, but poor resistance to trypanosomiasis with 50.7% of incidence rate.
Available parameters on physiology of Chinese buffaloes are given in table 3.

BREEDING GOALS AND GENETIC IMPROVEMENT PROGRAMMES

Programmes consist in providing information on

Shanghai buffalo

selection, crossbreeding, conservation.

1. Breeding objective: to breed new buffalo breed for dual-purpose (milk and meat)
2. Breeding method: two models
   Crossbreeding model between two breeds: using upgrading crossbreeding method
   N*L=F1 (NL)   N*NL=F2 (N·NL)
   Crossbreeding model between three breeds: using growing crossbreeding method
   M*L=F1 (ML)   N*ML=F2 (N·ML)
3. Breeding index:
   3.1 Milk performance index: 1500 kg of first lactation 305d milk yield, over 70% of milk fat rate
   3.2 Meat performance index: 350-400 kg of bull weight at 18-24 months, over 50% of killing-out percentage and over 40% of net meat rate.

follows page 6 ☞

Table 2. Meat Production

	Murrah	Nili-Ravi	Triple crossbred Research station	Triple crossbred Village	Nili Ravi crossbred F1 Research station	Nili Ravi crossbred F1 Village	Nili Ravi crossbred F2	Chinese local (in villages)
Preweaning growth rate (Kg/day)	0.67	0.70	0.94	0.59	0.62	0.63	0.67	0.42
Postweaning growth rate (kg/day)	0.45	0.51	0.52	0.62	0.62	0.62	0.40	0.44
Age at slaughter (males) (months)	19-24	19-24	18-24		18		26	19-21
Weight at slaughter (males) (kg)	292	437	441		398		361	216
Feed conversion efficiency (kg live wt gain/kg feed)	1:9.9	1:8.4	1:4.7		1:3.9		1:3.9	1:4.2
Carcass yield %	72.2	50.2	52.3		51.7		57.1	50.8
Carcass composition meat/bone/fat %	73.8/ 20.8/5.4	73.9/20.3 /5.8	77.0/17.9/5.1		76.2/18.5/5.3		81.4/15.3/3.3	74.5/21.7 /3.8
Weight weaned calf/year (kg/female/year)	88.2 (weaning at 3 months)	85.4 (weaning at 3 months)	85.5 (weaning at 3 months)					

Table 3. Physiology

	Shanghai breed	Juiangham breed	Dechang breed	Fuling breed
Haemoglobin (g/dl)	11.1-11.4	11.68-11.79	9.07-9.12	10.35
RBC ($x10^6$/(μl)	5.02-5.42	5.96-6.88	5.53-5.70	8.1
WBC (/(μl)	7.54-7.76	8.65-10.89	8.56-8.61	13.3

	Murrah	Nili Ravi	Triple crossbred	Guanxi breed
Plasma protein (g/dl)	46.00	48.48	41.20	41.88
Heart rate (beats/min)	40-50	40-50	40-50	40-50
Respiratory rates (breath/min)	10-20	10-20	10-20	9-18
Daily urine vol (ml/kg body wt)			4	
Daily fecal output (kg)			26.4	
Blood chemistry				
Total protein (g/dl)	7.03	6.77	6.54	6.89
(α1 globulin (g/dl)	8.55	6.44	7.73	10.27
(α2 globulin (g/dl)	8.20	7.59	8.37	7.66
(β1 globulin (g/dl)	8.48	5.65	7.12	7.20
(γ1 globulin (g/dl)	28.77	31.84	35.59	33.00

Breeding stock and semen available:

Breeding stock is supplied by Buffalo Research Institute in Guangxi.
Semen is supplied by Animal and Poultry Breeding Improvement Station in Guangxi
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Reproductive parameters (female buffalo)

Breeds	Puberty period (d)	First service period (d)	Estrus cycle (d)	Estrus duration (d)	Pregnancy period (d)	Postpartum estrus (d)	Calving interval (d)	References
Murrah	663.0	1071.4	22.9	60.0	307.9	66.9	435.6	Progress on studies in animal genetic breeding in China
Nili-Ravi	773.0	1079.0	22.0	52.0	305.2	67.7	446.2	
Triple crossbreed	605.3	896.5	23.9	56.2	309.7	59.8	441.1	
Guangxi buffalo	628.9	922.1	21.9	53.9	307.4	139.7	475.3	
Binhu buffalo	491.7	627.0	22.2	42.9	319.8	60.1		*
Fuling buffalo	585.0	1029.0	21.0		322.3	114.0	447.0	**

* Breed Record of Animal and Poultry in Hunan province
** Breed Record of Animal and Poultry in Sichuan province

Reproductive parameters (quality of bull semen)

Breeds	Semen volume (ml)	Semen density (100million)	Semen motility	Thawing motility	References
Murrah	6.13	6.62	0.68	0.38	Record from Animal and Poultry breeding improvement station in Guangxi
Nili-Ravi	6.19	6.70	0.68	0.38	
Triple crossbreed	6.09	6.15	0.69	0.36	
Fuling	3.50	9.18	0.75	0.36	Breed Record of Animal and Poultry in Sichuan province
Xinyang	3.30	9.80	0.74	0.46	Breed Record of Animal and Poultry in Henan province

Genetic parameters for economic traits

Trait	Heritability	Repeatability	Reference
Firstborn 305d adjustment lactation	0.382	0.438	Zhang Chunxi et al. "Preliminary study on traits genetic parameters of lactation in Murrah buffalo" Animal Husbandry and Veterinarian in Guangxi 1995(1)
Second-born 305d adjustment lactation	0.547		
Third-born 305d adjustment lactation	0.508		
Firstborn 60d adjustment lactation	0.395	0.429	
Firstborn 90d adjustment lactation	0.390	0.456	
Firstborn 150d adjustment lactation	0.429	0.483	
Firstborn highest daily lactation	0.135	0.310	
Fore-udder and post-udder pressure index	0.729		
Weight	0.035		
Body height	0.491		
Body length	0.640		
Heart girth	0.748		
Hip width	0.784		
Overall score	0.193		

INVESTIGATION ON CRYOSCOPICAL INDEX OF MEDITERRANEAN BUFFALO BULK MILK

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INTRODUCTION

The decreasing in freezing temperatures of solutions compared to that of solvents is called "cryoscopical index"; this index decreases the more concentrated the solution is.
Freezing temperature of milk is lower than 0 °C because of lactose and minerals, the content of which is quite constant; the cryoscopical index increases towards the value of 0 °C if water is added to milk.
By comparing the cryoscopical indexes of individual milk samples, considerable differences can be observed because of the variability of the components, which is furthermore strengthened by the eventual flow of ions from the ionic to the colloidal stage (Corradini, 1995).
The average value of the cryoscopical index of genuine cow milk, according to the European Union regulation 85/307, is -0.530 °C, while the accepted value not to suspect that water was added to cow milk is -0.520 °C. This increase in cryoscopical index compared to the physiological value is accepted because of the small non-voluntary addition of water during machine milking, transportation and storage, consisting of the water used for washing all facilities: in this case the index is called "technological cryoscopical index".
As regards to the cryoscopical index of buffalo milk, no value for acceptance is mentioned in the European Union regulations, making therefore quite vague the relationship between milk producers and dairies.
Little is known on this subject: a trial made on bulk milk in four buffalo farms in Southern Italy has referred an average value of cryoscopical index of -0.526 °C (Durante and Galiero, 2000).
In order to further investigate in this subject, the present trial has examined the results of monthly evaluations of cryoscopical indexes in bulk milk of Italian buffalo herds.


Italian buffaloes at Tor Mancina farm (Rome).

MATERIAL AND METHODS

The trial was performed in 9 buffalo herds of Central Italy (district of Latina, 80-100 km south of Rome).
During one year, every month, except August, bulk milk samples were withdrawn and analysed to determine the value of the cryoscopical index (Milkcryos, Foss, DK), pH and somatic cells (Somacounter 300, Bentley Instruments, USA; fluorine-optical-electronical method).
Herds were divided in two management type groups, according to milk yield and feeding systems, as follows: 1. Small-medium size herds, with milk yield lower than 9 kg/day (4 herds with less than 100 buffaloes); 2. Big herds with milk yield higher than 9 kg/day (5 herds with over 100 animals). Furthermore, samples were also grouped according to the season: warm season (May to September) and cold-temperate season (October to April).
In order to verify the differences in the considered parameters, the GLM procedure (monofactorial model) of the statistical package SAS (SAS, 1993) was used.

RESULTS AND DISCUSSION

The obtained values for the cryoscopical index ranged between -0.503 and -0.547 °C; these values are similar to the ones found in previous trials (between -0.509 and -0.544 °C) by Campanile et al. (1997) and Zicarelli (1999).
In table 1 the values for the cryoscopical index, pH and somatic cell numbers, according to farm type and season are reported.
Average value of cryoscopical

follows page 9 ☞

index was -0.530 °C; therefore, assuming an addition of water for technological processing of 1.89%, as stated in the European Union regulation 85/307, the physiological cryoscopical index of buffalo milk is -0.540 °C.
When examining the effect of herd type, small herds have a significantly lower pH value (6.705 vs. 6.736; P<0.01) and also of cryioscopical index (-0.532 vs. -0.529 °C) although non significant. These results coinfirm that the main cause of the decreasing of the cryoscopical index is acidity (i.e. the production of four molecules of lactic acid from one molecule of lactose).
On the contrary, big farms, having significantly higher values of somatic cells (140.756 vs. 111.059 n*1000/ml; P<0.10) have also higher values in the cryoscopical index (-0.529 vs. -0.532 °C). This increase could be due to sub-clinial mastitis, therefore a reduction in lactose and in the concentration of the solution.
When buffaloes are fed on diets with a low energy and protein level, an increase in the cryoscopical index could be expected. In fact, the highest cryoscopic index value (-0.521 °C) was detected in the farm where buffaloes were fed at the lowest energy and protein level (0.72 Milk FU/kg and 105.2 g/kg). The same trend is referred for dairy cows by Peterson and Freeman (1966).
Also "heat stress" can make the cryoscopical index to increase; when the results are analysed according to the different seasons, in the months when the temperature ranges between 25 and 37 °C also the values of cryoscopical index are higher (-0.528 vs. -0.531 °C).
In conclusion, the value of -0.530 °C can be considered as the technological cryoscopical index of buffalo milk. Further studies are requested to be able to define, also from the legal point of view, the limits in such index that can be accepted before considering that a fraud was done by adding water to milk.

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Table 1. Cryoscopical indexes, pH and somatic cell numbers, according to farm type and season.

Overall mean of technological cryoscopical index (°C)	- 0.530 ± 0.010
Overall mean of physiological cryoscopical index (°C)	- 0.540 ± 0.010

	Farm type		
	SMALL	BIG	rmse
Cryoscopical index (°C)	- 0.532	- 0.529	0.010
Acidity (pH)	6.705^B	6.736^A	0.096
Somatic cells (n*1000/ml) 111.059^b	140.756^a	78.209	

	Season		
	WARM	COLD-TEMPERATE	rmse
Temp. max (°C)	+ 25 ÷ + 37	+ 12 ÷ + 24	
Cryoscopical index (°C)	- 0.528	-0.531	0.010

a, b: P<0.10; A, B: P< 0.01

UREA CONTENT OF MILK OF MURRAH BREED OF BUFFALOES

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INTRODUCTION

Urea is a normal constituent of milk and comprises part of the non-protein nitrogen. Significant positive correlation between concentration of urea in blood and concentration of urea in milk has been reported (Bedo et al., 1997; Broderick and Clayton, 1997). All those factors which influence blood urea will also influence milk urea. These include rumen degradable protein intake, water intake, liver function and urinary output (Gustafsson and Carlsson, 1993; Baker et al., 1995; Cannas et al., 1998; Companile et al., 1998; Schepers and Meijer, 1998). Urea content of milk can be used as an indicator of crude protein and energy supply of dairy animals (Kirst et al., 1996), as a tool for the assessment of feedstuff, feed utilization, animal health and fertility (Bernhard and Schulz, 1992; Cheli et al., 1992; Hanus, 1995; Roth et al., 1996).
The average milk urea concentration from a group of animals should fall in a specific range. Deviations outside an acceptable range suggest that there are factors which should be examined, particularly in the light of adulteration of milk with the so called synthetic milk since urea is one of the ingredients of synthetic milk (Bansal and Bansal, 1997). Thus, it becomes essential to fix an upper limit of urea concentration in milk, so that beyond this level, the milk may be considered as adulterated with the so called synthetic milk. Since there is no report available in the literature on the levels of urea in milk of Murrah breed of buffaloes, maintained under standard feeding and management practices, the present investigation was carried out and the results obtained are presented here.

MATERIALS AND METHODS

Collection of Milk Samples

Individual milk samples were collected (in thoroughly cleaned and dried polythene bottles) from Murrah breed of buffaloes maintained under standard feeding and management practices at the Institute's Cattle Yard. The roughage fed to the animals mainly consisted of green berseem and oats fodder. The composition of concentrate mixture fed was as follows:

Wheat bran	20 %
Groundnut cake (expeller)	15 %
Maize	15 %
Rice polish (deoiled)	12 %
Mustard cake (expeller)	12 %
Barley	11 %
Cottonseed cake (undecoticated)	6 %
Oats	6 %
Mineral mixture	2 %
Common salt	1 %

This concentrate mixture contained 20 percent crude protein and 70 percent total digestible nutrients (TDN). The buffaloes were given 1 kg concentrate per day as let-down ration and animals yielding more than 5 kg milk per day received additional 1 kg concentrate for every 3 kg of milk produced. Concentrate mixture was fed at the time of milking and the roughage was fed ad libitum all day and night. Total ingested nutrients by each animal consisted in 1.49 kg crude protein, 3.7 kg fibre intake, 0.395 kg fat intake and 28.055 M Cal (mega calories) energy intake.
The milk yield of individual animals was also registered to find out the correlation, if any, between milk yield and natural urea content of milk.
Colostrum samples were also collected as and when available and analyzed for their urea content. The pooled buffalo milk samples were collected from the Experimental Dairy of the Institute.

Treatment of Milk Samples

Immediately after collection, milk samples were heated to 40°C in a water bath and then cooled to 27°C, before analysis.

Determination of the Urea Content in Milk

The urea content in milk was determined using p-dimethylamino benzaldehyde reagent as described by Bector et al. (1998). The fat content in milk was determined by Gerber method [IS:1224 (Part-I), 1977] and SNF content was determined by the lactometric method (IS: 10083, 1992).

Statistical Analysis

The statistical analysis of the data was done according to Snedcor and Cochran (1967).

RESULTS AND DISCUSSION

Milk Yield and Urea Content

The milk yield of morning milking of individual animals of Murrah breed of buffaloes varied from 0.5 to 9.0 kg with an average of 3.88 ± 0.18 kg (Table 1). The urea content of this milk varied from 21.06 to

follows page 11 ☞

56.58 mg with an average of 35.10 ± 0.55 mg per 100 ml. Table 2 shows the frequency distribution of urea content of buffalo milk samples. From this table, it can be seen that the urea content of 85 milk samples out of 103 (constituting more than 82%) was between 25 to 40 mg per 100 ml. The correlation coefficient between milk yield and urea content of buffalo milk was positive (0.1785), but it was not statistically significant (Table 1).

Urea Content of Pooled Buffalo Milk

The urea content of pooled buffalo milk, collected daily in the morning over a period of two weeks from the Experimental Dairy of the Institute, along with fat and SNF contents is shown in Table 3. From this table, it can be seen that urea content varied from 16.83 to 33.70 mg with an average of 28.22 ± 1.11 mg per 100 ml. A further perusal of this table shows that the average milk urea level of pooled buffalo milk was lower than the corresponding average milk urea level of individual buffaloes. The lower milk urea level of pooled buffalo milk could be due to mixing of milk from a large number of animals as there is significant variation in the milk urea levels between milking time and within milking.

Urea Content of Buffalo Colostrum

Table 4 shows the urea content of buffalo colostrum collected immediately after calving as and when it was available. From this table, it can be seen that urea content of buffalo colostrum varied from 13.97 to 19.58 mg with an average of 16.01 ± 0.80 mg per 100 ml. The urea content of colostrum was significantly lower than the corresponding normal milk (Table 1).

The milk urea content obtained in this study is in general agreement with those reported by Khan et al. (1986) and Bector et al. (1998). However, the urea content of this study is higher than those reported by Ganguli and Bhavadasan (1980). Carlsson et al. (1995) have reported lower milk urea concentration during the first month of lactation than later in the lactation.

CONCLUSION

With respect to the analysed samples, it is possible to suggest that the upper limit of urea content of pooled buffalo milk could be 45 mg/100 ml milk.

SUMMARY

The average natural urea content of milk of individual animals of Murrah breed of buffaloes, maintained under standard feeding and management practices, was 35.10 ± 0.55 mg per 100 ml. More than 82 percent of the milk samples had urea content between 25 to 40 mg per 100 ml. The correlation coefficients between milk yield and urea content was positive, but was not statistically significant. The average urea content of pooled milk samples (28.22 ± 1.11 mg) and colostrum (16.01 ± 0.80 mg) was significantly lower than the average urea content of milk of individual animals.

ACKNOWLEDGEMENT

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Table 1. Milk yield and milk urea content of buffaloes.

No. of samples	Milk yield (kg)		Urea content (mg/100 ml)		Correlation coefficient between milk yield and urea content
	Range	Mean ± S.E.	Range	Mean ± S.E.	
103	0.5 - 9.0	3.88 ± 0.18	21.06 - 56.58	35.10 ± 0.55	0.1785

Table 2. Frequency distribution of urea content of buffalo milk.

Milk urea range (mg/100 ml)	Number of samples
Less than 20	Nil
20 - 25	3
25 - 30	16
30 - 35	30
35 - 40	39
40 - 45	11
45 50	2
50 55	1
55 - 60	1
TOTAL	103

Table 3. Urea content of pooled buffalo milk.

Parameter	Range	Mean ± S.E.
Fat (%)	7.0 - 8.3	7.68 ± 0.09
SNF (%)	9.65 - 10.05	9.86 ± 0.03
Urea content (mg/100 ml)	16.83 - 33.70	28.22 ± 1.11

No. of sample = 15.

Table 4. Urea content of buffalo colostrum.

No. of samples	Urea content (mg/100 ml)	
	Range	Mean ± S.E.
6	13.97 - 19.58	16.01 ± 0.80

IMPROVING GENETICS IN BUFFALOES. SUGGESTED PROCEDURES FOR DEVELOPING COUNTRIES

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Since about 1930, efforts to improve the genetics for local animals, cows and buffaloss has started in Egypt. These efforts included the attempts to import and adapt European animals to local conditions.
For example:

- In 1940, Dr. Fadel El-Kheshen, Cairo University, performed selection for local cow (Demiaty) and collected exellent group of high productive cows.
- In 1950, Mr. Lenert, a Swiss citizen, owned a farm near Alexandria. His herd was "Brown Swiss cows".
- The American College in Assyut (Southern Egypt) had the Jersey and Guernsey herds.
- Researchers performed selection in buffaloes in Sakha and Mahallet Mousa (Governmental research stations).
- Other Animal Research Institutes and many farmers have performed performance recording and selection in buffalo long time ago.
- In 1953 , the Government established a unit for artificial insemination. It distributed better bulls in the Government veterinary clinics in the villages.

All these efforts had no effect on the millions of local

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animals, either buffalo or cow , because recording and selection were done individually and separately. These individual efforts stopped when the person in charge left the activity. The artificial insemination unit suffered for being too slow, and it did nothing during 50 years as it lacked facilities and procedures to perform the work in the appropriate time. Moreover, although the aim were to distribute better bulls in the villages, it was impossible to fulfil this aim because there were no sufficient bulls to distribute or to replace. Unfortunately, we can say that till now, in general, the performance recording of local animals is not standardised and lacks of accuracy.

Nowadays, we assist to several proposals and applications about improving the genetics of buffaloes in Egypt.

1. Publications of research institutes emphasise the urgency of the following methods:
• Distributing a large number of proved male buffalos, that have shown a high genetic merit, to the herds in the villages.
• Enabling small-scale farms to own herds of 15-20 buffaloes and supply them with a selected male.
• Increase the number of artificial insemination units.
• Import frozen semen of bulls of high genetic merit.
• Establish a national system for herdbook keeping (now feasible only in large farms and breeders).

2. Cairo University has established the Cattle Information System/ Egypt "CISE" which calls for:
• Improving genetics by limiting breeding bulls to 1-2%.
• Performin a progeny testing trial on large scale.
• Importing frozen semen from India (Murrah) and Italian buffalos migh give quicker results.
• Research institutes have to begin using uptodate reproduction techniques (multiple ovulation, transplant of embryos, and cloning).

3. The Animal Health Insitute and the Animal Production Research Institute provide valuable services for breeders:
• Young researchers provide field visits to farms and small breeders in order to perfom productivity recording, take samples and keep the recorded information (herdbooks).
• Breeders obtain monetary return for providing milk samples for microbic analysis also for somatic cells. Data is also collected about milk produced, constituents and period of lactation ...etc.

4. Animal production section of Menufia Faculty of Agriculture (Central Nile Delta) took the resolution in 1975 to give buffalos first priority in research, and now:
• It carries on field visits on large scale to breeders and other research institutes with herdbook keeping.
• It created a breeding farm (100 heads).
• It established special fund to cover the costs of the above projects with no government assistance.

These are samples of what was going on in Egypt during the last 10 years. They give good ideas and evidence of how important buffalo is for the Egyptian farmers, and show the desire of everybody to improve production.
In the meantime, one must be convinced that to obtain a sustainable success in the field of animal genetic improvement, every single activity should be supported by a national general target: therefore, it is necessary that efforts are done by a team of people, where everybody knows his responsibilities and input to reach the target.
First we have to set targets, identify the concerned people and their needs and how to fulfil these needs and achieve the targets.

THE MAIN TARGET

• A MARKETING BOARD
• where animals are purchased on the basis of a PEDIGREE
• which is certified by a SCIENTIFIC INSTITUTE.

This will get a flow in the market of the best selected animals, that will be sold at a higher price, and hence this will encourage farmers to breed better bulls and better heifers and gain money for their efforts . We can imagine how important the target is when we know that we need 5000 selected bulls to be distributed in small villages throughout Egypt, and that we need thousands of selected heifers to be exchanged between farmers.

WITH WHOM WE WILL DEAL?

• Small farmers who own one or two buffaloes, by exchanging the bulls in their villages with better bulls.
• Farmers who are trying to improve the productivity of their animals, by encouraging them to join the performance recording system and join the milk analys system of the province where they are located.
• Top farms that have already animals of higher genetic merit, for having imported genetic material. We have to encourage skilled farmers, institutes and faculties of agriculture to participate in the project with their top farms.

HOW TO FULFILL OUR TARGET?

1. Distribute the activities: It has been noted that every

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research authority tries to work on the national level, all over the country. Since the area being handled is big, researchers get confused, their results are distorted, they cannot cover all areas, and cannot always follow up.
It is suggested to divide the country into specific areas where research and recording are carried out by the local university or research institute.

2. Central organisation for administration: It is suggested that the Cairo University's (CISE) would deal only with local institutes, Governmental authorities and cooperatives and not deal directly with farmers. Its main job is supposed to be planning and organizing for the targets. Central recording system should appoint staff from local institutions. Animal certificates would be issued from the local institutions. Only the top merit bulls and dams will be revised and tested by CISE. The top bulls will get a certificate stamped from CISE. The council committee of CISE could be reorganized to include representatives from Government authorities, research institutes and cooperative societies.

3. Top Farms: The farm that belongs to the faculty of Agriculture in Menufia is a good example for our proposal. The farm is managed as a private sector and is financed by a special fund that utilizes its profits for the activities. Faculties of agriculture elswhere could follow the same steps. We have to facilitate the establishemnt of an excellent farm for skilled farmers. This will be easy done if, for example, we give them priority in buying from them best bulls and heifers for good price. This excellent farm will be the main source for top semen . Biotechnologies of reproduction will be performed there.

4. The animal Certificate and Pedigree. It is one of the major outputs of all the job. This certificate will favour marketing for bulls and heifers. It will give the perfect price for animals. All breeders, farmers, Government institutes and faculties will be happy to join the system.

5. Bulls distribution: In each village there will be one bull that inseminates all buffaloes. A Governmental decree would define the conditions for owning this bull. Among these conditions, there would be good health, lack of infectious and contagious diseases. Moreover, the bull would carry a certified pedigree. We should have a high number of certified bulls to fulfil the demand of all villages. This will be the key to contract with the farms, to buy better bulls from them. This will push farmers and institutes to join the recording system. Contracts will be between cooperatives and farmers, and then between cooperatives and individual owners of the bulls in the villages.

6. Artificial insemination
The following items are needed:
• Bulls of high genetic potential (genetic merit) to produce excellent and qualified semen.
• Skilled staff.
• Laboratory equipments to collect the semen and to deal with it.
• Mobile and quick methods to do the job in the appropriate time.
It is evident why many countries, using artificial insemination, failed in obtaining pregnancies. Until we fulfil these needs, we have to distribute selected bulls in the villages.
In the mean time, the following strategy is proposed:
• CISE. system will provide bulls of higher genetic merit.
• The Government institute in Sakha will establish a training center to train all those concerned with animal production and reproduction: young veterinarians, and interested persons would be trained for artificial insemination.
• The most important thing is to create private veterinarian clinics owned by young veterinarians in their villages. These clinics will aim to improve animal health and artifical insemination practice. Veterinarian doctors will be able to buy semen from the top farms or to import semen from India and Italy. In this case, both parties, vet doctors and farmers will benefit and try to work more effectively.

7. Financing: Milk production is a complex activity and entails a lot of hard work.It needs big capital for investment and gives a limited expected return. Thus, it is advisable to provide breeders with loans that have special low interest rate and for long period, 10 years for example. This would provide financial stability for private farmers to allow them to improve their herds through culling and replacement practices. This also would encourage the establishment of top farms by institutes and skilled farmers. The exchange of the bulls would be funded by the governmental animal production loans with a low interest rate. The private vet clinics owned by young veterinarian doctors would be funded by the youth loan projects.

8. Marketing Board: An internet site could be established under supervision of cooperatives to provide services and exchange information. For example:
Provide a listing of institutes, farmers, cooperatives and seller names, addresses and contact information.
Publish a periodical newsletter about prices and what is going on in the market about animal breeding. ....etc.

FUTURE BREEDING STRATEGIES FOR BUFFALO POPULATIONS IN SOUTH EAST ASIA : POTENTIAL CO-OPERATION BETWEEN ASIA AND EUROPE

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INTRODUCTION

Aleandri (1998) has described the buffalo populations in Europe and Asia, discussed differences in breeding objectives and practices between those populations, and considered possibilities for co-operation.

We would like to comment on Aleandri's proposals, from the perspective of our involvement with the EC-China Water Buffalo Development Project. The general aim of that project is the improvement of buffalo productivity and profitability in the southern provinces of China (Guangxi, Yunnan and Guangdong), with the emphasis on improving milk production. The Chinese buffalo, like most of those throughout South East Asia, is of the swamp type, and gains in milk production are being sought by crossing with river type buffalo.

The Chinese buffalo population, while the largest national swamp buffalo resource (see Aleandri, Table 1), has one major similarity with other swamp buffalo populations, in that its traditional uses in land preparation and transportation are nowadays less relevant, with increasing farm mechanisation, often with official encouragement. One consequence of this is declining buffalo numbers in China.

Table 1 illustrates this trend in China, and contrasts it with river buffalo population trends in India and Pakistan. Buffalo numbers are also increasing in Italy, albeit from a lower base, encouraged by the growing demand for mozzarella cheese. This pattern of declining numbers of swamp buffalo is also apparent elsewhere in South East Asia. For example, in Thailand, there were thought to be 4.6 million head in 1998 (Na-Chiangmai, 2001). This increased to 4.8 million in 1993, but numbers in 1999 had dropped to only 1.8 million.

Such declines in swamp buffalo numbers may be mitigated when the full benefits of buffaloes to the farm economy are appreciated, especially the financial value of its contribution to land preparation and of manure. Nevertheless there is now an even greater need to identify other roles for the buffalo, hence the renewed interest in milk and meat production. Improving milk production is one expectation of crossing swamp buffalo with a river buffalo breed. This paper will briefly summarise the effects of crossing on milk production, look at the possible or likely effects of crossing on other attributes of swamp buffalo, and considerable possible adverse effects, given that river and swamp buffaloes have different numbers of chromosomes.

Table 1: Trends in Buffalo Numbers (in millions) in a number of Asian Countries

Country	1989	1996	1997	1998	1999	% Change
China	21.1	23.6	19.6	18.6	16.9	-1.6%
India	79.0	90.1	91.8	90.9	92.1	+1.6%
Pakistan	16.9	20.2	20.7	21.3	21.3	+2.5%

Source: FAO 2000

MILK PRODUCTION

Swamp buffalo throughout South East Asia produce very little milk. Because they are rarely milked, average production figures are scanty, but swamp buffalo in countries such as China, Malaysia, Thailand, the Philippines and Vietnam would be expected to produce in the range 245-800kg per lactation (FAO, 2001). Often the amount of milk produced is deemed inadequate to meet the needs of the calf. By contrast, river buffalo in India, Pakistan and Italy are all renowned for their milk production. Buffaloes are a key ingredient in the rural economies of both India and Pakistan, where they are generally distributed in small household herds, just as are the swamp buffalo in South East Asia.

The obvious means of increasing milk production from swamp buffaloes is to cross them with one or more of the river buffalo breeds. Crossing programmes of this form have been undertaken in China for many years, using river buffalo bulls or (more commonly) semen from Nanning Buffalo Research Institute (BRI) and AI Station, in Guangxi province. Nanning BRI have maintained small herds of purebred Murrah and Nili Ravi, established there by donations from India and

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Pakistan respectively in 1958 and 1974. Both breeds have been used in crosses with indigenous swamp buffalo, although all published reports describe Murrah being crossed with indigenous, and the resulting crossbred females being top-crossed with Nili Ravi.
Comparative data on Murrah and Nili Ravi purebreds and crosses have been presented by Liu and Chang (1983) and by Cheng (1985), with mean yields of from 1 to over 2 tonnes per lactation being cited. Although often based on relatively small numbers of records, these show a marked advantage of the river breeds and crosses over the indigenous buffalo.
Unfortunately details given on models fitted and population structures are generally sketchy, so it is not possible to say from this information whether Nili Ravi or Murrah crosses are superior, how the top cross and first crosses compare, or whether heterosis ("hybrid vigour") is likely to be important. The sequence in which the river breeds were used (Murrah followed by Nili Ravi) probably reflects the order in which herds were established at Nanning, rather than an optimum exploitation route based on data analysis. A comprehensive analysis of Nanning data should throw light on such matters.

BREEDING OBJECTIVES

A key element in any improvement programme is the definition of the objectives, and Aleandri (1998) deals at length with this topic. This is a key step both in within-breed improvement schemes and in breed and crossbred evaluations. Both should use relevant economic values for all input and output traits. However, defining objectives within a breed requires information on phenotypic (eg standard deviations) and genetic parameters (heritabilities and genetic correlations). In a crossing programme we are essentially dealing with population means. In crossing the Chinese buffalo population, we need to look at all traits that might be changed. In addition to milk production, the Chinese buffalo population has traditionally been used for other purposes, such as draught power, transportation, meat, and for manure. As regards input traits, the availability of suitable feed to meet any extra output also needs to be considered.
In truth, our efforts in China on these fronts are at this stage at best only qualitative and approximate. The approach we have taken is to focus on possible gains in milk production, but without ignoring the impact on other important traits.
Nevertheless, some of our impressions may be of more general interest.
Firstly, it has become increasingly clear that the financial benefits of increasing milk production can be substantial. However the extent to which these benefits are realised depends on a number of factors, including:

- the availability and price of alternative milk sources (pasteurised or UHT cows milk, or milk powder), and
- the degree to which the unique compositional properties of buffalo milk, with its high levels of fat and protein, can be turned into a price premium.

Nanning BRI has recently started buying milk from surrounding areas and processing it into pasteurised milk and yoghurt. Farmers are being paid 3.6 Yuan (approximately 45 cents US) per kg milk, a premium of 50% over what Chinese farmers are being paid for cows milk. This level of premium should certainly encourage buffalo milk production, especially given local experience in their nutrition and management. Proximity to the marketplace or a processing plant can also be a key factor in providing a stable and profitable outlet for a product. Where these do not exist, farmers may well finish up breeding superior stock for sale to other parts of China, and thus may benefit only indirectly from genetic improvement. The financial benefits of crossing in this situation will undoubtedly be lower, and depend on the development of an orderly trade in livestock.
Size of production units will also be important. Where farmers have large herds, it is easier to visualise an integrated production/collection/processing/marketing route. Where individual households have only very few milking buffaloes, some degree of co-operation or central organisation is probably essential and certainly desirable, and this could affect profitability. Both India and Pakistan can provide suitable models for milk testing, collection and distribution from small household units.
What about other traits? The river buffalo breeds which have been tried to date in China (Murrah and Nili Ravi) are both larger than the indigenous swamp buffalo, and so the crosses are likely to be bigger at birth and then to grow faster. This should increase meat production (see Allen, 2001), and, arguably, draught power and manure production. Certainly the F1 calves are larger. From survey information collected in 2000, birth weights of the F1 calves are 8-10 kg heavier than the purebred swamp calves, an increase of about 30%. No increase in calving difficulty or mortality has been reported, perhaps because extra assistance has been given as a precautionary measure. The

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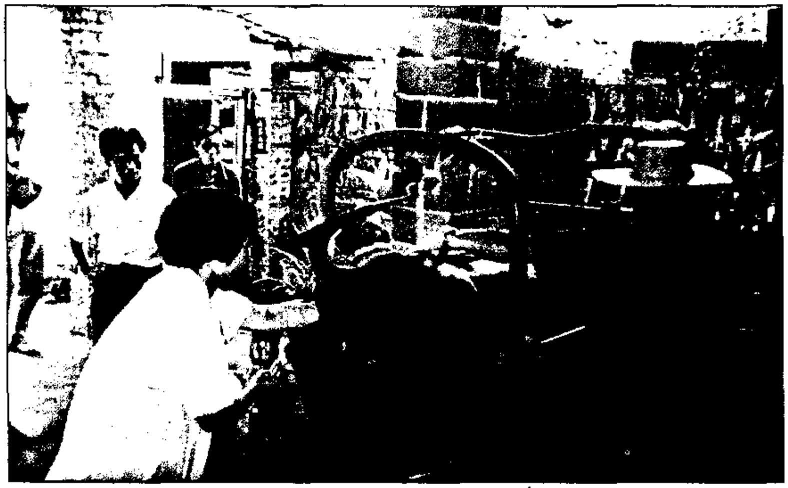

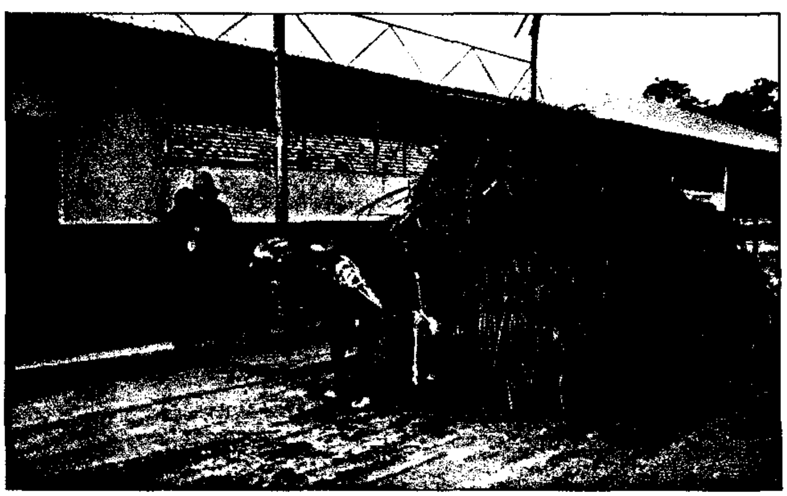

Management of buffaloes in China.

resulting F1 calves then certainly grow better, and, based on limited evidence in Yunnan, have fewer deaths. We know of no study that has compared say the feed requirements of F1 and swamp animals for these various functions and uses. That may be mainly an academic issue in southern China at this stage, where feed suitable for buffalo is generally not in short supply, and where there is ample opportunity for the development of pastures based on subtropical grasses and legumes. But we accept that this rather favourable picture may not be true in all areas.

WHICH BREED?

While river breeds clearly have a major role in upgrading the milk (and probably the meat) producing ability of indigenous swamp buffaloes, it is not clear what is the best way of using the river breeds. An analysis of Nanning data should help identify ways of doing this. For example, it is not clear whether Murrah or Nili Ravi crosses are superior, and how such crosses compare with the purebred herds. River breeds other than the Murrah and Nili Ravi should also be looked at. There are already plans to import Italian buffalo semen into Yunnan province, and an importation protocol already exists. But other Indian and Pakistani breeds should also be considered, especially some of the smaller breeds, such as the Surti, Meshana and Kundi (see Aleandri, Table 2). The size of the crossbred females will very likely affect feed maintenance requirements, which could be an important consideration when roughage is limited. Whatever breeds are tried, proper evaluation is essential. It is not really clear if the process should be of replacing

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the swamp buffalo with "a river breed", as Aleandri (1998) has suggested, or if the swamp buffalo should constitute some part of the final "mix". A long-term strategy might well be to produce a synthetic based on a mixture of (mainly) river and swamp, with the latter contributing adaptive traits. It will probably be wasteful to refine the percentage breed composition too precisely. Performance data for various first and top-crosses is clearly needed.
But the overriding aim should perhaps be a population that has a diploid chromosome complement of 50. This would avoid concerns with subfertility of either the crossbred male or female as described below.

BREEDING PROBLEMS

While Aleandri (1998) discussed these matters, the topic is sufficiently important to a swamp upgrading programme to warrant a fuller presentation here.
The water buffalo is unusual in that it includes both river and swamp buffalo, and these have different karyotypes. The river type has a karyotype of 2n=50 (ie 25 pairs of chromosomes), while the swamp buffalo generally has 2n=48. It has been reported (Ranawana, pers comm) that there are Sri Lankan swamp buffaloes with a chromosomal complement of 50, but it is not known if this situation is true of swamp buffalo populations in other countries.
It is still not agreed as to which chromosomes in the river type have fused into a single chromosome in the swamp This is because of disagreement over chromosome numbering, an issue that will no doubt be resolved as a more complete chromosomal map is developed. For convenience we have followed the suggestion of Bongso (1986), that the fusion is of chromosomes 4 and 9.

Despite this difference in chromosome number, swamp and river buffalo will breed and produce viable offspring, with the F1 having a karyotype of 2n=49. Each F1 animal will have one fused 4/9 chromosome, paired with single 4 and 9 chromosomes.

Since all of the necessary genetic components are present in the F1, there is no adverse effect on somatic cells, and one would expect the crossbreds to show any benefit of heterosis. But are there harmful effects on fertility?

Here opinions vary. For example, Jainudeen (1986) concluded that "present evidence favours the view that fertility is not adversely affected by crossbreeding of the two types of buffalo". On the other hand, there is a considerable body of evidence that various aspects of male fertility are affected in crossbred males, while in China there is also evidence that fertility is impaired in the crossbred female.
On the male side, several authors have shown that only 50% of germ cells in the F1 male had a stable chromosome complement of 24 or 25 (Basrur, Vudyadaran and Asmi, 1989; Dai, Gillies, Dollin and Hilmi, 1994; Guimaraes, Pinheiro and Guimaraes, 1995; Huang, Zhang, Liang, Shang and Huang, 2000). Cells containing more or less than these stable numbers presents problems at meiosis and while they will generally degenerate, the proportion of normal live sperm in an ejaculate is lower for bulls with 2n=49 than with bulls that are either 2n=48 or 50 (see Hilmi, 1991).
Despite such inefficiencies, F1 bulls can produce sperm of good quality, and produce normal offspring, although the reproductive "cost" associated with the use of crossbred bulls needs to be acknowledged.
Should such F1 bulls be used?

That depends very much on the available alternatives. Where bulls are to be used in AI, it seems sensible to ensure that all are 2n=50.
One of the consequences of unbalanced (ie 2n=49) chromosome number is that we can have uneven pairing of unbalanced chromosomes, which can mean gametes with a non-viable chromosome complement. This is a problem that can be difficult to quantify in the female, as there are so few oocytes. Nevertheless there are three pieces of evidence from China which suggest that reproductive efficiency in the F1 female is impaired.

- Liu and Chang (1983) reported on intercalving intervals, and found these to be substantially greater in F1 females (539 days) than in either purebreed (Murrah or Nili Ravi) groups (455 and 465 days respectively). Taking these results at face value, the poorer performance of the F1 perhaps indicates the "cost" of the chromosomal imbalance. The best group in the study, albeit a small one of only 11 animals, was the top-cross (Nili Ravi * (Murrah*swamp)), which had an intercalving interval of less than 12 months, only 342 days. Before pondering too deeply on the genetics of this situation, it is worth noting that all of these topcross females had been pre-selected as being 2n=50 (Professor Huang, pers comm), something which is not mentioned in the original paper.

- More recently at Nanning, Huang et al (2000) looked at the reproductive performance of top-cross females with either 2n=49 or 50. Both groups were mated with the same river type semen. While the conception rates were not different between the two types of females (49: 75.7% cf 50:

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82.0%), these results were not the outcome of a single service. The numbers of cycles/conception were 4-5 for 2N-49, but only 2-3 for 2N=50.

• Finally, at Shui Cao He farm, both indigenous (swamp) and F1 (Murrah* indigenous) females have been mated, and the indigenous cows show to advantage in conception rate to first service, and in the number of cycles per pregnancy (Table 2).

Every effort will now be made to examine these results more rigorously. However, it would seem that the fertility of F1 (river*swamp) females may be reduced, at least in China. If this is true, then there is a trade-off between the greater milk production of the river cross females, and their poorer reproduction. Attempts to model the impact of crossing on the Chinese swamp population need to accommodate both effects. Poorer reproduction will of course reduce sales of surplus livestock, which would further reduce the attraction of crossing to small farmers.

We need to develop a strategy to mitigate these adverse effects on reproduction. As mentioned earlier, we should think of ways of developing a population that is chromosomally stable, at 2n=50. This means that all males used in the crossing programme should be of the river (2n=50) type. It may also mean systematic culling of all F1 and triple cross males and possibly females with other karyotypes, using blood samples. However, this might be used to advantage if the crossbreds are superior for meat production (Allen, 2001).

Table 2: Fertility of F1 and Indigenous Females at Shui Cao He Farm

Group	Trait	1999	2000	Overall
Local Cows	No. inseminated	54	22	76
	No. conceived	43 (79.6 %)	14 (63.6 %)	57 (75.0 %)
	Cycles/pregnancy	1.90	1.86	1.89
F1 Cows	No. inseminated	16	10	26
	No. conceived	8 (50.0 %)	5 (50.0 %)	13 (50.0 %)
	Cycles/pregnancy	3.65	3.20	3.48

CO-OPERATION BETWEEN EUROPE AND ASIA

Greater co-operation between buffalo-rich countries can obviously be valuable, if only in sharing experiences. One consequence of the recently-held Regional Workshop on Water Buffalo Development (Surin, Thailand, February 2001) will hopefully be a more focussed and effective approach to national and international bodies, stimulated by the problems facing swamp buffalo populations in a number of Asian countries.

But co-operation between Europe and Asia, as proposed by Aleandri (1998), will work best if the priorities are the same in the two areas. Even if we base our grouping on swamp and river buffaloes, rather than Asia and Europe, how well do their research and development priorities agree?

If South East Asian countries aim to increase milk production from their buffaloes, then they can learn much from India and Pakistan as regards milk collection, testing and processing. That experience is also primarily with small household herds.
To spread genetic improvement in Asia using scarce river buffalo resources will probably require effective AI. Countries such as Italy can offer much in terms of semen processing and evaluation, although that would also hold for many countries with well-developed dairy cattle populations. However, Italian buffalo herds are large (see McGuirk, 2000), and their AI service poorly developed, largely because of problems with heat detection. While the manifestation of heat and the incidence of silent heats are widely-cited problems with buffalo, that has not stopped India and Pakistan developing effective AI services for small household units.
Longer term, South East Asian countries will require assistance and advice on the operation of progeny testing programmes, if improving milk production becomes an ongoing priority. However at this stage guidance and help on performance recording and the evaluation of genetic groups is a higher priority.
International attention needs to be drawn to the great importance of buffalo to the economic stability and prosperity of many South East Asian countries (see Chantalakhana, 2001), and the need for development funding. Much can be achieved by the sharing of experiences and resources within the region. Technical support can and should be sought from Europe and countries such as India and Pakistan, but in specific areas such as semen processing and evaluation, karyotyping, and aspects of milk testing, collection and processing and product development. However, it is critically important that these requests reflect Asian priorities.

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FIRST PROVINCIAL BUFFALO SHOW FOR THE SELECTION OF THE BEST DAIRY BUFFALO IN KHUZESTAN (Ahwaz, 12 march, 2001)

Hamid Reza Naderfard

National Coordinator of Buffalo Division in Ministry of Jihad for agriculture (M.O.J.A.), Tehran, Iran, and Abdol wahed Ganemy, Provincial Coordinator of Buffalo Division in M.O.J.A in province of Khuzestan

INTRODUCTION

Before first world war references indicate that there has been about 1.43 million buffalo in Iran. During the two world wars many animals were slaughtered; furthermore, because of periodic drought, expansion of artificial insemination and increase of crossbred cattle, together with complex socio-economic problems (migration of villagers to big cities, limited natural resources) caused buffalo population to decrease gradually to the present number of 500,000 head. Breeding goal of this livestock is now milk production; therefore, these animals play an important role in the improvement of economic status of farmers in rural areas of North and North west (Azerbaijan) and South west (Khuzestan) of Iran.

During the eight years war (1980 to 1988) ,which was fought mainly in the buffalo raising provinces, big losses and damages occurred to buffaloes. After the cease-fire in 1988, the government decided to support and pay more attention to buffalo, through five-year economic development plans. During the last decade, several supportive technical and development activities were performed in order to improve buffalo productivity in the country. In this connection, a comprehensive programme for buffalo development started, which includes the organisation of animal shows at national, regional and provincial level. Khuzestan is the province where the best dairy buffaloes in Iran are reared; it is located in the South West of Iran, bound by Persian gulf in the south, and sharing land boundaries with Iraq in the west, the provinces of Ilam and Lorestan in the North, Char mahal-Kohgiluie Boyer ahmad and Busher in the East. Human population is 3,800,000 people. Because of the abundant natural water resources such as wide marshes and some long rivers which flow in the gulf, the province has plenty of feeding resources, including reed (river cane) and residues of big sugar cane factories, products of horticulture and cereals and other miscellaneous feedstuff. Buffalo population consist of 115,000 head; therefore, in numbers, Kuhzestan is second

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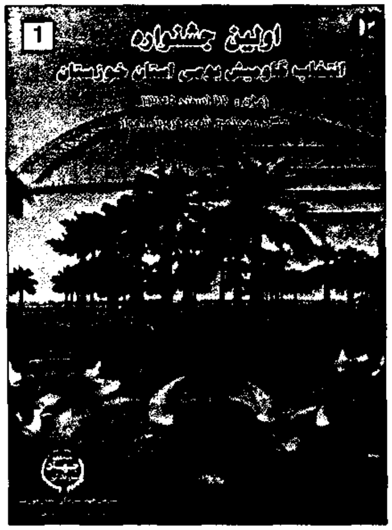
only to the province of West Azerbaijan (130,000 head). The main buffalo raising cities of the province are Ahwaz, Dezful, Susangerd, Shush, Shooshtar, Shadgan, Khoramshahr, Abadan, Ramhormoz.

OBJECTIVES OF THE BUFFALO SHOW

A - to increase buffalo as a valuable and economic animal
B - to conserve buffalo as an animal genetic resource
C - to encourage the breeders and unemployed young people and promote competition
D - to transfer extension advise and new knowledge of techniques related to buffalo to the farmers
E - to increase farmers income
F - to introduce and extend new system of buffalo breeding
G - to introduce the best buffaloes

PROCEDURE

Four months before the show took place, a technical organizing committee was established to perform the following activities:
First stage: primary study and selection of the suitable buffaloes based on the monthly milk records which are available in the software system; at this stage 200 animals were selected in four classes.
Second stage: the best 20% of the first list (40 head) were selected by a technical group in the 4 following classes:
Class(1)-pregnant heifers;
Class(2)-first lactation;
Class(3)-second lactation;
Class(4)-third and fourth lactation.
Third stage:(the judgement): a five-member judgement group was appointed including the following people: 1. Dr. Roshan Zamir; 2-Eng. A.W. Qanemy; 3-Eng. M. Sarag;
4-Eng. D. Kianzad; 5-Eng. H.R. Naderfard.
WINNER ANIMALS:
Class(1) -Hogeh(1) -Anamsaqir(2) -Omalsher(3).
Class(2) -Bentalhalveh(1) - Al melhe(2) -Bentolheyham(3).
Class(3) -Rafieh(1) -Borsheh(2) -Tarchieh(3).
Class(4) -Hahel(1) -Bentolchal(2) -Nagteh(3)
The champion was Hahel.



1. Leaflet of the show.
2. Mr. H.R. Naderfard.
3. The champion.
4. At the show.

REMARKS

While the scoring of the animals was being performed, an official ceremony took place, with following speakers:
Mr. RAHIMI, head of M.O.J.A in the province of Khuzestan gave a speech on the status of buffalo and its role in the milk and meat production in the world and in Iran.
2-Mr. M.R .Mollasalehy, dean of the national animal breeding center and director general for animal breeding in the duty for livestock affairs in the M.O.J.A., gave a speech about present and future breeding strategies of buffalo in Iran and the effective role of government and suitable technical policies, such as artificial insemination, in achieving goals of comprehensive development of buffalo in the country.
3-Mr. Qasemi, national coordinator of shows in the deputy for extension and popular cooperation in the M.O.J.A gave a speech about the importance of animal shows in encouraging the farmers and their effect in the rural areas.
4-Mr. H.R.Naderfard, national coordinator of buffalo division in the D.G. for animal breeding in the M.O.J.A gave a speech about the background of the buffalo project in Iran and desribed the role of this animal in the economy of farmers in the rural areas; he also explained the procedures for animal selection.
The winning farmers received prizes of the following kind:
a-Golden coins;
b-Animal inputs(animal feed-bran-concentrate);
c-Cash money;
d-Awards of participation (plates).

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First Italian Buffalo Congress Eboli, 2-5 October 2001

Organised by the University of Naples, with the support of local administrations, the First Italian Buffalo Congress aimed to emphasise the increase of importance in the role that this livestock plays in the economy of southern Italy.

The congress was addressed to both farmers and scientists, because it had been conceived as a co-operation means between the two sectors. Eighteen main papers and forty-two posters were presented, covering the major issues of buffalo research and production: milk, meat, reproduction, physiology, genetics, nutrition and pathology.

L. Zicarelli (University of Naples) pointed out that numbers of buffalo in Italy increased by 17 times during the past 50 years, registering a proportional increase in the milk recorded animals. Milk production increased by 33% in the same period, while protein content increased by 10%, only during the past 10 years. It is obvious that the full buffalo sector is expanding because of the increasing demand of mozzarella cheese, which is highly dependent on the high quality standards requested by the consumers.

L. Iannuzzi (Cytogeneticist of the National Research Council) has referred about chromosome anomalies that reduce fertility in buffalo.

R. Di Palo (University of Naples) has summarised the several studies conducted by her Institute on all features of estrus cycle in buffalo, the knowledge of which is a must if we want to improve the efficiency of artificial insemination.

G. Campanile (University of Naples) detailed the various aspects of the energy balance in buffalo, concluding that any mistake when making a diet, highly decreases the productivity.

P. Baruselli (University of Sao Paulo, Brasil) gave a detailed description of the techniques used to control follicular development in buffalo, and the results of superovulatory response on the basis of the use of several chemicals and protocoles.

More than 300 participants attended the congress, which was concluded by two further events: the Workshop organised by the FAO Buffalo Network and the Round Table on "Production regulations to promote marketing of buffalo meat".

The FAO Inter-regional Cooperative Research Network on Buffalo

Eboli Workshop (October 5th, 2001)

The Eboli workshop was held on October 5th 2001 during the 1st National Congress on Buffalo: this Italian Congress was a good opportunity to invite foreign researchers of the Buffalo network in a specific workshop, so that they could also meet buffalo breeders and researchers from Italy and other countries, could visit buffalo farms, exchange opinions and discuss the scientific issues that will be included in the short-term objectives of the Buffalo Network.

Coordinators and vice-coordinators of the four working groups were invited:

1. Reproduction and Biotechnology – A.H. Barkawi (Egypt) – G.M. Terzano (Italy)
2. Farming Systems – Y. Rouzbehan (Iran) – F. Di Lella (Italy)
3. Products – D. Matassino (Italy) – A. Georgoudis (Greece)
4. Genetic resources – B. Moioli (Italy) – T. Peeva (Bulgaria).

Only Georgoudis was not able to partecipate because he was attending another meeting in Italy.

The FAO Network workshop was open to all participants to the Eboli Congress.

The Coordinator, prof. Antonio Borghese, introduced the workshop by explaining the objectives of the FAO research networks, in the ESCORENA organization, and especially the specific objectives of the Buffalo network.

He showed the present structure of the network and the activity carried out in the past by the working groups, the meetings, the publications, the stages of foreign researcher that are promoted by the network. This activity is published in the Proceedings of the Eboli Congress.

Most relevant features of the developed activity are the joint programmes with international organizations, particularly with the International Buffalo Federation (IBF) that promotes every 3 years an International Congress which is held in a different continent, and the president of which changes every three years: therefore each time the President will organize the Congress in a different Continent. Links between the FAO network and IBF are extremely important: in this view, the Coordination centre of the Buffalo Network actively partecipated in the organization of the 5th World Buffalo Congress in Caserta (October 13-16, 1997). During the VIth World Buffalo Congress (Maracaibo May 20-23, 2001) the Buffalo International Federation appointed Prof. Antonio Borghese as the General Secretary: this nomination will help also to maintain continous and stronger links between the FAO Network and I.B.F.

A joint programme was also carried out by the Buffalo network with INTERBULL, including meetings and discussions that lead to the decision to involve a few countries in a pilot multi-country project of buffalo bull evaluation; this project will have the start this year in Turkey. Aims of the projects include promotion of technical improvement in oestrous induction and in artificial insemination in buffalo, and therefore genetic improvement in this livestock.

Major achievement of the cooperation with the International Committee for Animal Recording (ICAR) was the organization of the Joint FAO-ICAR Workshop on Animal recording for improved buffalo management stategies to which 30 participants of 17 countries took part. The output of the Workshop are the Simplified guidelines for milk recording in buffalo in developing countries that are in agreement with the ICAR standards, and were drafted to promote animal recording at country level as well as exchange of information on buffalo productivity in the world.

Prof. Donato Matassino, the coordinator of "Products" working group spoke about different products in the network area; he showed the products for each country and explained the possibility of evaluation and qualification of these products in the same way of buffalo mozzarella in Italy that was qualified with DOP (denomination origin controlled and protected). He emphasised the major differences between cow milk and buffalo milk, which is to have a higher casein content and therefore a higher cheese yield; moreover, casein genetic variants are different. Recently, a new genetic variant was also detected in alpha-lactalbumin.

A list of the variety of dairy products – cheese, butter, creams and yoghurts – produced from buffalo milk in many countries of the world was also presented. As regards to buffalo meat, it is generally considered, at least in many countries, a byproduct of milk. Therefore the need to promote its consumption is strongly required.

For both types of products – dairy and meat – the increased expectations of the consumers will be fulfilled through several actions: 1. high care in the cold chain in all stages (storage, transport, sale);
2. qualification of each typical product (through traceability, production standardisation and regulations); 3. research and exploitation of chemical peculiarities of the products (fatty acids, fibre, enzymes).

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Prof. Yousef Ruzbehan started his presentation by describing the harsh conditions for buffalo farmers of some Middle Eastern countries, in particular in the Northern area of Iran, to find forages for their livestock, due to drought of the past few years, which reduced both productivity and numbers of animals. He looks forward to co-operation with the countries of the Buffalo network thinking that co-operation will produce development and animal improvement.
A useful tool for the farmers and the researchers would be the conduction of a detailed survey on the production systems of specific areas, including the numbers of animals per owner and per land unit; the type of housing; months of grazing; type of feeding; diet formulation; marketing system. By examining the results of these surveys, experts and researchers could draft guidelines on how to direct the research and development programmes in the future.
Prof. Ashraf Barkawi emphasised the main aspects of endocrinology and biotechnology in buffaloes specifying what were the research areas where satisfactory results were reached and what were the major problems that were not solved.
He proposed the following plan of work:
1. Establish a database with buffalo research papers and results.
2. Hold an electronic conference for one month to discuss:
a) Constraints faced by the researchers in buffalo reproduction.
b) Causes for irregular calving or low fertility of female buffaloes.
c) Artificial insemination.
d) Applications of biotechnologies (prospects and constraints).
3. Hold a workshop to present the gap results of the electronic conference (by 3-4 speakers) ended by a round-table discussion.
Prof. Tzonka Peeva described the breeding systems for increasing the genetic progress in buffaloes. Because genetic improvement in buffalo suffers for infrastructural and biological constraints, the establishment of a project of open nucleus breeding system could be a feasible solution. For its realisation the following structures are requested:
1. A nucleus herd of at least 100 animals.
2. A testing herd included in the nucleus, where performance recording of productivity is done.
3. Basic herds that perform milk recording on field.
4. A.I. Station.
The breeding system could be open and the replacement of the nucleus could be done from the same herd or from the basic herds. On the other hand, female calves from the nucleus will be removed to the basic herds for replacement.
As a proposal of activities to develop within the Buffalo network, Prof. Peeva proposed the following multi-country buffalo progeny testing trial, for the period 2001-2007.
These project would require:
a) Exchange of deep frozen semen from elite bulls 1000 – 2000 doses from each bull.
b) Insemination of relevant number of buffalo cows and their control on:
age of first calving (AFC)
milk productivity at 1st lactation
calving interval (CI)
composition of milk (fat, protein, lactose, dry matter etc.)
body measurements at 3, 6, 12, 18 and 24 months.
c) Unification of the documents for gathering information for the productive and reproductive traits.
d) This information should be sent to the leader of the project.
e) Estimation of the breeding value of bulls for the important selection traits. Working out the method of economic selection indices.
f) Estimation of the breeding value of the bulls should be done on the modern methods BLUP and AM-BLUP.
Organization of regular meetings, to report the results from each separate trial in each country and plan future work.
B. Moioli has referred the main achievements of the Working Group on buffalo genetics, which has two types of activities:
1. to promote milk performance recording and its standardisation all over the world;
2. to promote common research projects on genetic diversity
Activity of type 1 was developed thanks to the cooperative work with the International Committee for Animal Recording (ICAR). Data were collected by the coordination centre of the Buffalo network on the results of milk recording activity in the various countries that have an ongoing official recording system on their own; a booklet of statistics was produced and circulated and will be hopefully circulated every second year with updated statistics; data are referred on numbers of milk recorded buffaloes and herds as well as their milk production in each country. This publication wants to help contacts between recording organizations, which are in there listed.
The Working Group has organised a workshop during the 32nd Session of ICAR (May 2000) on "Animal Recording for Improved Breeding and Management Strategies of Buffalo". The workshop was attended by 30 participants from 17 countries. The workshop included the presentation of seven country cases of successful buffalo milk recording systems; afterwards, the participants

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discussed on "Justification and components of a functional milk recording scheme"; "Initiation and implementation of a sustainable recording scheme" and "Necessary components for a buffalo improvement programme". Logical and practical output of the Workshop was the definition of standard guidelines for simplified milk recording in buffalo for low to medium input production systems. These guidelines have been published in the ICAR Technical Series, No. 4.
As regards to activity no. 2 (promote common research projects), a cooperative research project was carried out by three teams of three network member countries on: "Genetic diversity between Italian, Greek and Egyptian buffalo populations". Buffaloes to be genotyped - 30 for each population -were chosen in order to assure that they were a representative sample of each. DNA of all animals was amplified at 15 highly polimorphic loci, called microsatellite loci, which are repeated DNA sequences of two or three base pairs. Microsatellites analysis is used for various purposes:
- assessment of genetic diversity between populations and evolution studies;
- parentage assessment;
- measurement of allele effect affecting QTLs.

A very low degree of differentiation was found between the Italian and the Greek buffalo populations; a slightly higher differentiation between the Egyptian population and the previous two was found, which, however, is to be considered moderate. The lowest rate of inbreeding was found in the Egyptian population, obviously, because it is far the largest in number. However, the Greek population, although very small in numbers, has a lower rate of inbreeding compared to the Italian one, which can be explained by the total absence of any directional selection.
B. Moioli presented also proposals and suggestions to continue the cooperative activity in the future. As regards to the milk recording and selection area, the proposal consisted in the possibility to establish a multi-country project for the initiation of sustainable milk recording systems in buffalo in some developing countries. Tentative title of the project, already agreed among a few countries, is: Development of unified animal recording procedures to work out strategies for the enhancement of food security and sustainable use of livestock genetic resources.
As regards to the common research programmes, it is intended to find out new laboratories with facilities for DNA typing and regularly exchange standard samples among them to assure that the results will be the same; record buffalo performances of a few interesting economic traits with a common procedure on all animals that will be genotyped, so that an analysis of association between marker and QTL might be performed in all participating countries; search for polymorphisms in the sequence of known candidate genes which might affect buffalo productivity.
An active discussion followed the presentations, particularly about the difficulties to realize the open nucleus breeding scheme for buffalo.
Prof. Borghese closed the workshop of the network emphasising the first priorities of the network activities, i.e. to create a research database and perform the electronic conference, as Barkawi proposed, and to organize another meeting next year in Cairo, during the E.A.A.P. Congress (September 2002), to stimulate the activity of the groups and favour the links with other buffalo organizations.

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