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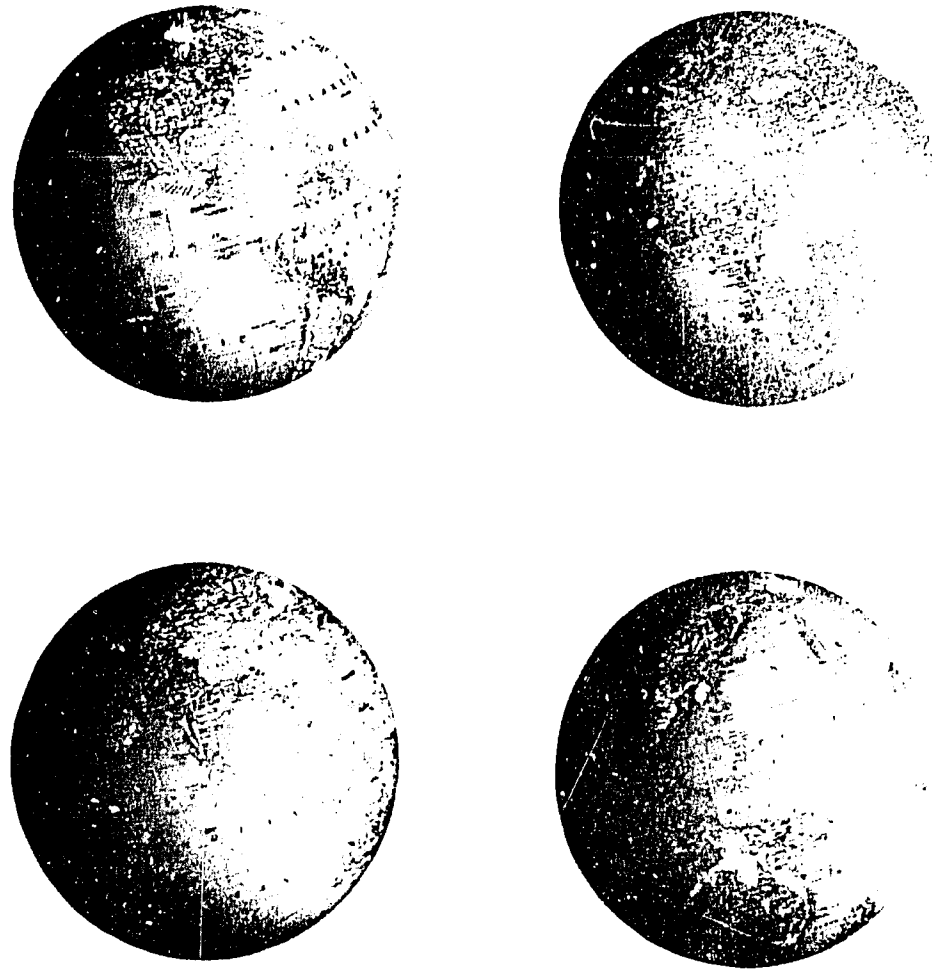

A WORLD BIBLIOGRAPHY ON GOATS

Michael Sands and Robert E. McDowell

DEPARTMENT OF ANIMAL SCIENCE
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by

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Introduction

Goats are multipurpose animals, producing meat, milk, fiber, and skins. Their varied roles have stimulated a recent renewed interest in the goat among development planners. The world population of goats in 1977 was estimated at 410 million (Table 1) of which 95% were in the developing world (FAO, 1978). Over the past 12 years goat numbers increased worldwide but decreased within the more developed world as evidenced by a decline in Europe and North America.

Mason (1961) has identified over 60 recognized breeds and over 211 varieties of goats around the world. The vast majority of these animals would be classed as multipurpose breeds. Approximately ten breeds have been developed principally for milk production, the majority of these originated in Europe. However, several tropical breeds have been identified as valuable milk producers.

Milk

In 1974, the contribution by goats to world milk supplies was 1.65% (FAO, 1975). This varied from .41% of milk consumed in the Americas to more than 10% in Africa (Table 2). In a few countries, such as Niger and Yemen Arab Republic, goat milk comprises over 50% of the milk produced.

There is enormous variation in the milk production among goats throughout the world. Some of the high producing goats of the temperate areas may yield in excess of 5 kg per day over a 300 day lactation. Yields throughout the developing world are much lower, less than one kg per day. Many factors contribute, among which are genetic potential for milk yield, availability of feed, mature size, stresses from disease or parasites and the priority given by owners to milk yield versus use for meat or hair production.

There have been efforts to increase the milk yield of tropical breeds, principally through the introduction of temperate genotypes. In India, for example, there is strong government support for increased milk supplies

Table 1. The goat population of the world (FAO, 1978)

Continent	1961-65 Number (10^3)	1961-65 % of world total	1977 Number (10^3)	1977 % of world total
Africa	102,750	28	131,126	32
N. America	12,935	4	9,768	2
S.C. America	29,366	8	20,795	6
Asia	205,435	55	231,453	56
Europe	14,477	4	11,505	3
Oceania	182	—	155	—
U.S.S.R.	6,422	2	5,539	1
World	371,568	100	410,343	100
Developing	340,892	92	386,344	94
Developed	30,677	8	23,999	6

from goats. An all India coordinated project to produce stall fed high milk producing goats by crossing local breeds with breeds imported from developed countries, such as Alpine or Saanen, represents one approach (Sengar, 1976). Similarly, in Mexico, government support in the form of credit, research, and marketing have stimulated a marked rise in milk production in the states of Durango and Coahuila (Juarez, 1976). In the region of "La Comarca Lagunera" there are about 275,000 milking does. Most of the milk is processed locally into cheese or "cajeta", a caramel candy. It is said that cacao blends best with goat milk for candy production.

The majority of goats in Europe are found in countries along the Mediterranean Sea. There are also concentrations in Switzerland and Norway. In most of Europe milk production is the major focus. A high demand for cheese from goat milk in France has stimulated the development of a large commercial scale milk processing and marketing industry. The industry is supported by high levels of technology, such as artificial insemination, cultivated pastures and other management inputs for intensive production (Vissac, 1976).

Table 2. Milk production in countries having high production from goats in 1974 (FAO, 1975)

Area/Country	Goat	Cow	Buffalo	Sheep	Goat as % of total
	10^3 MT				
EUROPE	1557	160908	41	3376	.94
France	348	29600	—	817	1.13
Greece	382	656	3	525	24.39
Spain	286	5084	—	229	5.11
Germany	120	7804	—	—	1.51
Italy	115	10300	—	460	1.07
USSR	385	91800	—	80	.42
AFRICA	1336	10119	1113	640	10.12
Morocco	139	490	—	209	16.79
Sudan	471	1320	—	149	24.28
Algeria	118	342	—	116	20.49
Niger	100	46	—	8	64.94
AMERICAS	361	86903	—	30	.41
Mexico	192	3506	—	—	5.48
ASIA	3347	24599	21906	3206	6.31
Turkey	610	2580	277	970	13.74
Iran	222	1021	51	570	11.91
China	264	3457	1024	437	5.09
Pakistan	490	919	3928	288	8.71
India	681	8400	15900	—	2.73
Bangladesh	525	713	107	13	38.66
Yemen Arab Republic	128	75	—	49	50.79

In Greece, 24% of the milk produced comes from goats (FAO, 1975). The national herd of Greece could be split into two groups; a lowland sedentary flock, principally Saanens and Saanen crosses, account for about 20%, and local breeds that are kept in transhumant production systems (80%). Kidding takes place in the lowlands and after weaning the herds are moved to the higher elevations for summer grazing. Herd size varies from 20-100 does. Approximately 75 percent of the milk produced is made

into feta cheese. Similar production systems are common in Italy and countries of the Iberian penninsula.

Meat

The world production of edible protein from accountable slaughtering of cattle, buffaloes, sheep, goats, horses, and swine was 17.9 million MT (carcass weight) in 1975 (FAO, 1976). Goat meat accounted for about 5.7%. This value is no doubt a gross under estimate for goat meat as most goats are slaughtered and consumed at the village level; therefore, their contribution is not fully recorded in national statistics.

At the present time there are few breeds identified as specialized meat producers. However, many of the small or dwarf breeds, for example, the West African Dwarf, are kept principally for meat production. Also, some of the larger breeds, e.g. Mubende, Boer, Jamunapari, Sabel are known to be good meat producers. In herds kept principally for other purposes (dairy, hair) meat is a major by-product.

"Cabrito" is a favorite dish throughout Latin America. It is prepared from young kids weighing about 8-10 kg. Exclusive of vegetarian societies, there are no religious taboos on goat meat.

Other Contributions

Hair production is another major component of goat production. Mohair production from Angora goats is a valuable foreign exchange earner for a number of the developing countries, such as Turkey, Nambia, India, Pakistan and Afghanistan (McDowell, 1977).

In many countries of Africa the export of goat skins is a major reason for keeping goats. The skins of the Red Sokoto goats of Nigeria and Niger are world renowned as a source of the finest leather for gloves and handbags. The Mubende of Central Africa also produces a very fine skin.

In many rural areas, the skins of goats are preferred over other species for water bags and other household items. A soured milk popular in Africa is fermented in goat pelt bags (McDowell, 1977).

Production systems involving goats are of four major types: 1) intensive commercial production herds; 2) large nomadic or migratory herds; 3) large sedentary herds found on the outskirts of urban areas, and 4) small household units kept primarily for subsistence needs. The commercial herds are found primarily in the developed countries. La Comarca Lagunera in Mexico is a notable exception. The other three systems are practiced in various combinations throughout most of the tropics and subtropics. Herds of up to 40-50 goats are often kept by the landless on the fringe of urban areas, grazing alongside highways. Crop farmers will often let them graze crop aftermath in the fields for the weed control and to provide manure for fertility.

On small farms, goats and sheep are often tethered with a rope up to 4 meters long. By changing the location as needed a cheap method of browsing and grazing rotation is practiced. In other small farmer systems, goats are kept within the household compound and are cared for by women and fed principally cut forages and household by-products. These two systems permit goats to provide several services in addition to meat or milk. Manure is concentrated where it can be of the most use and weed control in fallow fields is improved. Both of these services have the potential to increase crop yields and give greater economic returns to the small farmer.

It is widely recognized that where feed supplies are limited, production with large animals can be rather inefficient. Much of the energy available is used to provide maintenance requirements. On small farms feed supplies from all sources often amount to only 2000-3000 Mcal of

Digestible Energy (DE) annually. A 350 kg cow would require about 4500 Mcal DE per year for maintenance needs. But a 25 kg doe would require only about 680 Mcal DE annually for maintenance. In these situations it should be possible to provide more than the maintenance requirements for two does.

It has been common practice to utilize goats as experimental animals, especially in the conduct of nutrition investigations, since they were cheaper and easier to handle than cattle. Currently there are programs underway to determine the feasibility of using goats for the production of animal products on small farms in developing countries. Under Title XII of the Foreign Assistance Act of 1961 as Amended (HR 9005) - Famine Prevention and Freedom from Hunger - passed by the U.S. Congress in 1975, a collaborative research program was initiated on small ruminants (goats and sheep). The goals are to: 1) expand the body of knowledge on small ruminants; 2) expand the competence of the U.S. and developing country scientists to conduct research on these two species; 3) develop and test technologies designed to improve small ruminant productivity in the developing countries; and 4) improve the small ruminant food and fiber production within the small holder systems of the developing countries. There are 13 participating U.S. institutions in the fields of nutrition, genetics, health, physiology, socio-economics, systems analysis, management and economics. Field sites overseas were chosen to represent major ecological and socio-economic systems. The initial locations for the studies are in Kenya, Brazil, Indonesia and Morocco. It is anticipated that later investigations will be pursued at locations in Peru, Nigeria, Pakistan and Turkey (Robinson and Raun, 1979).

Two of the International Centers sponsored by the Consultative Group on International Agricultural Research (CGIAR) have research programs

working on goats. The International Livestock Centre for Africa (ILCA) located in Addis Ababa, Ethiopia has inaugurated investigations on the merits of goats for meat and milk production under transhumant herding in the arid and semi-arid regions. In this area the herders have a high dependence on livestock for food and other essential needs. Feed supplies and soci-economic constraints on marketing goats for meat are the focal points of these investigations (Allonby, 1976).

Scientists from ILCA in collaboration with local institutions are also investigating the role of goats in the more humid regions of Africa. Initially the main location of research will be in the humid region of Nigeria (near Ibadan). The efficiency of the goat in utilizing locally available materials for feed and the feasibility of expanded use of goats in the tsetse fly infested regions are presently under study.

The International Laboratory for Research on Animal Diseases (ILRAD), a second international center under CGIAR, located in Nairobi, Kenya, is investigating the comparative resistance of goats and cattle to trypanosomiasis and health problems encountered by goats in warm, humid climates.

The knowledge which will be generated under the Title XII program, by efforts of the international centers and by institutions in the developing countries should by the mid-1980's provide a vast expansion of knowledge which will be useful in determining the best roles for goats in contributing to man's welfare. Up tho this time much of the experimental work on goats as well as field studies on their roles in certain societies is difficult to identify. Largely because of previous low interest in the merits of goats, many of the reports on goats have appeared in the lesser known journals. This bibliography has been prepared in response to the current interest around the world in goats. Previous publications

in the Cornell International Agriculture Mimeograph Series: "The Goat as a Producer of Meat", No. 56, November, 1977 by R.E. McDowell and Lea Bové and "The Potential of the Goat for Milk in the Tropics", No. 60, February, 1978 by M. Sands and R.E. McDowell, contain extensive reference lists but dealt with selected topics. The bibliography encompasses a much broader range of topics.

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USE OF BIBLIOGRAPHY

The entries are listed alphabetically by the last name of the first or senior authors. (Spanish authors have been listed under the paternal name).

To assist users the bibliography has been indexed as follows:

Origins, Breeds and Roles

Breeds and Origin (identified breeds or types)

Role in Developing World Agriculture (estimates of the potential of goats to support of man)

Country (location of observations)

Biological Data

Behavior

Birth Weight

Growth Rate

Health

Management

Meat Production

Milk Composition

Milk Yield

Nutrition and Feed Efficiency

Physiology

Reproduction

It is intended that these subject headings will help researchers identify useful references.

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BIRTH WEIGHT	A18, C6, D7, E24, M8, M9, M31, M54, M65, N3, S37, S65, S73
GROWTH RATE	A17, A21, A29, B39, B61, C12, C13, C17, C33, C59, C60, D7, D9, D11, D20, D39, D40, D43, E15, G6, G45, H28, J22, L36, L37, M32, M40, M43, M55, M57, R11, R33, S4, S37, S63, S66, S67, S73
HEALTH	A8, A9, A10, A13, A14, A16, A18, A19, A20, A22, A25, A27, A28, A30, A31, A42, A43, A44, A49, A56, B1, B2, B3, B12, B16, B24, B25, B48, B62, C1, C20, C40, C41, C42, C43, C54, C55, C62, D8, D34, D51, D53, D54, E2, E6, E25, E26, F3, F4, F5, F16, F24, G24, G25, G41, G48, G51, G52, H4, H7, H14, H46, H51, H52, H54, I4, I7, J1, J3, J31, J35, K1,

HEALTH	K3, K5, K6, K10, K23, K24, K27, K28, K30, L3, L7, L12, L16, L20, L22, L33, L35, L40, Mc1, Mc5, Mc6, Mc7, Mc8, M3, M5, M10, M11, M30, M38, M67, N5, N7, N9, O6, O7, O8, O11, O17, O23, P2, P3, P13, P14, P15, P19, P29, P30, P31, P37, P44, Q24, R2, R4, R5, R15, R23, R24, R27, R61 R62, S27, S30, S31, S36, S41, S44, S57, S64, S68, S88, S89, S90, S91, S105, S116, S119, S121, S126, T1, T2, T10, T19, T23, V13, V16, W1, W11, W26, W28, W40, Y1, Y6
MANAGEMENT	A3, A15, B9, B18, B43, B50, C2, C3, C20, C34, C35, D2, D3, D14, D16, D32, D50, E1, F19, F27, G10, G38, G39, G40, G41, G43, G53, H1, H5, H8, H16, H20, H22, H29, H30, H31, H55, I8, I9, K35, L6, L17, L19, M2, M4, M34, M35, M39, N4, N10, O1, O11, P25, Q3, Q4, R12, R36, R45, R55, R59, R60, S48, S60, S87, S101, S104, S112, T7, T8, U4
MEAT PRODUCTION	A51, A60, B23, B63, C17, C37, C38, D9, D18, E8, G3, G4, G5, G18, G20, H2, H61, J13, J20, J22, K15, L1, Mc2, Mc4, M40, N19, O3, O18, O19, O20, O21, O22, R59, S3, S4, S26, S29, S73, S80, S86, S95, S103, S122, T11, U1, V24, W29, W34, W35, W36, W37
MILK COMPOSITION	A12, A48, C4, D27, D37, F2, G22, G23, H25, H35, I3, J8, K16, K20, K34, L21, L31, L48, M1, M28, M37, M49, N8, P8, R10, R38, R44, R51, S2, S32, S33, S62, S73, S76, S120, S123, S125, V1
MILKING MACHINES	B43, D3, M39, M50, M51, R60
MILK YIELD	
Age effects	H36, H41, I2, K31, L5, M8, M54, P34, P35, R17, R18, R47, R49, R50, R57, S73, S107, S108, S115
Breed differences	A12, A21, A57, B27, B45, C8, C9, C29, D42, G27, I2, I10, L14, M8, M49, O12, P6, R6, R7, R13, R47, S8, S9, S73,

Breed differences	T21, U2, W37
Endocrine effects	A1, B13, C11, C16, C28, H18, H34, H47, H49, H60, L30, M20, S23, Y4
Frequency of milking	M50, M51
Heritability	G16, I2, K31, P34, R48, R53, S70, S71, S73, S107, S115
Milk synthesis	C26, C63, C64, C65, C66, C67, C68, C69, C70, C71, C72, F17, F18, H6, H49, L28, L29, L31, L32, L34, M33, R67, S56, S62, S78, S106, S124, W3
Nutrition effects	A37, A38, B51, C60, F12, J30, L5, L36, M54, O12, R46, S2, S73, S107
Persistency	C4, F9, H42, I2, J29, K31, M8, M54, N2, N8, P35, R6, R47, R53, S19, S73, S107, S115
Season effects	C4, G22, H18, H41, I2, K31, L49, M8, M54, P34, R6, R31, R47, R57, S67, S73, S107, S115, T22
Selection effects	B46, B47, D12, D41, D42, D44, F1, I2, K9, K31, M8, M37, M45, O14, P26, R28, R29, R44, R47, R52, R53, R56, S35, S67, S70, S71, S107, S108, S109
Size and conformation effects	B51, C30, C61, D5, D6, G7, G8, G11, G12, G13, H37, H38, H39, H40, J36, L27, N2, O15, P34, R47, S20, S108
UTRITION AND FEEDING EFFICIENCY	A2, A5, A6, A7, A32, A47, B5, B6, B15, B21, C2, C14, C21, C22, C23, C24, C53, C59, D18, D19, D20, D21, D22, D28, D31, D45, E7, E14, F10, F11, F12, F13, F22, F25, F29, F33, G14, G15, G19, G26, G30, G49, G54, G55, H5, H45,

NUTRITION AND FEEDING EFFICIENCY	H47, H48, H55, H56, H57, H58, H59, J4, J18, J34, J38, K19, K32, L24, L25, L26, M6, M7, M12, M13, M16, M26, M27, M29, M41, M66, N6, N9, Q1, R8, R37, R63, R64, R65, R66, S1, S2, S43, S54, S73, S75, S83, S85, S99, S110, S128, S129, T3, T4, T5, V5, V11, V14, W12, W17, W20, W25, W31, W32, W33, W34, W36, Z1
PHYSIOLOGY	A41, A55, A58, A59, B4, B5, B7, B8, B13, B17, B19, B20, B28, B29, B30, B31, B49, B54, B55, B58, B59, C11, C15, C16, C39, E9, E18, E19, E20, E21, F15, F32, G31, G49, H12, H13, H24, H26, H53, H61, J9, J10, J11, J23, K7, K8, K11, K13, K29, L51, M41, M53, M58, M60, N1, N6, N11, N20, N21, O2, O5, P1, P4, P5, P16, P20, P21, P22, P33, P39, Q2, R1, R8, R14, R16, R26, R40, S10, S24, S25, S40, S59, S63, S69, S74, S78, S102, S127, T[illegible], T4, T5, T15, T18, T24, V21, V25, W15, W16, W18, W19, W20, W21, W22, W23, Y5
REPRODUCTION	
Abortion	B52, B53, B60, C1, F8, K37, M14, T1, V2, V4, V5, V6, V7, V8, V9, V11, V12, W13, W16, W17, W18, W19, W20, W21, W24, W25, W30
Artificial insemination	A26, B35, B36, B37, C47, C48, C49, C50, F21, F23, G32, G33, G35, G46, H50, K22, L23, L41, L47, N14, R43, S5, S22, S118, V22, V23, W8, W9

Breed differences	A17, Q2, S73, S81, V23
Effect of season	A11, A23, G36, H21, K14, L15, M46, M52, P28, P36, R1, R35, S46, S49, S67, S73, S107, T22
Embryo transfer	M61, M62, M63, M70, N15, N16, N17, N18, S114, W5
Estrous cycle	B10, B32, B42, C5, C10, C16, C44, C46, C48, D35, D36, G1, G2, G36, H10, H21, J5, J15, K14, L4, Mc3, M18, M19, M42, M46, N12, P7, P27, P40, P42, P43, R35, S45, S49, S58, S107
Gestation length	A45, B42, C10, F10, G50, J14, J23, K14, L45, N12, S49, S73, S113
Hormone levels	B33, B60, B65, C56, C57, C58, D10, J16, J17, L15, L46, P41, R20, R21, R22, S40, T12, T13, T16, T17, T18, U3, V3, V8, V9, V10, V12, V18, W18, W19, W20, W21, W23, W24
Kidding interval	B56, K14, N12, R9, S39, S49, S67, S73, S107, S113, V24
Kidding percentage	B56, C7, E1, E24, H60, J32, K14, M54, M64, M68, N12, R9, S5, S37, S39, S46, S49, S67, S73, S93, S107, S113, T6, T12, T21, V10, V24
Polledness and infertility	A46, B14, B57, D48, E3, E4, F28, H9, H11, L8, L10, L11, L43, R34, S84, S92, S93, S94, S113, V21, W10
Puberty of buck	D11, E16, E17, L38, M57, N12, S49, S79, S81, Y2
Puberty of doe	B44, K36, M54, N12, P36, R9, R18, R33, S23, S49, S67, S72, S73, S107

Semen A24, A52, C45, E5, F14, F20, F30, F31, H27, H50, I1, I5, J2, K21, M48, M52, P10, P11, P28, R58, S6, V15, Y5, Y7

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