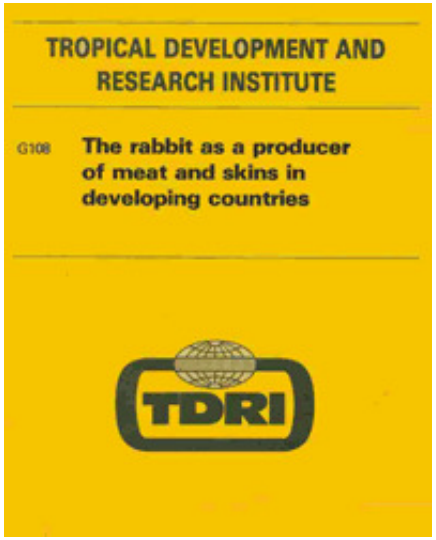

The rabbit as a producer of meat and skins in developing countries

J. E. Owen, D. J. Morgan and J. Barlow

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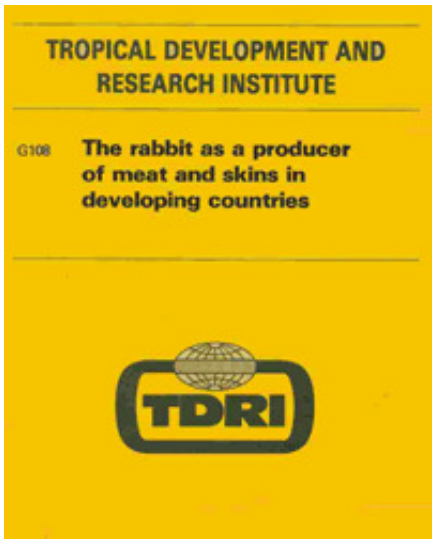

The rabbit as a producer of meat and skins in developing countries

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Summary and conclusions

The rabbit as a producer of meat and skins in developing countries

Rabbit production on a relatively small scale, involving minimal inputs,

could make a substantial contribution to the supply of animal protein for human consumption in tropical developing countries. Rabbits are already being bred for meat in many of these countries and in some, rabbit meat production is being actively encouraged and supported by the Government, the most notable example being Ghana.

Heat is one of the most important environmental factors which may affect rabbits in tropical developing countries. At ambient temperatures above approximately 30°C rabbits suffer increasing discomfort and physiological stress. Also at temperatures of 30°C and above, fertility in the male rabbit is impaired, although not irreversibly, and embryo mortality increased in the female. However, the detrimental effects of high ambient temperatures on the rabbit can be greatly reduced by the construction of suitably designed housing. This can be easily carried out using locally available materials.

There is evidence that feeding can also be based on locally available materials, although production levels similar to those experienced in commercial rabbitries are not likely to be attained. However, high commercial production levels are not necessary in a small-scale, low input system where the emphasis would be on the production of cheap meat for local consumption. The formulation of diets from locally available materials which are of no direct nutritional value to humans presents an important and largely unexplored area for future work.

With regard to breeding, there is considerable scope for the development of breeds which are physiologically more suited to local environmental

conditions in various areas of the tropics.

Good stockmanship and cleanliness are of paramount importance and, if these qualities are adhered to, disease is less likely to result.

Government support is extremely important for the successful establishment and development of rabbit production in developing countries. Not only can stock be provided to farmers by a government owned central breeding station, but advice, training and publicity can be provided more effectively with government support.

Rabbits, by virtue of their small size, are convenient to handle as regards slaughter and processing on a small scale. Good hygiene standards are, however, essential for success of such operations. Rabbit slaughter can be effectively carried out with relatively simple equipment and the carcases can be processed relatively easily by traditional methods.

Rabbit skins represent a source of potential income to the producers if handled carefully. The processing of rabbit skins could form the basis of a rural industry. On large land masses in the tropics (e.g. Africa) escaped domestic rabbits are unlikely to constitute a problem similar to that caused by wild rabbits introduced in Australia. On small islands, especially those with no natural predators, the situation may be entirely different. In all such cases, expert advice should be sought from ecologists who are familiar with local circumstances.

RESUME ET CONCLUSIONS

Le lapin, producteur de viande et de peaux dans le pays en voie de développement

La production de lapins, à une échelle relativement petite, comportant une mise de fonds minimum, pourrait apporter une contribution réelle à l'approvisionnement de l'homme en protéines animales dans les pays tropicaux en voie de développement. Les lapins sont déjà élevés pour la viande dans plusieurs de ces pays, et, dans certains, la production de viande de lapin est activement encouragée et soutenue par le Gouvernement, l'example le plus notable étant le Ghana.

La chaleur est un des facteurs ambiants les plus importants qui peuvent influencer le lapin dans les pays tropicaux en voie de développement. Aux températures ambiantes supérieures à environ 30°C, les lapins sont incommodés et subissent un stress physiologique. De même, aux températures de 30°C et au dessus, la fécondité du lapin mâle est altérée, quoique de façon non irréversible, et la mortalité embryonnaire augmente chez la femelle. Cependant, ces effets néfastes des températures ambiantes élevées sur le lapin peuvent être nettement réduites si l'on construit des logements appropriés. Ceux-ci peuvent facilement être fabriqués en utilisant des matériaux localement disponibles.

II est évident que l'alimentation des lapins peut également être à base

de substances disponibles localement, bien que probablement des niveaux de production semblables à ceux obtenus dans les élevages industriels de lapins ne soient pas atteindus. Toutefois, les hauts niveaux de production industrielle ne sont pas nécessaires à petite échelle, dans un système à faible mise de fonds destiné surtout à la production de viande à bon marché pour la consommation locale. La formulation de rations alimentaires à base de substances disponibles localement et qui ne sont pas de valeur nutritionnelle directe pour l'homme, constitue un vaste champ d'investigation encore inexploré.

En ce qui concerne la reproduction, de bonnes perspectives existent pour le développement de races qui soient physiologiquement plus adaptées aux conditions locales du milieu dans différentes régions des pays tropicaux.

De bonnes pratiques d'élevage et une bonne propreté sont d'une importance capitale; là où ces conditions règnent, les maladies régressent.

L'appui du Gouvernement est extrêmement important pour un établissement et un développement couronnés de succès de la production de lapins dans les pays en voie de développement. Non seulement les fermiers peuvent alors être approvisionnés par une station centrale et gouvernementale de reproduction, mais encore des conseils, une instruction et la publicité peuvent être prodigués plus efficacement avec l'appui du Gouvernement.

En raison de leur petite taille, les lapins sont commodes à manipuler pour l'abbatage et l'apprêt à une échelle petite. De bonnes conditions d'hygiène sont toutefois essentielles pour le succès de telles opérations. L'abattage des lapins peut être effectué d'une façon efficace avec un équipement relativement simple, et les carcasses peuvent être apprêtées assez facilement par des méthodes traditionnelles.

Les peaux de lapin représentent une source de revenus potentiels pour les producteurs si ceux-ci les traitent avec soin. Le traitement des peaux de lapin peut constituer la base d'une industrie rurale.

Sur les grandes masses de terres sous les tropiques (par exemple l'Afrique), il est improbable que les lapins domestiques échappés constituent un problème semblable a celui causé par les lapins sauvages introduits en Australie. Sur de petites îles, particulièrement celles où il n'existe pas de prédateurs naturels, la situation peut être entièrement différente. Dans tous ces cas, l'avis éclairé d'écologistes familiarisés aux conditions locales est requis.

RESUMEN Y CONCLUSIONES

El conejo como productor de carne y piel en los países en vías de desarrollo

La producción de conejo a escala relativamente pequeña, implicando inversiones minimas, podría suponer una contribución importante para

el suministro de proteínas, animales el consumo humano de países tropicales en vías de desarrollo. Ya se están criando conejos para carne en muchos de estos países, y en algunos el Gobierno está promocionando intensamente la producción de carne de conejo, siendo Ghana el ejemplo más notable.

En los países tropicales en vías de desarrollo, uno de los factores ambientales que más pueden afectar a los conejos es el calor. A temperaturas ambientales superiores a los 30°C, los conejos sufren un malestar creciente y stress fisiológico. Igualmente, a temperaturas de 30°C ó superiores, la fertilidad del conejo macho desciende, aunque no de forma irreversible, y aumenta la mortalidad del embrión en la hembra. Sin embargo, los efectos perjudiciales sobre el conejo de altas temperaturas ambientales se pueden reducir considerablemente con instalaciones adecuadas, que se pueden construir fácilmente utilizando materiales locales.

Es evidente que también la alimentación se puede basar en productos disponibles en la localidad, a pesar de que no es probable que se alcancen niveles de producción similares a los de las explotaciones comerciales de conejos. No obstante, los altos niveles de producción comercial no son necesarios en sistemas de producción a pequeña escala con bajas inversiones, donde se concede la principal importancia a la producción de carne barata para el consumo local. La formulación de dietas a partir de productos locales que no tengan valor nutritivo directo para el hombre, ofrece un campo de trabajo futuro importante y casi sin explorar.

En relación con la mejora genética, hay un campo considerable para el desarrollo de razas que sean fisiológicamente más adecuadas a las condiciones ambientales locales en diversas zonas de los trópicos.

La limpieza y las prácticas de explotación adecuadas son de importancia primordial, y, cuando se llevan a cabo correctamente, el resultado es que hay menos probabilidades de que aparezcan enfermedades.

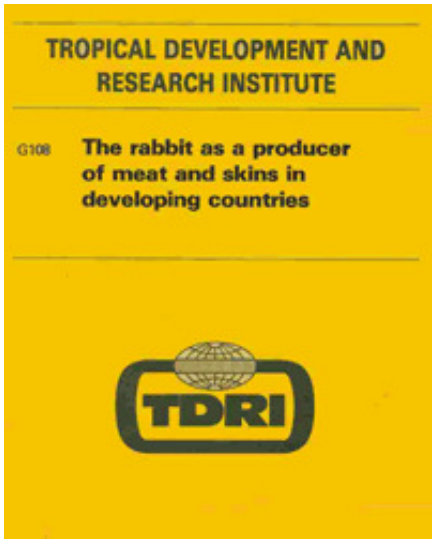
La ayuda del Gobierno es de gran importancia para el buen establecimiento y desarrollo de la producción de conejos en los países en vías de desarrollo. No solamente el Gobierno puede proporcionar ganado selecto a los agricultores, procedente de sus propias estaciones centrales de mejora, sino que también puede suministrar de forma más efectiva asesoramiento, adiestramiento y publicidad.

Los conejos, por su pequeño tamaño, se manejan fácilmente en cuanto a su sacrificio y elaboración a escala pequeña. Pero, es esencial para el éxito de esas operaciones tener unas buenas normas higiénicas. Se pueden sacrificar conejos de forma eficaz con un equipo relativamente simple, y se pueden elaborar las canales con relativa facilidad por métodos tradicionales.

Las pieles de conejo, si se tratan cuidadosamente, representan una fuente potencial de ingresos para los productores. La elaboración de pieles de conejo podría constituir la base de una industria rural.

En grandes extensiones de los trópicos (por ejemplo, en Africa), los

conejos domésticos que se han escapado, no es probable que constituyan un problema similar al creado al introducir conejos salvajes en Australia. En islas pequeñas, sobre todo en las que no tienen predadores naturales, la situación puede ser completamente diferente. En todos estos casos, se deben seguir las indicaciones de los ecólogos familiarizados con las circunstancias locales.



The rabbit as a producer of meat and skins in developing countries

Contents:

Chapter 1

Introduction

In many countries commercial rabbit production is increasing. This involves the use of large numbers of rabbits of improved breeds and strains, scientifically balanced and pelleted feeds, and strictly controlled environmental conditions. In contrast to these relatively sophisticated rabbit industries, rabbit production on a small scale, or backyard level, is still important in many countries, including Malta, France and Spain. This type of system involves small numbers (a few dozen or less) of animals, fed on a variety of green forage, vegetable household waste, and agricultural by-products (where available). The rabbits are then supplied to local markets. It is essentially a low input system with minimal costs.

This report is concerned with rabbit production in developing countries, most of which lie in the tropics. The authors believe that small-scale, low input systems of rabbit production, using locally available materials (Figure 1), are relevant to the needs of many rural and urban populations in developing countries. Production targets in such a system would be lower than those achieved in intensive commercial rabbitries. Commercial production targets of 35 to 45 young reared/doe/year (5-7 litters) are achieved in developed countries, and even 60 young reared/doe/year is considered to be realistic by some producers (Dodd, 1974).

Figure 1 Rabbit production in Algeria illustrative of simple housing constructed from local materials, and forage based feeding. (Courtesy of FAO and OXFAM)

However, lower levels such as the 16 young reared/doe/year (4 litters) currently being achieved in countries such as Ghana (Mamattah, personal communication) are quite satisfactory, at least to begin with, in small, non-intensive production systems. Growth rates of 2kg in 8-10 weeks currently being achieved in European commercial rabbitries (Ministry of Agriculture, 1973) cannot be expected, at least initially, in backyard systems. This is not to say that production cannot eventually be raised, with the development of rabbit strains more suited to the tropics and of improved feed formulations based on locally available materials. It must be emphasized that, although the production levels quoted for non-intensive systems may appear to be low, meat is still being produced cheaply and in reasonable quantity. The low inputs would not demand the high production performance, and concomitant returns, needed to cover costs incurred in large commercial rabbitries. Perhaps another point to consider is that rabbit production might well be challenged by poultry at commercial levels. This does not mean that there would be no scope for the simultaneous development of both rabbit and poultry production in developing countries, as both could be successful in certain circumstances.

In areas of high human population growth, and limited space particularly, rabbits could help to alleviate the shortage of animal protein which often exists. Their ability to utilise fibrous cellulose-based feedstuffs not suitable for human consumption, their convenient size and relatively high productivity (Anon., 1970) make them eminently suitable for this purpose. Moreover, the carcases of rabbits usually have very high meat to bone ratios in comparison to other forms of livestock such

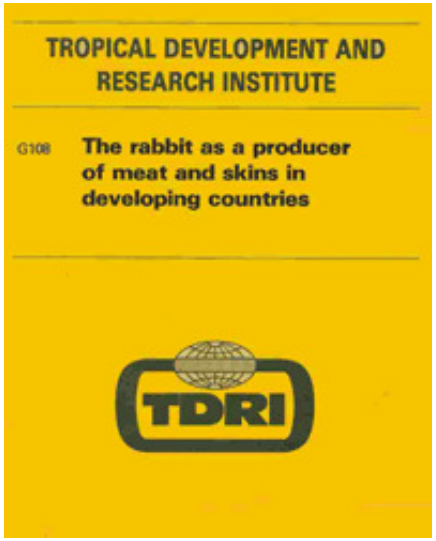
as cattle, sheep and pigs. Rabbit meat also has relatively high levels of protein and low levels of fat, in comparison to the meat of other animals (Ministry of Agriculture, 1973).

Rabbit manure is very useful, its dry matter content being about twice that of horse manure and over three times that of dairy cow manure under conventional UK farming systems (Sandford, 1974). Moreover, rabbit manure is relatively rich in phosphorous and nitrogen when compared to the manure of other livestock on a dry matter basis (Casady, 1975; Mills, 1974). Consequently, it is a useful fertilizer and has been used in local vegetable plots in Tanzania, which in turn provide food for the rabbits (Stamp, personal communication).

The utilisation of rabbit skins to make such things as coats, rugs and small miscellaneous articles can also provide additional income and employment.

This report attempts to examine and identify some of the problems related to rabbit production in tropical developing countries and to discuss the general viability of meat and skin production from these animals. While it is not intended to produce a rabbit keepers manual as such, some aspects of basic rabbit meat production are described. This is to illustrate the sort of problems which arise in some developing countries and to show how producers can overcome them. By giving an account of the extent and relative success of rabbit production in various developing countries, the advantages and problems associated with this can be seen in perspective. A further aim of the report is to promote

cooperation and an interchange of information and ideas between rabbit producers in different parts of the developing world.



The rabbit as a producer of meat and skins in developing countries

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Chapter 2

The present state of rabbit production in developing countries

AFRICA

In Ghana, the National Rabbit Project was established in 1971, with Government support (Figures 2 and 3). By 1974 the rabbit breeding herd at Kwabenya, near Legon, had increased to approximately 698 and by 1975 to approximately 1,478 (Mamattah, personal communication). Applied research in breeding, disease control, housing and feeding (based on locally available materials) and marketing is being conducted. Extension services for the training of local farmers are being developed, and long-term plans include the establishment of regional marketing and breeding centres. A very important part of this project is concerned with rabbit production on a small backyard scale. Rabbits from the centre have now been distributed to, and are breeding in, every region in Ghana, and it is estimated that 5,000,000 rabbits are being eaten

annually (Mamattah, personal communication).

In the Republic of Zaire, rabbit production projects have been supported by Oxfam, World Neighbours, and the Service de Developpement Agricole (an organisation which has been operating in the central part of Zaire for over 10 years). Extension work has been carried out by the latter organisation and there are now 500 farmers reported to be raising rabbits in this country.

Similar projects are being supported by Oxfam in the Tribal Trust Lands of Rhodesia (Stamp, personal communication; Mills, 1974) and a smaller one at the YMCA farm school at Marangu, Tanzania.

A rabbit project aimed at increasing local meat supplies has also been planned in Malawi, at Bunda College, Lilongwe (McNitt and Makhambera, personal communication).

In Malawi, rabbit production is carried out on a small backyard scale only, and there are, as yet, no overall development schemes in operation. Most of the rabbits are kept near the main urban areas of Lilongwe, Blantyre and Zomba. The herds do not usually exceed 30 in number. Rabbits are kept in open run systems in which they are allowed to burrow and breed at will and in cages. They have even been allowed to run free (McNitt, personal communication).

According to the publication *Agricultural Development in Nigeria*, 1973-1985 published by the Federal Ministry of Agriculture and Natural

Resources (1974), rabbit production is becoming popular in Nigeria and every effort will be made to increase production levels.

Figure 2 The National Rabbit Project at Kwabenya in Ghana. This illustrates the use of simply constructed housing from local materials. (Courtesy of N Mamattah)

Figure 3 A large crossbred rabbit at the National Rabbit Project in Ghana. (Courtesy of N Mamattah)

SOUTH AMERICA

On the South American continent, Peru has a population of approximately 200,000 rabbits. The majority of these are bred on a small scale, though large-scale production is just beginning in Lima where a considerable amount of rabbit meat is sold to supermarkets (Dresser, personal communication). There is also interest from many private breeders although rabbit breeding in rural communities is practically unknown. The Livestock Division of the Ministry of Agriculture has expressed interest in rabbit breeding within the community created by the Agrarian Reform Process.

In Brazil, rabbit breeding is reported to have increased considerably in the last few years due to the increasing demand for rabbit meat and skins. Four official Associations, which are recognized by the Ministry of Agriculture, are in existence and the rabbit population is officially estimated to be 150,000. Unofficial estimates almost double this figure (Karlic, personal communication).

The Ministry of Agriculture and Livestock in Ecuador has recently set up a rabbit breeding and distribution farm (Mena, personal communication). However, rabbit production in Ecuador is only carried out by a few farmers in the Andean zone at present.

ASIA

In Asia, China is well known as a rabbit producing country; rabbits are

widely reared by rural communities, with apparently successful results (Blaxter, personal communication).

A small unit consisting of 20 breeding does and 4 bucks has been set up in Lumle Agricultural College, Nepal as a part of the British Ex-servicemen's Reintegration Training Scheme (Karki, personal communication). The project is still at its early stages, but commercial units are being set up, particularly in Kathmandu.

A very different situation exists in India where rabbit production does not seem to have gained in popularity. One of the reasons put forward for this is that rabbit meat has not been accepted by the meat eating population (Anand, personal communication). The Ministry of Agriculture has suggested that there is fear of a rabbit problem similar to that in Australia (Walker, personal communication). Moreover, many local populations do not like killing and eating white rabbits. The nearer rabbits are to the wild type in colour the more acceptable they become (Casebow, personal communication). Although much interest has apparently been shown by livestock producers in New Delhi, the introduction of meat rabbits has not received the support of the Indian Agricultural Institute. Nevertheless, some private individuals keep rabbits in India. One rabbit scheme is being run by the Young Men's Christian Association at Pathanamithatha, Kerala. However, a project at Diptipur failed largely due to a shortage of suitable stock (Casebow, personal communication). Some research institutes breed their own rabbits for vaccine testing, e.g. the Institute of Veterinary Biology Products at Poona (Salvi, personal communication). Rabbits are not kept

on any large commercial scale in India or Bangladesh and their use for meat production is not officially encouraged.

THE INDO-PACIFIC

There has been some interest in rabbit production of meat in the Pacific area (Bewg, personal communication). Rabbit production enterprises have been considered in Fiji but in New Guinea the Department of Agriculture, Stock and Fisheries decided against permitting the development of a commercial rabbit industry. Special permits are granted to enable rabbits to be housed in laboratories, however, and it has been found that they will survive there only if air conditioning is provided (Fennessy, personal communication).

In Mauritius, a rabbit production development scheme is in progress, sponsored by the Ministry of Agriculture jointly with interested international bodies (Bewg, 1974). The rabbits in this country are kept mainly in small backyard systems (Borland, personal communication).

THE WEST INDIES

In the Caribbean, small-scale rabbit production is fairly common and is actively encouraged by the Governments of several territories (e.g. Jamaica, Trinidad, Antigua, Montserrat, St Lucia and Dominica). Large-scale units are rare, although a large commercial unit, planned to house a herd of several thousand does, has recently been established in Trinidad. In Jamaica, the Ministry of Agriculture set up a breeding and

distribution Centre at the Bodles Experimental Station in the early 70's. In Antigua, a small rabbit herd has been set up at the Government Livestock Station.

DEVELOPING COUNTRIES IN GENERAL

It is evident that domesticated rabbits have already been introduced to several tropical developing countries, and now exist in considerable numbers in countries such as Ghana. In many cases rabbits of various breeds were first introduced locally by expatriates. This was followed in some cases by special importations of commercial meat breeds. Another factor responsible for the introduction of rabbits in developing countries is their widespread use by medical and veterinary laboratories. In Brazil, this is said to have contributed to their subsequent use and development as meat animals (Karlic, personal communication). This has not happened in India despite the use of rabbits in such laboratories.

Organisations such as Oxfam and the Men's Baptist Association have made valuable contributions to the development of rabbit meat production in developing countries. However, it would appear that Government support is necessary if the developments are going to be extensive and permanent (Figure 4). This is very evident in Ghana, which has achieved considerable success in the development of rabbit production in rural communities.

Ideally, a central breeding and distribution centre (together with regional centres in large countries) supported by the Government should

be set up, as in Ghana, Nepal, Jamaica and Antigua. From such a centre, rabbits can be supplied to villages in various parts of the country. In countries where rabbit production is a relatively new venture, experience can be gained by the setting up of a pilot unit at a central breeding station. An important feature of such a rabbit development scheme is the training of extension workers and the provision of practical advice for farmers. This also could be carried out at a central breeding station or regional centres

Figure 4 The publicity campaign for the Government sponsored National Rabbit Project in Ghana. (Courtesy of N Mamattah)

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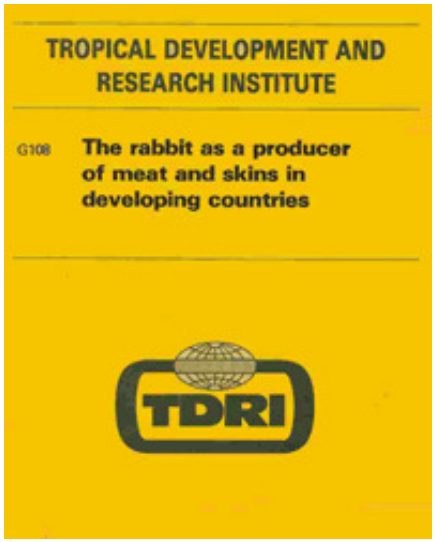


Chapter 3

The effects of high ambient temperatures on rabbit production

GENERAL EFFECTS OF HEAT AND HUMIDITY

Heat is one of the most important environmental factors which may affect rabbit production in the tropics. The rabbit is very largely dependent on respiratory evaporation for the regulation of its body temperature and this confers only a limited power of adaption to hot climates. Heat is also dissipated by radiation and convection, but these are somewhat restricted by the rabbit's furry covering.

It was reported by Johnson, Ragsdale and Cheng (1957) that short hair and larger ears helped the cooling process in New Zealand White rabbits. According to these workers, growth and development were impaired at ambient temperatures of 28.3°C and above. Generally the higher the ambient temperature the greater was the disturbance of the rabbit's functions.

The temperature of a rabbit's body is best measured by recording rectal temperature. A rectal temperature of 38°C is considered to be within the normal range. Lee, Robinson and Hines (1944) found that at ambient temperatures above 29.4°C the rectal temperature begins to increase in the rabbit. When the rectal temperature of Angora rabbits reached 39.8°C the animals became disinclined to move; at a temperature of 40°C they lay down on their sides; and at 41.7°C the rabbits suffered obvious distress but were able to carry out ordinary movements. These rabbits were found to be unable to tolerate ambient temperatures of 37.8°C to 43.3°C for more than 7 hours, within which time the critical rectal temperature of 41.7°C was reached. El Sheik and Casida (1955)

found that rabbits exposed to temperatures of 43.3°C, with relative humidities (RH) of 30% to 40%, for 1 hour experienced an increase in body temperature of 2.5°C. A progressive decrease of RH below 75% brought about definite improvements in the rabbit's ability to withstand high temperatures (as measured by respiratory increase and rectal temperature) at very high ambient temperatures above 37°C (Lee *et al*, 1944). Below this temperature, improvements caused by lowering RH levels were less marked. It would appear from the data of Lee *et al*. (1944) that any adaption the rabbit might be able to make to increasing environmental temperatures would depend largely upon the increased evaporation of water. An appreciable proportion of this can be accounted for by increased respiratory rate. Dribbling from the mouth would also account for a large part. In hot dry (RH 30%) conditions, cooling by increases in respiratory evaporation can be achieved by the provision of adequate drinking water. The rabbit can undoubtedly acclimatise to temperatures up to 31°C (Lee *et al*., 1944). There is evidence, however, that low night temperatures might reduce the degree of acclimatisation to high day-time temperatures (Mills and Ogle, 1933; Lee *et al*., 1944).

EFFECTS OF HIGH AMBIENT TEMPERATURES ON FEED AND WATER INTAKE

Ambient temperatures of 30°C were reported by Prudhon (1976) to decrease the amount and frequency of feed intake of 20 week-old rabbits. The average intake at each meal changed very little between ambient temperatures of 10°C and 20°C, but at 30°C the solid food intake had diminished from 5.6g to 4.4g for each meal and the liquid

intake had increased. The rabbits were held at each temperature for two weeks successively. The water/solid food ratios for the 3 temperatures were: 1.70 (10°C), 1.85 (20°C), and 2.50 (30°C) respectively.

The increase of water intake by rabbits at higher temperatures (Johnson et al., 1957) is an important management consideration. Even at relatively moderate ambient temperatures (about 20°C) a nursing doe of 10 lbs live weight with 7 young (8 weeks old) can consume 1 gallon of water daily (Anon., 1975; Olsen, 1974).

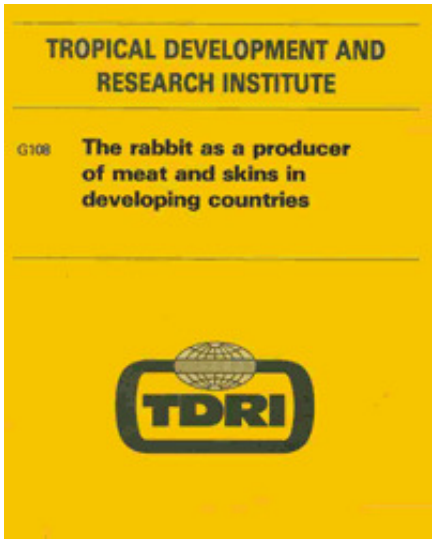
EFFECTS OF HIGH AMBIENT TEMPERATURES ON REPRODUCTION

There is evidence that high ambient temperatures can impair the reproductive performance of rabbits. In New Zealand Whites a temperature of 32.8°C reduced fertility in the male rabbits, a continuous high temperature being more detrimental than intermittent heat (Oloufa, Bogart and McKenzie, 1951). The testes were affected directly by temperature, suffering weight loss, and indirectly by reduced thyroid activity (temperature induced). Other workers have also observed that exposure to high temperatures can lead to a marked seminal degradation in male domestic rabbits. Rathore (1970) found that temperatures of 36.1°C (RH of 50%) for 1 to 2 days affected New Zealand White males and resulted in a reduced fertilisation rate due to damaged sperm. In the female, smaller blastocysts and embryos, and an increase in embryo mortality rates were also observed. El Sheikh and Casida (1955) concluded that the maximum temperature to which rabbits could be exposed (for 1 hour) without impairing health or sperm

motility was 43.3°C at a relative humidity of 30 to 40%. Chou, Yi-Ch'uan and Chen-Ch'ao (1974) heated the testes of live rabbits to 43°C for 20 min on three successive days. No spermatozoa or spermatids were present in the seminiferous tubules up to 30 days after the treatment. However, recovery was complete at about 10-14 weeks following the treatment. Hiroe and Tomitzuka (1965) observed a marked fall in semen quality in male rabbits subjected to ambient temperature of 30°C for 14 days. These changes in quality were associated with an increase in the pH of the semen, a fall in sperm motility, a decrease in sperm concentration, an increase in the percentage of abnormal spermatozoa and a decline in libido. These workers found that, with the exception of sperm concentration, the changes could be reversed by reducing the ambient temperature.

Rich and Alliston (1970) produced evidence on the effect of heat on female New Zealand White rabbits exposed to temperatures of 21.1°C and 32.2°C for 18 days. There was a trend for all does exposed to some degree of heat stress (constant or fluctuating) to suffer fertility failure compared to those housed at a constant 21.1 °C. Embryo survival was depressed by heat stress and this was more severe under constant heat stress than under fluctuating heat stress, and was due largely to postimplantation losses. Embryo survival at 12 days post insemination was lower at 32.2°C than 21.1°C. Shah (1955) reported that severe prenatal losses occur in pregnant does exposed continuously in the first 6 days of pregnancy to environmental temperatures sufficiently high to cause a rise in body temperature of 1.2°C to 1.7°C. Such losses occurred through resorbtion of embryos following implantation. The adverse affect

of heat is on the maternal tissues rather than directly on the embryos. When laboratory rabbits were exposed to a Sahelo-Sudanean dry climate by Tacher (1970) breeding was only successful for 5 months out of 12.



The rabbit as a producer of meat and skins in developing countries

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Chapter 4

Management of rabbits in tropical developing countries

HOUSING

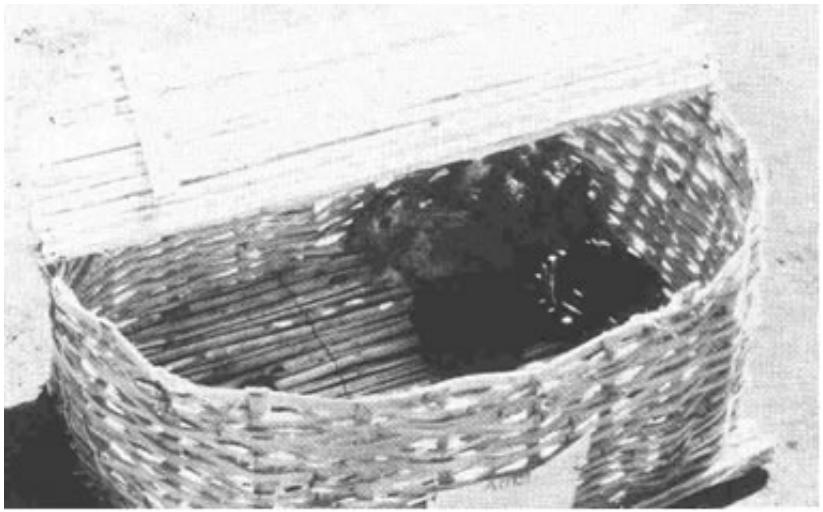


Figure 5 A basket cage made of interwoven split bamboo at Bunda College, Malawi. The roll back lid is constructed from split bamboo and wire. The floors are constructed with the outer portion of the bamboo upwards, which reduces damage from gnawing, and facilitates cleaning. (Courtesy of J I McNitt and P E Makhambera)

In many rural areas of developing countries, the materials for building

rabbit cages and insulated housing, and electricity to power fans and ventilators (which are used in commercial rabbitries in the more developed countries) are often not available. Moreover, the cost may be too high to justify their use in anything but highly developed commercial rabbit industries. It is possible, however, to construct rabbit housing from locally available materials such as old packing cases (Bewg, 1974), intermeshed branches or bamboo strips (Action for Food Production, 1974; World Neighbours, 1974), or indeed any local hard wood or bamboo-like material (Figure 5). Obviously the housing would have to be renewed more frequently (because of gnawing) than that constructed from wire for example. Rabbit housing in tropical countries should be designed and situated to keep the rabbits as cool and quiet as possible, to keep out small predators such as the python and mongoose, and to keep out dogs and children which may disturb the rabbit. The housing should be made of bamboo or bamboo-like materials and nailed or, especially in the case of bamboo, tied to upright supports with local cords or vines; wire could perhaps be used for exposed ties to minimise gnawing damage (Figure 6).

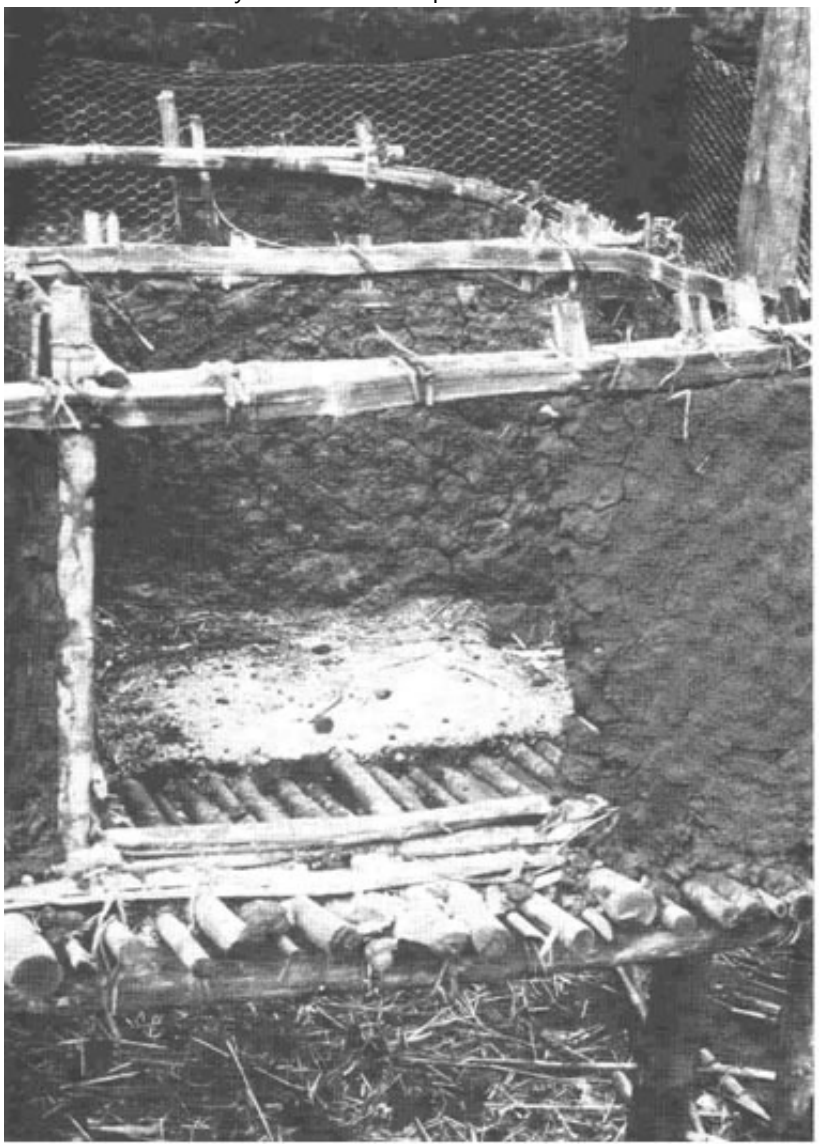


Figure 6 Experimental rabbit housing at Bunda College, Malawi. The cage is of bamboo construction with walls and a part of the floor plastered with mud. Wire has been used for exposed ties to avoid damage by gnawing. The roof has been removed to give a clearer view of the interior. (Courtesy of J I McNitt and P E Makhambera)

Flooring can be made of hard bamboo-like material slatted together. Bamboo flooring of this type is recommended for adult rabbits only, as young rabbits tend to slip on the smooth slats and can develop deformed

legs. Splitting and weaving bamboo strips into a mat provides much better footing for all rabbits. The outer surface of the bamboo should face upwards in order to minimise damage from gnawing and to facilitate cleaning.

Nesting boxes can be constructed from thinner material or even from clay (Figure 7). Wire has many advantages (Ministry of Agriculture, 1973) when used for rabbit housing, especially for floors and the fronts of cages. It should be noted, however, that this material can rust rapidly in warm humid climates if not galvanised or if the galvanised coating is damaged. Possibly its most important use would be in making ties, as mentioned above.

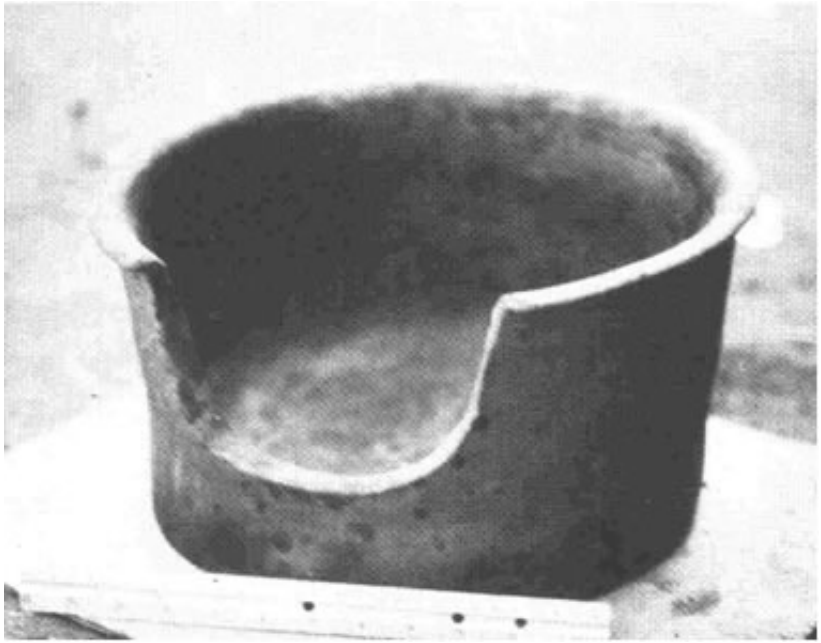
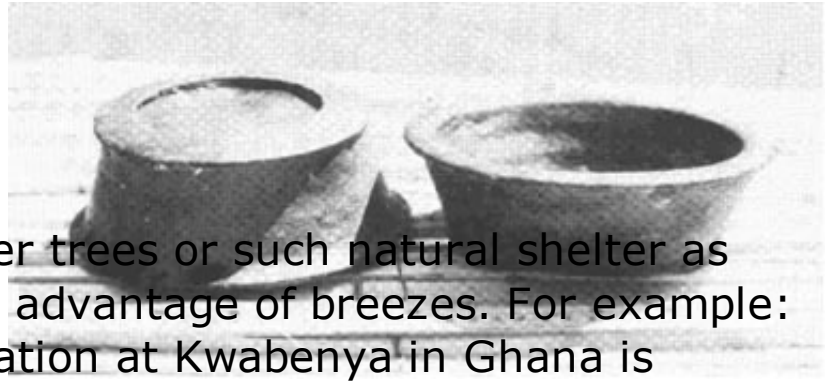


Figure 7 A nesting box made from local clay at Bunda College, Malawi (Courtesy of J I McNitt and P E Makhambera)

Figure 8 Feeding and drinking



bowls made from local clay at Bunda College, Malawi. (Courtesy of J I McNitt and P E Makhambera)

Rabbit housing should be built under trees or such natural shelter as exists and, if possible, sited to take advantage of breezes. For example: the Government rabbit breeding station at Kwabenya in Ghana is situated near a river and takes advantage of the cool breezes which blow in this region. If little or no natural shade exists then artificial shade must be constructed, again from local materials such as branches, leaves and grasses. The shelter must also be capable of keeping out heavy rain.

A fence of bamboo can be constructed (Anon, 1972) to keep out dogs and predators. Both fencing and housing should be constructed so as to allow the free passage of air for cooling.

In areas where wind and rain are experienced, housing would have to be more solidly constructed, with shutters being provided in some cases. In Brazil, rabbits are kept in cages situated in open sheds, which have removable panels for wind and rain protection (Karlic, personal communication).

For feeding and drinking, containers made from cans, old bottles and cheap wooden trough ing can be used (Stamp, personal communication; World Neighbours, 1974). Clay can also be used for this purpose (Figure 8).

The above outline illustrates some of the more important points which have to be considered when constructing rabbit housing in developing countries. Simple housing using local materials similar to that described has already been used quite successfully in Ghana, Zaire and Tanzania.

The use of water sprays (Lipinsky, Collings and Litchfield, 1972) and even the installation of sprinklers (Templeton, 1968) in the rabbitry in very hot areas, where water supply is no problem, have been suggested. In more arid areas where the water supply is restricted, the construction of underground compartments with inspection hatches has also been suggested (Templeton, 1968). The latter would undoubtedly greatly assist in keeping rabbits cool in hot climates but would be relatively difficult to clean and could increase parasitic disease problems such as coccidiosis. Although this type of housing has been used in villages of countries such as Ghana, it is not encouraged there and is not to be generally recommended if alternatives are available.

DISEASE PROBLEMS

Domestic rabbits kept in tropical developing countries are of course prone to the common diseases which affect rabbits in other countries. These include coccidiosis, enteritis and pasteurellosis. Problems can be caused also by such external parasites as ear mites and chicken fleas (McNitt, personal communication). However, cleanliness and correct management, which does not necessarily have to be sophisticated or involve the use of expensive drugs, can be extremely effective in the prevention of disease (Stewart, 1974). With special attention and energy

devoted to proper management and cleanliness, rabbit diseases should not cause any undue difficulties in rural areas of tropical developing countries.

FEEDING

Rabbit production in developing countries is commonly based on low cost feeding, using locally available feedstuffs. In any promotion of rabbit husbandry in these countries an emphasis on simple feeding methods should be maintained. In developed countries, compounded rabbit feeds were primarily developed to increase growth rate and to minimise labour requirements (Walsingham, 1972). However, in the tropical developing countries more important considerations would be to formulate cheap diets based on feedstuffs that are of little direct value as human food. Providing the rabbits are kept on a relatively small scale, diets based on green fodders can be fed without incurring high collection and transportation costs.

Current feeding practices vary widely in the tropics, depending on the types of feed material that are available locally, but, in general, feeding is based on fresh green forage and succulents. For instance, in tropical Africa, feeds commonly given to rabbits include grasses, e.g. Guinea grass (*Panicum maximum*) and stargrass (*Cynodon dactylon*); legumes, e.g. Kudzu (*Pueraria phaseoloides*), groundnut haulms and cowpea haulms; root crops, e.g. sweet potato leaves and cassava chips; and various herbs, e.g. *Tridax procumbens*, *Euphorbia* and *Aspilla* (Mamattah, personal communication). In Mauritius, herbs and grasses such as *Tridax*

procumbens, Sonchus oleraceus and *Sonchus asper* constitute the staple rabbit feeds (Borland, personal communication), while in Nyanga, Zaire, rabbits are fed on vegetables grown in nearby plots with minimal dependence on cereals (Stamp, personal communication). Palm nuts have also been fed in Zaire as a source of vitamins (World Neighbours, 1974).

Rabbits may be maintained solely on green feeds together with household vegetable waste. However, careful management and balancing of diets is necessary. The two most common deficiencies encountered in such diets are of energy and protein rather than minerals or vitamins. Although the rabbit is by nature herbivorous, growth rates on forage based diets containing high fibre levels (upwards of 25 per cent) will be increasingly curtailed with increasing fibre level. This is due to the animal's inability to obtain sufficient digestible material to satisfy its energy demands. The nature of the fibrous components is also important; the greater the degree of lignification, the greater the reduction in the digestibility. In general, tropical species of grasses are less digestible than temperate species at the same stage of maturity and are often of low protein content. The feeding of forage legumes, cut at an early stage, could help to increase protein supply. Alternatively, a protein supplement may be provided, such as vegetable oil seeds or oil seed residues.

Better organised producers may provide a balanced supplement. In Brazil, maize, rice bran, soyabean, wheat bran, alfalfa, bone flour and molasses are used in addition to green fodder (Karlic, personal

communication). In Malawi, maize bran (McNitt, personal communication) is widely used by rabbit producers and in Ghana and parts of Asia, rice bran is often used. In Nepal, for instance, where a group project has been set up to breed and distribute rabbits, the feed consists of *ad lib* grass plus limited amounts of a home mixed 20 per cent crude protein supplement made from maize, rice bran, soyabean, bone meal, salt and limestone (Karki, personal communication).

Agricultural by-products constitute a useful source of rabbit feeds. For instance: in Ghana, dried waste brewery malt and blood meal is fed in addition to such things as groundnut cake, coconut cake, wheat bran, rice bran and additives (eg common salt, palm oil and vitamin mix). Following initial investigations into rabbit nutrition in Ghana, the following rations have been suggested:

	For adult rabbits:	***For young rabbits (creep feed up to weaning):***
crude protein (min)	**18.0%**	**22.0%**
crude fat (min)	**3.0%**	**5.0%**
crude fibre (max)	**20.0%**	**12.0%**
ash (max)	**10.0%**	**8.0%**

It should be pointed out, however, that rabbit producers in many

other countries have not found it necessary to provide creep feeds.

As in the case of breeding (Chapter 4), feeding is best carried out in the early morning and in the evening, the coolest times of day when rabbits are naturally more active.

Despite recent interest in identifying the nutrient requirements of the rabbit for maximum growth and efficiency of feed conversion, the nutritional requirements of the rabbit are still not well known compared to those of other classes of domesticated livestock. Information concerning rabbit performance on forage based diets as compared to concentrate diets is even more scant. There is an urgent need to evaluate the feeding value of tropical forage species and other commonly used local feed sources. Work has already commenced on these problems in some tropical countries (Ministry of Agriculture, Jamaica; National Rabbit Project, Ghana) but a lot more information is required so that small-scale producers can be adequately advised as to the most suitable feed and feeding practices.

RABBIT BREEDS AND BREEDING IN THE TROPICS

At present there are many rabbit breeds being used for meat and skin production in the developing countries. The following list gives an indication of the great variety of breeds used (in addition to the numerous local strains) in some of the countries

already discussed:

Brazil:	**New Zealand White, Californian, Chinchilla, Palomino, Hollander, Rex, Dalmation, Flemish Giant, New Zealand Red, Barboleta, Champaigne, d'Argent.**
Ecuador:	**New Zealand White, Blue Viennese, Silver German and Angora.**
Malawi:	**New Zealand White, Californian, Angora, Rex.**
Nepal:	**Californian Hybrids.**
Ghana:	**Thuringa, Blue Viennese, Flemish Giant, Checkered Giant, Lop, Californian, Alaska, Yellow Silver.**

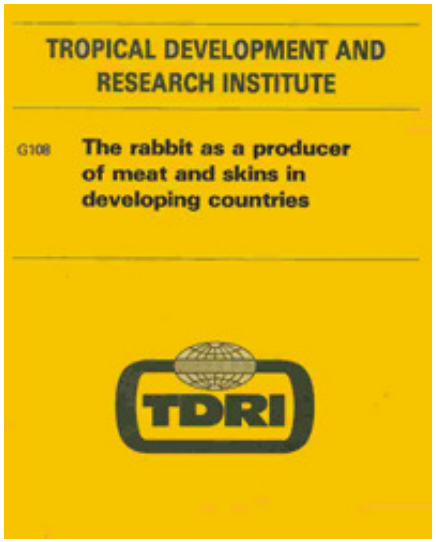
All of these strains of domestic rabbits are descendents of the European wild rabbit, *Oryctolagus cuniculus.* Although many of these are breeding successfully in various countries, the most popular breeds are the New Zealand White and the Californians. The latter breed in particular has been very successful in Nepal (where the climate is relatively cool). These two breeds are also the most popular in commercial rabbit industries in the developed countries. When the various production traits such as fertility, growth and feed conversion rates are considered, under commercial conditions, New Zealand Whites and Californians are amongst the better breeds available for meat production (Sandford, 1974; Bombeke, Okerman and Moermans, 1975). However, these breeds have been evolved in quite different

environments from those in tropical developing countries. Consequently, there is considerable scope for improvement by breeding strains which are physiologically better suited to local tropical conditions. Once the foundation stock has been purchased, then strong emphasis must be placed on the development of such a breeding programme.

There are several tropical and sub-tropical rabbits species, such as the South African genus *Pronalagus* (4 species), the Ugandan *Poelagus* or the Brazilian *Sylvilagus* (*S. brasiliensis*), which are well suited to tropical conditions. Some of these varieties might be worthy of investigation as possible domesticants. To the author's knowledge, no attempt has yet been made to domesticate any of these species, although the genus *Romerolagus* (Mexico) has been bred in Jersey Zoo and the eastern cottontail, *Sylvilagus floridanus*, has been tamed in American zoos (Crandall, 1964). Plans have been made in Malawi to investigate the local *Pronolagus crassicaudatus* or Red Rock Hare. Such programmes are essentially long-term, however, and more useful and immediate results are likely to be achieved from the development of existing domestic strains.

In wild rabbits, maximum activity, including sexual activity, occurs at around sun rise and sun set (Mech, Heezen and Siniff, 1966; Rowley and Mollison, 1955). Stodart and Myers (1964) demonstrated the similarities of such behaviour patterns between wild and domestic rabbits; it has also been reported that

domestic rabbits display a higher rate of successful mating when pairing takes place in early morning or late in the evening (Williams, 1972). By restricting breeding to these times, not only is the apparent natural cycle of activity of the rabbit being followed but the detrimental effects of high ambient temperature on the fertility of male rabbits in the tropics (Chapter 3) can also be minimised, particularly if mating takes place in the morning following a relatively cool night.



The rabbit as a producer of meat and skins in developing countries

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Chapter 5

Rabbit slaughter and processing

Of critical importance to any rabbit meat production enterprise is the efficient and hygienic slaughter and handling of the animals and also the hygienic handling of the carcases. This applies to both the large-scale commercial enterprises and small-scale enterprises alike. Problems concerning these aspects are common to meat production from all types of livestock in developing countries, particularly in rural areas.

The relatively small size of the rabbit presents advantages over larger kinds of livestock in that slaughter and transport is easier. Moreover, the rabbit carcase can be readily consumed by a few people so that

processing and preservation is not always necessary.

Although it is not intended to treat the slaughter and handling of rabbits in great detail in this chapter, some general principles should be noted.

Rabbits should be starved for about six to ten hours before slaughter, to empty the gut as far as possible. They should be well watered during this period to prevent dehydration and weight loss especially in warm weather.

It is better to slaughter rabbits in an area fenced or walled off from other people and domestic animals such as dogs. It is also preferable to have a roof of some kind over the area and a water supply for cleaning purposes.

Rabbits are best slaughtered by dislocating the neck. The hind legs should be held firmly in the left hand, with the right hand holding the rabbit's head directly behind the ears. Pulling sharply on the head with a downward and backward twist of the hand will effectively break the neck. This operation should be followed immediately by bleeding, which is best carried out by severing the head with a knife in one smooth cut.

Skinning and dressing the carcase is most conveniently carried out while the rabbit is suspended from a horizontal rail or bar of some kind. The rabbit can be attached to this bar by the hind feet using simple shackles, which can be made from a thick gauge wire. A simple rail system can be constructed from tubular steel. While it is not suggested that each

producer attempts to make or purchase such equipment, it could be utilised on a co-operative basis in a village.

Skinning can take place when the head and forefeet have been removed. A light incision is made around the hock on each hind leg and a cut is made to the vent and around it. The skin can then be pulled off the carcase in one piece without further cutting, the front legs being pushed through. The skins should be hung up individually and carefully handled as outlined in Chapter 6.

Evisceration is effected by making a longitudinal cut through the body wall from the vent through the belly to the breast bone. The gut, lungs and heart are removed through this cavity while the liver and kidneys are usually left in the carcase. Care should be taken, however, to remove the gall bladder without bursting as the contents could taint the carcase (Ministry of Agriculture, 1973). (Another Report in this series will deal with the principles of the slaughter of animals under rural conditions with emphasis on hygiene and inspection.) The remainder of the offal should not be thrown away as it constitutes a useful source of protein. Investigations into simple methods of converting such offal into proteinaceous concentrates suitable for animal feeds are currently taking place at the Tropical Products Institute.

Although rabbit carcases are mostly consumed fresh, where this is not the case some kind of processing and preservation becomes necessary. Again the small size of the rabbit presents the advantage of easy handling. Facilities such as refrigeration are not always available in rural

areas of developing countries, so in these areas more traditional methods of processing have to be considered. The oldest and most widely used methods of processing and preservation of meat in rural communities involve drying, smoking and sometimes salting. The principles of these methods are well described in the literature (Mann, 1960; Ashbrook, 1955; Pellett and Miller, 1963).

In West African countries, a large rodent, *Thryonomys swinderianus* or 'grasscutter', which is similar in size to the rabbit (Asibey, 1974; Ajayi, 1971), has been used for meat for many years. The animal is often preserved by drying and smoking and the skin may be left on to reduce wastage (Figure 9). To the best of the author's knowledge the same procedure is used with rabbits in Ghana (Mamattah, personal communication). Figures 10 and 11 demonstrate rabbit carcases, unskinned and skinned respectively, smoked and dried at 80°C for 12 hours in a kiln at the Tropical Products Institute laboratories. The final moisture content of the meat was approximately 40%.

Figure 9 Traditionally smoked and dried grasscutter (Thyronomys swinderianus) in Ghana

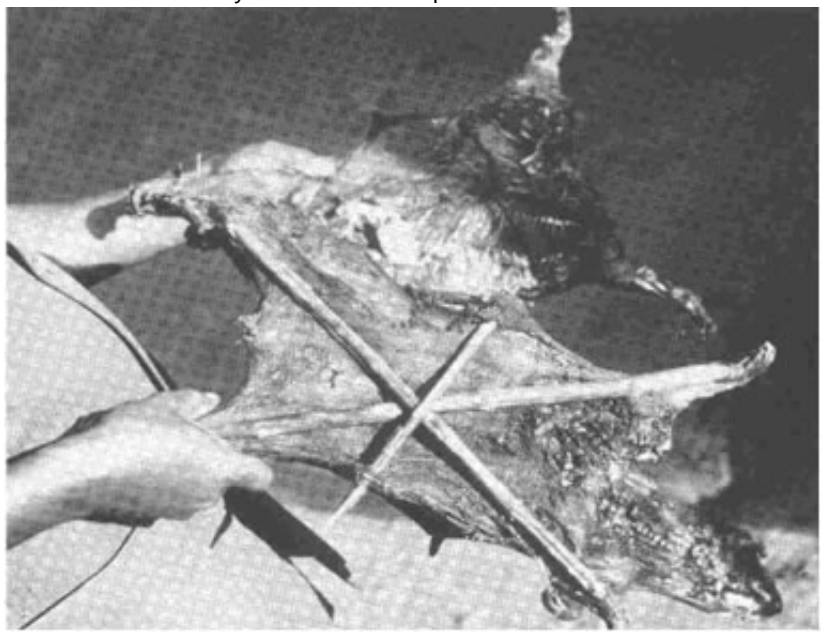
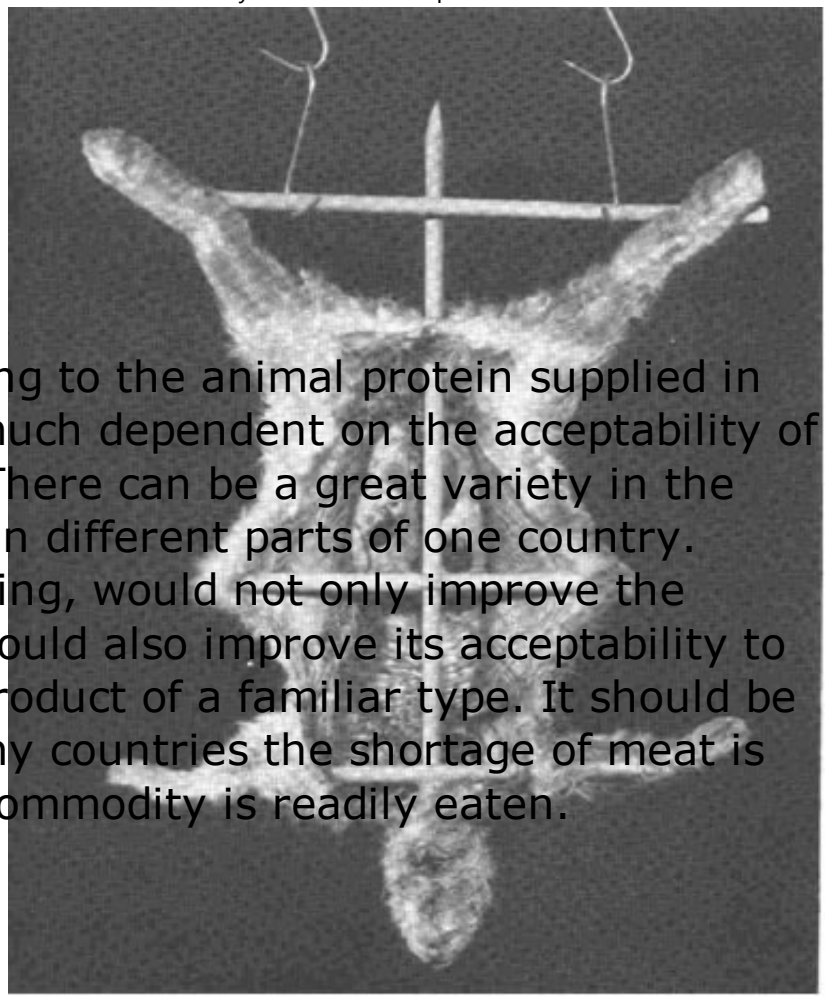
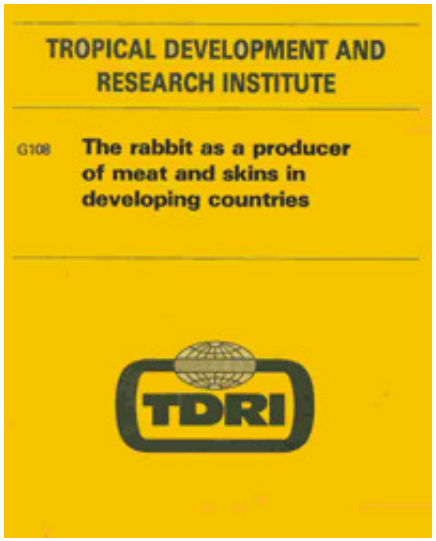


Figure 10 Traditionally prepared rabbit carcase smoked in a kiln for 12 hours: ventral view. (The fur would normally be burned or singed off)



The success of rabbits in contributing to the animal protein supplied in developing countries will be very much dependent on the acceptability of rabbit meat to local communities. There can be a great variety in the meat eating habits of people even in different parts of one country. Processing, such as drying or smoking, would not only improve the storage life of rabbit carcases but could also improve its acceptability to local communities by providing a product of a familiar type. It should be remembered, however, that in many countries the shortage of meat is such that almost any form of this commodity is readily eaten.

Figure 11 Conventionally dressed rabbit carcase smoked in a kiln for 12 hours: ventral view (left) and dorsal view (right)



The rabbit as a producer of meat and skins in developing countries

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Chapter 6

Rabbit skins

In some cases, the rabbit skin is of more value than the rest of the carcase but it should always provide a useful income to the breeder to offset some of his costs. Rabbit skins, when properly processed and made into garments, are very attractive and command a high price. While it is not suggested that the production of fullyprocessed skins is within the capacity of small-scale breeders, dried or salted skins can easily be produced and, if due care is taken in their preparation, can give a good return.

The first essential with all furskins, whether from a rabbit or any other animal, is to prevent putrefaction taking place. Unless checked, decay will set in within a few hours of flaying and one of the first results, loss of hair, makes the skin totally unsuitable for use in fur garments.

Therefore, all skins should be properly cured or preserved very soon after flaying. Methods of preservation include salting or sun-drying (or both) and simple rules will ensure that a top-quality cured skin is produced:

1. Cure as soon as possible after flaying.

2. If sun-drying, do so in the shade with the skins hanging flesh-out.

3. If salting, use a fairly small grain salt and apply carefully over all parts of the skin.

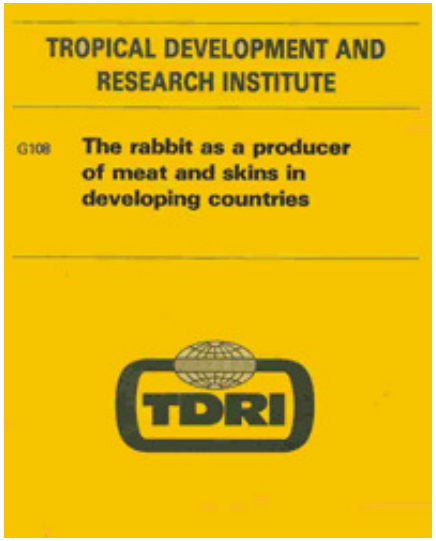
Small-scale breeders may keep their preserved skins for several weeks, to build up the larger loads required by skin dressers.

Processing of rabbit skins involves a long and complicated series of chemical reactions and physical treatments, including pickling (in acid/salt mixtures), tanning, dyeing, oiling and numerous finishing operations. A great deal of work is expended on improving the appearance of the fur, using brushing, combing, shearing and ironing techniques.

Rabbit skins are a major component in the international fur trade, with large numbers also being used for the manufacture of hats, trimmings and gloves. They can readily be dyed and also treated to imitate many other kinds of furskin (seal, beaver, ocelot, leopard, etc.). White rabbit skins are particularly in demand as they lend themselves to dyeing.

There appears to be a good future for the marketing of rabbit skins in Nepal, (Karki, personal communication) and Brazil, where they are reported to have a high market value for the manufacture of such items as blankets and garments (Karlic, personal communication).

The production and processing of rabbit skins and the manufacture of various marketable products from them could ideally be carried out by labour intensive industries, as in Malta for example (Joseph, 1975). Such industries would be relevant to the needs of rural communities in developing countries.



The rabbit as a producer of meat and skins in developing countries

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Chapter 7

Possible problems concerning escaped stock

One aspect of rabbit keeping, which is of major concern to many developing countries, is the potential threat to other agricultural enterprises of escaped domestic stock. The unfortunate experience of the Australians is no doubt responsible for this. The genus *Oryctolagus*, to which the European rabbit belongs, is widespread in Europe and Australia. There are 8 other genera in the family *Leporidae* to which

rabbits and hares belong. The family is widespread in the world but is nowhere very numerous (apart from Europe and Australia), particularly not in the tropics. On certain islands, however, domestic rabbits have multiplied almost regardless of climate from sub-arctic regions to the tropical Phoenix Island only 4°S from the Equator (Flux, personal communication; Watson, 1961).

Unless the rabbit breed is genetically very pure it can revert to the wild type quite quickly: A male and 3 female white rabbits liberated in 1954 on Middleton Island, Alaska, had increased to 5,000 of various colours by 1962 (O'Farrel, 1965). Exdomestic stock thrive in the wild on small islands, especially where there are no competing lagomorphs or predators such as cats. They have established themselves successfully on Hawaii, San Juan (USA), Robben Island (South Africa), Kerguelan, Enderby and other islands off New Zealand and Japan, exhibiting a wide range of environmental tolerance. It is important to note, however, that on Enderby Island (Auckland), a genetically pure strain of the Argente de Champaign breed was liberated and has remained true to form since 1840. rabbits liberated on Moturiau Island (New Zealand) reverted to wild type colour and remained about 30% heavier than ordinary New Zealand wild type rabbits exterminated in 1962 (Flux, personal communication).

Thus in areas such as the Tonga Islands where an interest in rabbit production has been shown (Nance, personal communication), extreme caution should be taken and only very pure genetic strains should be considered (Fenner and Ratcliffe, 1955). In Tonga, escaped rabbits could

not be eradicated by hunting and poisons would be difficult to use because of the danger to people and stock. It took 4 years of hard effort (guns, gas poisons and use of helicopters) to clear feral rabbits from a flat 9 acre island off the New Zealand coast (Flux, personal communication). It should also be noted, however, that on the small heavily populated island of Malta, domestic rabbits have been kept for many years without problems. The island also has a population of wild rabbits (genus *Oryctolagus*).

On large islands and mainland areas without native lagomorphs, domestic rabbits have spread only slowly, if at all, for example Silver Grays on the South Island of New Zealand and domestic rabbits from Tierra del Fuego on the Patagonian mainland.

Domestic rabbits from San Juan have been liberated in many states of America without establishing even temporarily. There, they face competition with indigenous rabbit breeds and suffer the attentions of predators. Wild-type rabbits would differ from the domestic breeds and would have a better chance of establishing themselves and would be far more difficult to control.

In Australia in the mid 19th century, domestic rabbits were kept in almost every town and city, and were known to have escaped or have been liberated but they remained in the locality and gave little or no trouble (Fenner and Ratcliffe, 1955). The trouble in that country only began when wild rabbits were released. Stodart and Myers (1964) consider that the behaviour patterns of domestic rabbits, which sleep on

the surface by day, render them more susceptible to predators. The burrowing habit, which provides wild rabbits with a microclimate of moderate stable temperatures and relatively high humidities, undoubtedly helps them to withstand periods of very high ambient temperatures and water shortage in warm countries (Hayward, 1961).

It is worth emphasising here that all successful mainland invasions, i.e. Europe, England, Australia, New Zealand and South America, have sprung from wild stock. Even in Australia, where the invasion was spectacularly successful, wild rabbits have not permanently colonised the tropical parts of the country (Myers and Parker, 1965). The distribution is confined mainly to the southern third to half of the continent, which has a climate similar to the Mediterranean area from which they came.

Before domestic rabbits are introduced to a country where they have not previously existed, particularly in the case of small islands, expert ecological advice should be sought.

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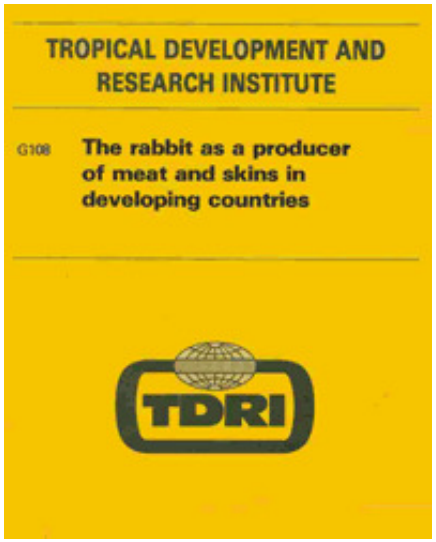

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