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FEED MODULE:
Requirement Functions and Restriction Factors

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Index

Abstract

The functions on the animal requirements and on the restriction factors are reported and described for the different animal categories involved into the CAPRI model.

1 Requirements function

1.1 BOVINE

1.1.1 Dairy and suckling cows

PL_raz assumes a duration of lactation of 305 days for dairy cows and 125 days for suckling cows; the dry period is assumed to last 60 days for dairy cows and 240 days for suckling cows.

The inclusion of the dry period is necessary; as in the dry period the requirements of the cows are very different when compared to the lactation period, both in qualitative and quantitative terms.

The method of calculation considers the requirement of dry matter, the requirements of net energy, of protein (PDI, or digestible intestinal proteins) and of fibre (NDF, or neutral detergent fibre); NDF is needed because assures the correct rumination (see restriction chapter).

The functions include maintenance, milk production and mating requirements; for milk production considers the fat content; the milk production is the standardised with 4% of fat (FCM, fat corrected milk).

Lactation period

FCM*i* = MD * (0.4 + (0.15 * FAT)) ;

REQ*i*,DM = (LW*i* * 0.0185 + FCM*i* * 0.305) * LP*i* ;

REQ*i*,EN = REQ*i*,DM * (FCM*i* * 0.0062 + 0.7204) * 7.11 ;

REQ*i*,PT = REQ*i*,DM * ((FCM*i* * 0.144 + 12.008) / 100) ;

REQ*i*,NDF = REQ*i*,DM * ((FCM*i* - 0.29 + 43.92) / 100) ;

Dry period

REQi,DM = (LWi * 0.0185) * DPi ;

REQi,EN = REQi,DM * 0.65 * 7.11 ;

REQi,PT = REQi,DM * 0.12 ;

REQi,NDF = REQi,DM * ((FCMi - 0.29 + 43.92) / 100) ;

Last mating period

REQi,EN = 2.2 * 7.11 * LMPi ;

REQi,PT = 0.200 * LMPi ;

Then:

REQ*i,a* = REQ*i,a*LP*i* + REQ*i,a*DP*i* + REQ*i,a*LMP*i* ;

Where:

REQ = requirements per head

MD = milk production per lactation day

FAT = real average fat content (available in REGIO)

LW = average live weight : 600 kg for dairy cows, 550 kg for suckling cows

EN = net energy

PT = protein (PDI)

DM = dry matter

LP = lactation period

DP = dry period

LMP = last mating period

i = production activities (MILK , CALV)

a = requirements

1.1.2 Growth phases of young animals (related with nutrient requirements)

PL_raz assumes that calves are not fed by cows, except for the first sex days, when they are fed with colostrum.

Fattening of calves

It's assumed a daily weight increase of 1.2 kg , this period is closed within one year.

Rearing of calves

It's considered three first growth phases, these periods are closed within one year:

1° The next 50 days, corresponding to the weaning period, they are fed with artificial milk and hay, until they reach a weight of 80 kg. The calves, males and females, are reared together (by a feeding point of view).

2° The next 125 days with a daily weight increase of 0.8 kg, until to have a weight of 150 kg. They are reared together.

3° In the last 184 days they are reared separated. The females, with an average daily weight increase of 0.8 kg, until to have a weight of 298 kg and the males, with an average daily weight increase of 1 kg, until to have a weight of 335 kg .

In the last growth phase, which terminates within one year, the males, with an initial weight of 335 kg and an average daily weight increase of 1 kg, are fattened until the slaughtering weight .

A quota of females, with an initial weight of 298 kg and an average daily weight increase of 0.8 kg, are fattened until to have their slaughtered weight, the others are reared, within one year, until to have a final weight of 590 kg, ready to became cows.

(See flow in Annex A).

1.1.3 Fattening of calves

DW = 1.2 ;

IW = 50 ;

DUF = (FW - IW) / DW ;

CW = (FW + IW) / 2 ;

REQ,EN = (0.1877 * CW + 0.0197 * DW - 7.225) * DUF ;

REQ,PT = (1.02 * CW + 0.214 * DW + 19.98) * DUF ;

REQ,DM = (0.0271 * CW - 0.433) * DUF ;

Where

REQ = requirements per head
DW = average weight increase (kg)
IW = initial weight (kg)
FW = final weight (kg)
CW = weight to calculate requirements (kg)
DUF = period of fattening (days)
EN = metabolizable energy
PT = protein (PDI)
DM = dry matter

1.1.4 Rearing of calves

Weaning period

DUF = 50 ;

REQ,EN = EN,MILK * DUF ;

REQ,PT = PT,MILK * DUF ;

Next 125 days

DW = 0.8 ;
IW = 80 ;
FW = 150 ;
DUF = 125 ;
CW = (FW + IW) / 2 ;

REQ,EN = (0.1877 * CW + 0.0197 * DW - 7.225) * DUF ;

REQ,PT = (1.02 * CW + 0.214 * DW + 19.98) * DUF ;

REQ,DM = (0.0271 * CW - 0.433) * DUF ;

Next 184 days: females

DW = 0.8 ;
IW = 150 ;

FW = 298 ;
DUF = 184 ;
CW = (FW + IW) / 2 ;

REQ,EN = (0.1257 * CW + 0.0363 * DW - 10.327) * DUF ;

REQ,PT = (0.7099 * CW + 0.2123 * DW + 55.571) * DUF ;

REQ,DM = (0.0172 * CW + 1.5069) * DUF ;

Next 184 days: males

DW = 1 ;
IW = 150 ;
FW = 335 ;
DUF = 184 ;
CW = (FW + IW) / 2 ;

REQ,EN = (0.138 * CW + 0.0342 * DW - 22.571) * DUF ;

REQ,PT = (0.633 * CW + 0.19 * DW + 116.376) * DUF ;

REQ,DM = (0.0116 * CW + 0.0002 * DW + 2.433) * DUF ;

Where

REQ = requirements per head
DW = average weight increase (kg)
IW = initial weight (kg)
FW = final weight (kg)
CW = weight to calculate requirements (kg)
DUF = period of rearing (days)
EN = metabolizable energy
PT = protein (PDI)
DM = dry matter
EN,MILK = energy content of milk (1 kg) - available in SPEL (ENMR,FMIL)
PT,MILK = protein content of milk (1 kg) - available in SPEL (CRPR,FMIL)

1.1.5 Heifers for breeding and fattening

DW = 0.8 ;

IW = 298 ;

CW*i* = (FW*i* + IW*i*) / 2 ;

REQ*i*,EN = (0.1257 * CW*i* + 0.0363 * DW*i* - 10.327) * DUF*i* ;

REQ*i*,PT = (0.7099 * CW*i* + 0.2123 * DW*i* + 55.571) * DUF*i* ;

REQ*i*,DM = (0.0172 * CW*i* + 1.5069) * DUF*i* ;

Where

REQ = requirements per head

DW = average weight increase (kg)

IW = initial weight (kg)

FW = final weight (600 kg for dairy cows, 550 kg for suckling cows, slaughtered weight for HEIF)

CW = weight to calculate requirements (kg)

DUF = period of fattening ((FW - IW) / DW) ; 365 days for breeding

EN = metabolizable energy

PT = protein (PDI)

DM = dry matter

i = production activities [HEIF (for suckling cows and dairy cows) , HEIB]

1.1.6 Adult male cattle for fattening

DW = 1 ;

IW = 335 ;

DUF = (FW - IW) / DW ;

CW = (FW + IW) / 2 ;

REQ,EN = (0.138 * CW + 0.0342 * DW - 22.571) * DUF ;

REQ,PT = (0.633 * CW + 0.19 * DW + 116.376) * DUF ;

REQ,DM = (0.0116 * CW + 0.0002 * DW + 2.433) * DUF ;

Where

REQ = requirements per head

DW = average weight increase (kg)

IW = initial weight (kg)

FW = final weight (kg) - slaughtered weight

CW = weight to calculate requirements (kg)

DUF = period of fattening (days)

EN = metabolizable energy

PT = protein (PDI)

DM = dry matter

1.2 PIGS

1.2.1 Introduction

The pig, despite its reputation of being a greedy animal, regulates its feed consumption according to its own energy requirement; the feed ingestion is thus reduced as the energy concentration of the feed increases. The optimum energy ingestion, as suggested from the literature, ranges from 3.135 Mcal and 2.850 Mcal per kg of dry matter (considering 1 kg / tq = 0.87 kg of dry matter - average content).

In this case the animal nutritional requirement in energy, protein, lysine (an essential amino acid lacking in the pig) results satisfied and balanced.

1.2.2 Pigs for breeding

According to SPEL, the macro category PIGL has been considered given the unavailability of data related to the single pig categories[1].

[1] This category includes sows, maiden gilt, piglets and boars.

The requirements considered refer to the maintenance, mating period (in this period the requirements are doubled), piglets production (that is the requirements of piglets), maiden gilt production (the requirements of maiden gilt) and for boars.

REQ,EN = OSOW * 8219.75 + OSOW * 3703.2 + PIGL * 404.75 + YSOW * 4217.57 + BOAR * 9836.75 ;

REQ,PT = OSOW * 101.71 + OSOW * 46.5 + PIGL * 5.5 + YSOW * 52.2 +BOAR * 121.71 ;

REQ,LISI = OSOW * 0.610 + OSOW * 0.372 + PIGL * 0.074 + YSOW * 0.313 + BOAR * 0.730 ;

REQ,DM = OSOW * 610.35 + OSOW * 261 + PIGL * 26.1 + YSOW * 313.2 + BOAR * 730.6 ;

Where

OSOW = old sows (total sows - maiden gilt)

PIGL = piglets produced by a sow

YSOW = maiden gilt

BOAR = boars

REQ = requirements per head

EN = metabolizable energy

PT = crude protein

LISI = lysine - essential amino acid for pigs

DM = dry matter

1.2.3 Pigs for fattening

The calculation refers to a model defined at the DIPROVAL, Animal Productions Unit; the model takes into account different parameters: the average genetic type used in Europe, its growth potential (allometric coefficient), the quantity of protein retained (quantity of lean muscle in the carcass).

Given these parameters the models calculates the daily weight increase, the requirements of energy, crude protein, lysine and dry matter.

With this model, two type of pigs for fattening are considered: a light pig (max weight of 115 kg) and a heavy pig (max weight of 170 kg).

The two pigs need, in the different growth phases, different requirements; by introducing different type of fodder, in every phase, the model process a list with the requirements for every days.

(Annex B & C available in ftp account).

So

If FW <= 115 ;

then

$$REQ,r = \sum_{FW}^{IW} REQ,r \qquad \text{from the light pigs list}$$

Where

FW = slaughtered weight

IW = initial weight (20 kg)

REQ = requirements per head

r = requirements of energy, crude protein, lysine, dry matter

And

If FW <= 170 ;

then

$$REQ,r = \sum_{FW}^{IW} REQ,r \qquad \text{from heavy pigs list}$$

Where

FW = slaughtered weight

IW = initial weight (20 kg)

REQ = requirements per head

r = requirements of energy, crude protein, lysine, dry matter

1.3 SHEEP and GOATS

1.3.1 Ewes

To calculate the requirements for ewes, PL_raz considers a standard ewe with a weight of 55 kg.

The functions include requirements for maintanance, milk production and for last mated period:

the maintance period covers 305 days, the last mated period 60 days.

REQ,EN =((0.166 + 0.009 * LW) * 305 + (0.267 + 0.0085 * LW + 0.568) * MD
+ (0.08 + 0.15 * LW) * 60) * 7.11;

REQ,PT = ((13.6 + 0.71 * LW) * 305 + (25.57 + 0.614 * LW + 72.88) * MD +
(- 19.88 + 2.22 * LW) * 60) / 1000;

REQ,DM = (0.393 + 0.022 * LW) * 305 + (1.1065 + 0.0187 * LW + 0.278) * MD
+ (0.268 * LW – 0.24) ;

Where

REQ = requirements per head

MD = milk production per lactation day

LW = average live weight 55 kg

EN = energy

PT = protein (PDI)

DM = dry matter

1.3.2 Mother goats

To calculate the requirements for ewes, PL_raz considers a standard goat with a weight of 60 kg. and fat milk content of 4%.

The functions include requirements for maintenance, milk production and for last mated period:

the maintenance period covers 305 days, the last mated period 60 days.

REQ,EN =((1.845 + 0.119 * LW) * 305 + (4.475 * MD – 0.0065) +
(2.108 + 0.138 * LW) * 60) ;
REQ,PT = ((12.66 + 0.8 * LW) * 305 + (61 * MD) +
(14.66 + 1.425 * LW) * 60) / 1000;
REQ,DM = (0.55 + 0.013 * LW) * 305 + (0.3 * MD) +
(0.0122 * LW + 0.5316) ;
Where

REQ = requirements per head
MD = milk production per lactation day
LW = average live weight 60 kg
EN = energy
PT = protein (PDI)
DM = dry matter

1.3.3 Ewes and mother goats

In according to SPEL , ewes and mother goats are collect in MUTM activity, so:

MUTM,REQ,*a* = (EWES,REQ,*a* * EWES,LEVL + GOATS,REQ,*a* * GOATS,LEVL)
/ (EWES,LEVL + GOATS,LEVL) ;
Where
REQ = requirements per head
a = energy, protein and dry matter
EWES,LEVL = activity level of ewes – available in ZPA1
GOATS,LEVL = activity level of mother goats – available in ZPA1

1.3.4 Sheep and goats for fattening

Sheep and goats for fattening have an initial weight of 5 kg, a daily weight increase of 0.3 kg and a utilization coefficient of 0.60 (this is an average coefficient, the real is available with data of slaughtering).

DW = 300 ;

IW = 5 ;

DUF = (FW - IW) / DW ;

CW = (FW + IW) / 2 ;

REQ,EN = (0.0376 * CW + 0.00098 * DW) * 7.6 * DUF ;

REQ,PT =((0.33 * CW + 0.258 * DW + 21.778) * DUF) / 1000 ;

REQ,DM = (0.0494 * CW - 0.167) * DUF ;

Where

REQ = requirements per head

DW = average weight increase (grams)

IW = initial weight (kg)

FW = final weight (kg) - slaughtering weight

CW = weight to calculate requirements (kg)

DUF = period of fattening (days)

EN = metabolizable energy

PT = protein (PDI)

DM = dry matter

1.4 POULTRY

1.4.1 Laying hens

We are working on, use SPEL function.

1.4.2 Poultry for fattening

The requirement function for fattening poultry uses the slaughtering weight, for an average animal in according to SPEL, even if the functions are refered to broilers.

$REQ,EN = (5.1035 * FW^{1.3023} * 7.6) * 1000;$

$REQ,DM = (1.6463 * FW^{1.3023} * 0.87) * 1000;$

$REQ,PT = REQ,DM * 0.19 * 1000 ;$

$REQ,LISI = REQ,PT * 0.011 * 1000 ;$

Where

REQ = requirements per head

FW = final weight (kg) - slaughtering weight

EN = metabolizable energy (MJ)

PT = crude protein (kg)

DM = dry matter (kg)

LISI = lisine (kg)

2 Restriction factors

2.1 INTRODUCTION

The animal feed requirements are satisfied by different type and quantity of ingredients, specific for each animal category. The choice of ingredient which will be included in the animal feed is influenced by the physiological and biochemical characteristic of each single species. Substantial differences are related to the ingestion capacity of each animal category.

For the ruminants the ingestion capacity indirectly regulates the ratio (requirements)/(feed,wet basis). In practical terms the animal cannot ingest feed above a certain volume; if the feed is not balanced the different nutritional requirements could therefore not be satisfied.

Each ingredient, in turn, has a specific bulk capacity, related to its content in fibre, to the type of fibre and to the animal category which is destined to.

The bulk capacity is essentially due to the duration of the digestion process; therefore easily digestible ingredients (concentrate feed, cereals and similar ingredients) are not bulky and cannot be considered as constraints in these context.

The ingestion capacity allows us to predict the quantity of feed voluntarily assumed by the animal.

An effective constraint for monogastrics (pigs and poultry), is the energy content of 1 kg of ingested dry matter; these animal even though tend to be voracious, ingest feed until their energy requirement is satisfied; this can result in a risk of not having other nutritional requirements satisfied. Therefore using feed formulae balanced in their energy, crude protein, lysine and dry matter content respects the natural animal nutritional behaviour and the requirements satisfaction.

2.2 BOVINE

2.2.1 Dairy and suckling cows

The right nutrients intake and the maximum efficiency of their digestion is fundamental for their production. This can be guaranteed by the right feed category and their correct share in the diet.

Given this foreword three fundamental constraints for the feed formulation can be defined:

cows ingestion capacity (UEL), that is the max dry matter intake:

UEL = 0.140 kg / dry matter * kg $W^{0.75}$

- The ratio forage/ concentrate feed: defines the forages quantity (kg of dry matter) to be included in the feed; this quantity is calculated on the basis of the forage fibre content and of the daily milk production (higher production means higher requirements)
- Minimum quantity of long fibre; it is necessary for a correct rumination and must be equal to REQ,NDF / 3

So,

FODDER*i* = (144.325 - FODDER,NDF + (- 1.222 * FCM*i*)) / 100 ;

NOTFODD*i* = 1 - FODDER*i*

then

UEL*i* <= REQ,DM*i* * FODDER*i* + REQ,DM*i* * NOTFODD*i* ;

and

HAY,NDF*i* = REQ,NDF*i* / 3

Where

FODDER = dry hay, straw, fresh and silage fodder

FCM = fat corrected milk (see requirements function for *i*)

NDF = neutral detergent fibre content

NOTFODD = is not FODDER

REQ,DM = requirement of dry matter

REQ,NDF = requirement of NDF

HAY = dry hay and straw

i = production activities (MILK , CALV)

2.2.2 Growing and fattening bovine

Once the share of feed concentrate to be used in the diet is defined, it is possible to calculate the forages intake, knowing the animal intake capacity and the forages bulk coefficient.

Subtracting the forage nutritional intake from the total feed requirements, the feed concentrate intake is obtained.

FODDER,DRMA,*i* = 4.499 + (- 4.176 * FODDER,UEB) + (- 0.712 *
NOTFODD,DRMA) + (0.976 * UEB*i*) ;

Where

FODDER,UEB = foraged bulk capacity in growing and fattening cattle

NOTFODD,DRMA = share of feed concentrates in the diet (kg of dry matter)

UEB =REQ*i*,DM - intake capacity (kg of dry matter)

i = production activities (RCAL, CALF, HEIF, BEEF) ;

2.3 PIGS

The constraints adopted for the pig diet formulation are essentially related to the energy content. Once the range of energy voluntarily assumed by the animal is defined (14.82 MJ e 13.47 MJ per kg of dry matter), it is possible to estimatethe max and min dry matter intake.

2.3.1 Pigs for breeding

DRMAX = REQ,DM / DRMA,ENmin

DRMIN = REQ,DM / DRMA,ENmax

Where

DRMAX = max dry matter intake (kg)

DRMIN = min dry matter intake (kg)

REQ,DM = requirement of dry matter

DRMA,ENmin = min energy content in 1 kg of dry matter (13.47 MJ)
DRMA,ENmax = max energy content in 1 kg of dry matter (14.82 MJ)

2.3.2 Pigs for fattening

If FW <= 115 ;

then

$$REQ,r = \sum_{FW}^{IW} REQ,r \qquad \text{from light pigs list}$$

Where

FW = slaughtered weight

IW = initial weight (20 kg)

REQ = requirements per head

r = max and min dry matter intake

And

If FW <= 170 ;

then

$$REQ,r = \sum_{FW}^{IW} REQ,r \qquad \text{from heavy pigs list}$$

Where

FW = slaughtered weight

IW = initial weight (20 kg)

REQ = requirements per head

r = max and min dry matter intake

(For data see Annex B & C available in ftp account)

2.4 SHEEP and GOATS

Also for this categories the maximum intake is linked to the bulk capacity of some ingredients: fresh and dry foraged, silage , etc.

2.4.1 Mother goats

Let us consider the parameters defining a standard goat: live weight 60 kg, daily milk production 4 kg, with 3.5% of fat.

On this basis, once the energy content of the forages and their bulk coefficient is known, it is possible to estimate the forage intake (kg of dry matter) and the feed concentrates bulk coefficient.

FODDER,DRMA = 3.895 + (0.1441 * FODDER,EN) + (- 2.55 * FODDER,UEC)

NOTFODD,UEC = 0.1466 + (0.0708 * FODDER,EN) + (- 0.1057 * FODDER,UEC)

NOTFODD,DRMA = (UEC – FODDER,DRMA) / NOTFODD,UEC ;

Where

FODDER,DRMA = forages intake (kg of dry matter)

NOTFODD,UEC = feed concentrate bulk coefficient

FODDER,UEC = forages bulk coefficient
NOTFODD,DRMA = feed concentrate intake (kg of dry matter)

UEC = REQ,DM - goats intake capacity

2.4.2 Ewes

It possible to calculate the bulk capacity of the feed concentrates for the ewes, starting from the bulk cacacity of the forages included in the feed composition.

NOTFODD,UEM = 1.9817 + (FODDER,UEM * 0.7971)

Once the forage intake is defined it follows that :

FODDER,DRMA = FODDER,UEM * FODDER,TQ

NOTFODD,DRMA = (UEM – FODDER,DRMA) / NOTFODD,UEM

Where

FODDER,DRMA = forages intake(kg of dry matter)

FODDER,UEM = forages bulk coefficient
NOTFODD,DRMA = feed concentrates intake (kg of dry matter)
NOTFODD,UEM = feed concentrates bulk coefficient

UEM = REQ,DM - ewes intake capacity

The forage intake plus the feed concentrate must satisfy the animal requirements.

2.5 POULTRY

The same constraints adopted for the pigs apply also to the poultry, the only difference is represented by the energy intake range.

DRMAX*i* = REQ*i*,DM / DRMA,ENmin

DRMIN*i* = REQ*i*,DM / DRMA,ENmax

Where

DRMAX = max dry matter intake (kg)

DRMIN = min dry matter intake (kg)

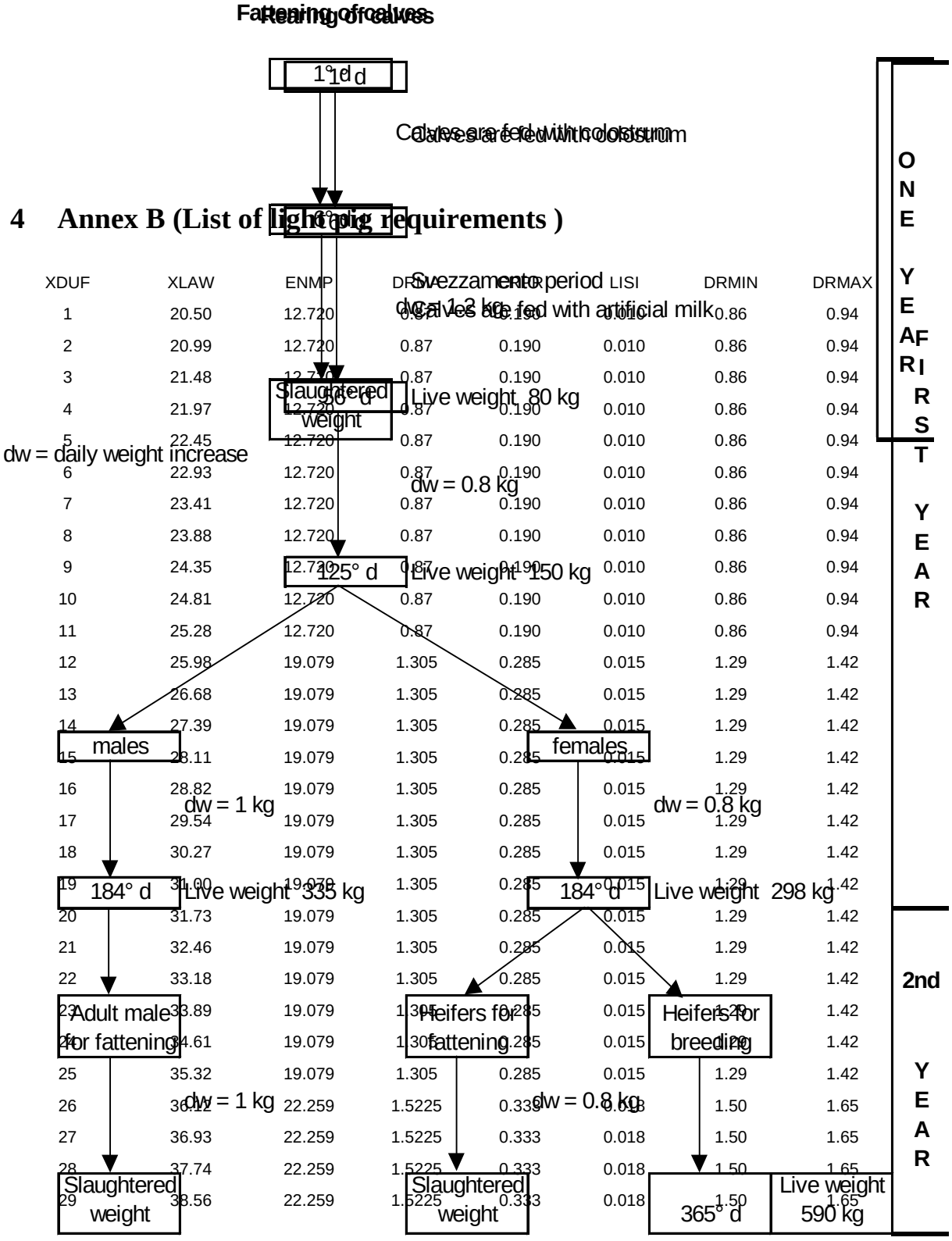
REQ,DM = requirement of dry matter

DRMA,ENmin = min energy content of 1 kg of dry matter (22.8 MJ)
DRMA,ENmax = max energy content of 1 kg of dry matter (28.12 MJ)

i = activities: laying hens and poultry for fattening

3 Annex A

Flow of growth phases of young animals



4 Annex B (List of lighting requirements)

XDUF	XLAW	ENMP	DRMA	ENER	LISI	DRMIN	DRMAX
1	20.50	12.720	0.87	0.190	0.010	0.86	0.94
2	20.99	12.720	0.87	0.190	0.010	0.86	0.94
3	21.48	12.720	0.87	0.190	0.010	0.86	0.94
4	21.97	12.720	0.87	0.190	0.010	0.86	0.94
5	22.45	12.720	0.87	0.190	0.010	0.86	0.94
6	22.93	12.720	0.87	0.190	0.010	0.86	0.94
7	23.41	12.720	0.87	0.190	0.010	0.86	0.94
8	23.88	12.720	0.87	0.190	0.010	0.86	0.94
9	24.35	12.720	0.87	0.190	0.010	0.86	0.94
10	24.81	12.720	0.87	0.190	0.010	0.86	0.94
11	25.28	12.720	0.87	0.190	0.010	0.86	0.94
12	25.98	19.079	1.305	0.285	0.015	1.29	1.42
13	26.68	19.079	1.305	0.285	0.015	1.29	1.42
14	27.39	19.079	1.305	0.285	0.015	1.29	1.42
15	28.11	19.079	1.305	0.285	0.015	1.29	1.42
16	28.82	19.079	1.305	0.285	0.015	1.29	1.42
17	29.54	19.079	1.305	0.285	0.015	1.29	1.42
18	30.27	19.079	1.305	0.285	0.015	1.29	1.42
19	31.00	19.079	1.305	0.285	0.015	1.29	1.42
20	31.73	19.079	1.305	0.285	0.015	1.29	1.42
21	32.46	19.079	1.305	0.285	0.015	1.29	1.42
22	33.18	19.079	1.305	0.285	0.015	1.29	1.42
23	33.89	19.079	1.305	0.285	0.015	1.29	1.42
24	34.61	19.079	1.305	0.285	0.015	1.29	1.42
25	35.32	19.079	1.305	0.285	0.015	1.29	1.42
26	36.12	22.259	1.5225	0.333	0.018	1.50	1.65
27	36.93	22.259	1.5225	0.333	0.018	1.50	1.65
28	37.74	22.259	1.5225	0.333	0.018	1.50	1.65
29	38.56	22.259	1.5225	0.333	0.018	1.50	1.65

30	39.37	22.259	1.5225	0.333	0.018	1.50	1.65
31	40.20	22.259	1.5225	0.333	0.018	1.50	1.65
32	41.02	22.259	1.5225	0.333	0.018	1.50	1.65
33	41.84	22.259	1.5225	0.333	0.018	1.50	1.65
34	42.65	22.259	1.5225	0.333	0.018	1.50	1.65
35	43.46	22.259	1.5225	0.333	0.018	1.50	1.65
36	44.27	22.259	1.5225	0.333	0.018	1.50	1.65
37	45.07	22.259	1.5225	0.333	0.018	1.50	1.65
38	45.96	25.439	1.74	0.380	0.020	1.72	1.89
39	46.85	25.439	1.74	0.380	0.020	1.72	1.89
40	47.75	25.439	1.74	0.380	0.020	1.72	1.89
41	48.64	25.439	1.74	0.380	0.020	1.72	1.89
42	49.54	25.439	1.74	0.380	0.020	1.72	1.89
43	50.44	25.439	1.74	0.380	0.020	1.72	1.89
44	51.34	25.439	1.74	0.380	0.020	1.72	1.89
45	52.25	25.439	1.74	0.380	0.020	1.72	1.89
46	53.15	25.439	1.74	0.380	0.020	1.72	1.89
47	54.05	25.439	1.74	0.380	0.020	1.72	1.89
48	54.94	25.439	1.74	0.380	0.020	1.72	1.89
49	55.83	25.439	1.74	0.380	0.020	1.72	1.89
50	56.82	30.527	2.088	0.456	0.024	2.06	2.27
51	57.82	30.527	2.088	0.456	0.024	2.06	2.27
52	58.82	30.527	2.088	0.456	0.024	2.06	2.27
53	59.81	30.527	2.088	0.456	0.024	2.06	2.27
54	60.81	30.527	2.088	0.456	0.024	2.06	2.27
55	61.81	30.527	2.088	0.456	0.024	2.06	2.27
56	62.81	30.527	2.088	0.456	0.024	2.06	2.27
57	63.81	30.527	2.088	0.456	0.024	2.06	2.27
58	64.81	30.527	2.088	0.456	0.024	2.06	2.27
59	65.80	30.527	2.088	0.456	0.024	2.06	2.27
60	66.85	33.071	2.262	0.494	0.026	2.23	2.45
61	67.89	33.071	2.262	0.494	0.026	2.23	2.45
62	68.93	33.071	2.262	0.494	0.026	2.23	2.45
63	69.97	33.071	2.262	0.494	0.026	2.23	2.45
64	71.01	33.071	2.262	0.312	0.018	2.23	2.45
65	71.91	33.071	2.262	0.312	0.018	2.23	2.45
66	72.81	33.071	2.262	0.312	0.018	2.23	2.45
67	73.71	33.071	2.262	0.312	0.018	2.23	2.45
68	74.60	33.071	2.262	0.312	0.018	2.23	2.45
69	75.49	33.071	2.262	0.312	0.018	2.23	2.45
70	76.47	35.615	2.436	0.336	0.020	2.40	2.64
71	77.45	35.615	2.436	0.336	0.020	2.40	2.64

72	78.42	35.615	2.436	0.336	0.020	2.40	2.64
73	79.39	35.615	2.436	0.336	0.020	2.40	2.64
74	80.36	35.615	2.436	0.336	0.020	2.40	2.64
75	81.32	35.615	2.436	0.336	0.020	2.40	2.64
76	82.28	35.615	2.436	0.336	0.020	2.40	2.64
77	83.23	35.615	2.436	0.336	0.020	2.40	2.64
78	84.18	35.615	2.436	0.336	0.020	2.40	2.64
79	85.13	35.615	2.436	0.336	0.020	2.40	2.64
80	86.12	36.887	2.523	0.348	0.020	2.49	2.74
81	87.10	36.887	2.523	0.348	0.020	2.49	2.74
82	88.09	36.887	2.523	0.348	0.020	2.49	2.74
83	89.06	36.887	2.523	0.348	0.020	2.49	2.74
84	90.04	36.887	2.523	0.348	0.020	2.49	2.74
85	91.01	36.887	2.523	0.348	0.020	2.49	2.74
86	91.97	36.887	2.523	0.348	0.020	2.49	2.74
87	92.94	36.887	2.523	0.348	0.020	2.49	2.74
88	93.90	36.887	2.523	0.348	0.020	2.49	2.74
89	94.85	36.887	2.523	0.348	0.020	2.49	2.74
90	95.80	36.887	2.523	0.348	0.020	2.49	2.74
91	96.80	38.159	2.61	0.360	0.021	2.57	2.83
92	97.79	38.159	2.61	0.360	0.021	2.57	2.83
93	98.78	38.159	2.61	0.360	0.021	2.57	2.83
94	99.76	38.159	2.61	0.360	0.021	2.57	2.83
95	100.74	38.159	2.61	0.360	0.021	2.57	2.83
96	101.72	38.159	2.61	0.360	0.021	2.57	2.83
97	102.69	38.159	2.61	0.360	0.021	2.57	2.83
98	103.66	38.159	2.61	0.360	0.021	2.57	2.83
99	104.63	38.159	2.61	0.360	0.021	2.57	2.83
100	105.59	38.159	2.61	0.360	0.021	2.57	2.83
101	106.60	39.431	2.697	0.372	0.022	2.66	2.93
102	107.60	39.431	2.697	0.372	0.022	2.66	2.93
103	108.60	39.431	2.697	0.372	0.022	2.66	2.93
104	109.59	39.431	2.697	0.372	0.022	2.66	2.93
105	110.58	39.431	2.697	0.372	0.022	2.66	2.93
106	111.57	39.431	2.697	0.372	0.022	2.66	2.93
107	112.56	39.431	2.697	0.372	0.022	2.66	2.93
108	113.54	39.431	2.697	0.372	0.022	2.66	2.93
109	114.51	39.431	2.697	0.372	0.022	2.66	2.93

XLAW = live weight

XDUF = day of fattening period

ENMP = requirement of energy

CRPR = requirement of crude protein

LISI = requirement of lysine

DRMA = requirement of dry matter

DRMIN = min. intake of dry matter

DRMAX = max intake of dry matter

5 Annex C (List of heavy pig requirements)

XDUF	XLAW	ENMP	CRPR	RLIS	DRMA	DRMIN	DRMAX
1	20.47	12.720	0.139	0.010	0.87	0.86	0.94
2	20.95	12.720	0.139	0.010	0.87	0.86	0.94
3	21.43	12.720	0.139	0.010	0.87	0.86	0.94
4	21.91	12.720	0.139	0.010	0.87	0.86	0.94
5	22.38	12.720	0.139	0.010	0.87	0.86	0.94
6	22.85	12.720	0.139	0.010	0.87	0.86	0.94
7	23.32	12.720	0.139	0.010	0.87	0.86	0.94
8	23.79	12.720	0.139	0.010	0.87	0.86	0.94
9	24.25	12.720	0.139	0.010	0.87	0.86	0.94
10	24.71	12.720	0.139	0.010	0.87	0.86	0.94
11	25.16	12.720	0.139	0.010	0.87	0.86	0.94
12	25.77	19.079	0.209	0.015	1.31	1.29	1.42
13	26.38	19.079	0.209	0.015	1.31	1.29	1.42
14	26.98	19.079	0.209	0.015	1.31	1.29	1.42
15	27.59	19.079	0.209	0.015	1.31	1.29	1.42
16	28.21	19.079	0.209	0.015	1.31	1.29	1.42
17	28.82	19.079	0.209	0.015	1.31	1.29	1.42
18	29.43	19.079	0.209	0.015	1.31	1.29	1.42
19	30.05	19.079	0.209	0.015	1.31	1.29	1.42
20	30.66	19.079	0.209	0.015	1.31	1.29	1.42
21	31.28	19.079	0.209	0.015	1.31	1.29	1.42
22	31.90	19.079	0.209	0.015	1.31	1.29	1.42
23	32.51	19.079	0.209	0.015	1.31	1.29	1.42
24	33.13	19.079	0.209	0.015	1.31	1.29	1.42
25	33.75	19.079	0.209	0.015	1.31	1.29	1.42
26	34.38	19.079	0.209	0.015	1.31	1.29	1.42
27	35.00	19.079	0.209	0.015	1.31	1.29	1.42

28	35.62	19.079	0.209	0.015	1.31	1.29	1.42
29	36.30	22.259	0.244	0.017	1.52	1.50	1.65
30	36.98	22.259	0.244	0.017	1.52	1.50	1.65
31	37.66	22.259	0.244	0.017	1.52	1.50	1.65
32	38.34	22.259	0.244	0.017	1.52	1.50	1.65
33	39.02	22.259	0.244	0.017	1.52	1.50	1.65
34	39.70	22.259	0.244	0.017	1.52	1.50	1.65
35	40.38	22.259	0.244	0.017	1.52	1.50	1.65
36	41.06	22.259	0.244	0.017	1.52	1.50	1.65
37	41.74	22.259	0.244	0.017	1.52	1.50	1.65
38	42.42	22.259	0.244	0.017	1.52	1.50	1.65
39	43.10	22.259	0.244	0.017	1.52	1.50	1.65
40	43.77	22.259	0.244	0.017	1.52	1.50	1.65
41	44.45	22.259	0.244	0.017	1.52	1.50	1.65
42	45.13	22.259	0.244	0.017	1.52	1.50	1.65
43	45.87	25.439	0.278	0.020	1.74	1.72	1.89
44	46.60	25.439	0.278	0.020	1.74	1.72	1.89
45	47.34	25.439	0.278	0.020	1.74	1.72	1.89
46	48.07	25.439	0.278	0.020	1.74	1.72	1.89
47	48.80	25.439	0.278	0.020	1.74	1.72	1.89
48	49.53	25.439	0.278	0.020	1.74	1.72	1.89
49	50.26	25.439	0.278	0.020	1.74	1.72	1.89
50	50.99	25.439	0.278	0.020	1.74	1.72	1.89
51	51.72	25.439	0.278	0.020	1.74	1.72	1.89
52	52.45	25.439	0.278	0.020	1.74	1.72	1.89
53	53.18	25.439	0.278	0.020	1.74	1.72	1.89
54	53.90	25.439	0.278	0.020	1.74	1.72	1.89
55	54.63	25.439	0.278	0.020	1.74	1.72	1.89
56	55.35	25.439	0.278	0.020	1.74	1.72	1.89
57	56.16	30.527	0.334	0.024	2.09	2.06	2.27
58	56.97	30.527	0.334	0.024	2.09	2.06	2.27
59	57.78	30.527	0.334	0.024	2.09	2.06	2.27
60	58.59	30.527	0.334	0.024	2.09	2.06	2.27
61	59.39	30.527	0.334	0.024	2.09	2.06	2.27
62	60.20	30.527	0.334	0.024	2.09	2.06	2.27
63	61.00	30.527	0.334	0.024	2.09	2.06	2.27
64	61.80	30.527	0.334	0.024	2.09	2.06	2.27
65	62.60	30.527	0.334	0.024	2.09	2.06	2.27
66	63.40	30.527	0.334	0.024	2.09	2.06	2.27
67	64.19	30.527	0.334	0.024	2.09	2.06	2.27
68	64.99	30.527	0.334	0.024	2.09	2.06	2.27
69	65.78	30.527	0.334	0.024	2.09	2.06	2.27

70	66.61	33.071	0.362	0.026	2.26	2.23	2.45
71	67.44	33.071	0.362	0.026	2.26	2.23	2.45
72	68.27	33.071	0.362	0.026	2.26	2.23	2.45
73	69.10	33.071	0.362	0.026	2.26	2.23	2.45
74	69.93	33.071	0.362	0.026	2.26	2.23	2.45
75	70.75	33.071	0.317	0.018	2.26	2.23	2.45
76	71.58	33.071	0.317	0.018	2.26	2.23	2.45
77	72.41	33.071	0.317	0.018	2.26	2.23	2.45
78	73.24	33.071	0.317	0.018	2.26	2.23	2.45
79	74.06	33.071	0.317	0.018	2.26	2.23	2.45
80	74.88	33.071	0.317	0.018	2.26	2.23	2.45
81	75.70	33.071	0.317	0.018	2.26	2.23	2.45
82	76.56	35.615	0.341	0.019	2.44	2.40	2.64
83	77.42	35.615	0.341	0.019	2.44	2.40	2.64
84	78.28	35.615	0.341	0.019	2.44	2.40	2.64
85	79.13	35.615	0.341	0.019	2.44	2.40	2.64
86	79.98	35.615	0.341	0.019	2.44	2.40	2.64
87	80.83	35.615	0.341	0.019	2.44	2.40	2.64
88	81.68	35.615	0.341	0.019	2.44	2.40	2.64
89	82.52	35.615	0.341	0.019	2.44	2.40	2.64
90	83.36	35.615	0.341	0.019	2.44	2.40	2.64
91	84.20	35.615	0.341	0.019	2.44	2.40	2.64
92	85.03	35.615	0.341	0.019	2.44	2.40	2.64
93	85.89	36.887	0.353	0.020	2.52	2.49	2.74
94	86.74	36.887	0.353	0.020	2.52	2.49	2.74
95	87.59	36.887	0.353	0.020	2.52	2.49	2.74
96	88.43	36.887	0.353	0.020	2.52	2.49	2.74
97	89.28	36.887	0.353	0.020	2.52	2.49	2.74
98	90.12	36.887	0.353	0.020	2.52	2.49	2.74
99	90.95	36.887	0.353	0.020	2.52	2.49	2.74
100	91.78	36.887	0.353	0.020	2.52	2.49	2.74
101	92.62	36.887	0.353	0.020	2.52	2.49	2.74
102	93.44	36.887	0.353	0.020	2.52	2.49	2.74
103	94.27	36.887	0.353	0.020	2.52	2.49	2.74
104	95.09	36.887	0.353	0.020	2.52	2.49	2.74
105	95.93	38.159	0.365	0.021	2.61	2.57	2.83
106	96.77	38.159	0.365	0.021	2.61	2.57	2.83
107	97.60	38.159	0.365	0.021	2.61	2.57	2.83
108	98.43	38.159	0.365	0.021	2.61	2.57	2.83
109	99.26	38.159	0.365	0.021	2.61	2.57	2.83
110	100.08	38.159	0.365	0.021	2.61	2.57	2.83
111	100.90	38.159	0.365	0.021	2.61	2.57	2.83

112	101.72	38.159	0.365	0.021	2.61	2.57	2.83
113	102.54	38.159	0.365	0.021	2.61	2.57	2.83
114	103.35	38.159	0.365	0.021	2.61	2.57	2.83
115	104.16	38.159	0.365	0.021	2.61	2.57	2.83
116	104.96	38.159	0.365	0.021	2.61	2.57	2.83
117	105.76	38.159	0.365	0.021	2.61	2.57	2.83
118	106.58	39.431	0.378	0.021	2.70	2.66	2.93
119	107.40	39.431	0.378	0.021	2.70	2.66	2.93
120	108.22	39.431	0.378	0.021	2.70	2.66	2.93
121	109.03	39.431	0.378	0.021	2.70	2.66	2.93
122	109.83	39.431	0.378	0.021	2.70	2.66	2.93
123	110.64	39.431	0.378	0.021	2.70	2.66	2.93
124	111.44	39.431	0.378	0.021	2.70	2.66	2.93
125	112.24	39.431	0.378	0.021	2.70	2.66	2.93
126	113.03	39.431	0.378	0.021	2.70	2.66	2.93
127	113.82	39.431	0.378	0.021	2.70	2.66	2.93
128	114.61	39.431	0.378	0.021	2.70	2.66	2.93
129	115.39	39.431	0.378	0.021	2.70	2.66	2.93
130	116.19	40.703	0.390	0.022	2.78	2.75	3.02
131	116.99	40.703	0.390	0.022	2.78	2.75	3.02
132	117.79	40.703	0.390	0.022	2.78	2.75	3.02
133	118.58	40.703	0.390	0.022	2.78	2.75	3.02
134	119.37	40.703	0.390	0.022	2.78	2.75	3.02
135	120.16	40.703	0.390	0.022	2.78	2.75	3.02
136	120.94	40.703	0.390	0.022	2.78	2.75	3.02
137	121.72	40.703	0.390	0.022	2.78	2.75	3.02
138	122.49	40.703	0.390	0.022	2.78	2.75	3.02
139	123.27	40.703	0.390	0.022	2.78	2.75	3.02
140	124.04	40.703	0.390	0.022	2.78	2.75	3.02
141	124.80	40.703	0.390	0.022	2.78	2.75	3.02
142	125.56	40.703	0.390	0.022	2.78	2.75	3.02
143	126.32	40.703	0.390	0.022	2.78	2.75	3.02
144	127.08	40.703	0.390	0.022	2.78	2.75	3.02
145	127.83	40.703	0.390	0.022	2.78	2.75	3.02
146	128.58	40.703	0.390	0.022	2.78	2.75	3.02
147	129.32	40.703	0.390	0.022	2.78	2.75	3.02
148	130.07	40.703	0.390	0.022	2.78	2.75	3.02
149	130.80	40.703	0.390	0.022	2.78	2.75	3.02
150	131.54	40.703	0.390	0.022	2.78	2.75	3.02
151	132.27	40.703	0.390	0.022	2.78	2.75	3.02
152	133.00	40.703	0.390	0.022	2.78	2.75	3.02
153	133.72	40.703	0.390	0.022	2.78	2.75	3.02

154	134.45	40.703	0.390	0.022	2.78	2.75	3.02
155	135.17	40.703	0.390	0.022	2.78	2.75	3.02
156	135.88	40.703	0.390	0.022	2.78	2.75	3.02
157	136.59	40.703	0.390	0.022	2.78	2.75	3.02
158	137.30	40.703	0.390	0.022	2.78	2.75	3.02
159	138.01	40.703	0.390	0.022	2.78	2.75	3.02
160	138.71	40.703	0.390	0.022	2.78	2.75	3.02
161	139.41	40.703	0.390	0.022	2.78	2.75	3.02
162	140.10	40.703	0.390	0.022	2.78	2.75	3.02
163	140.80	40.703	0.390	0.022	2.78	2.75	3.02
164	141.49	40.703	0.390	0.022	2.78	2.75	3.02
165	142.17	40.703	0.390	0.022	2.78	2.75	3.02
166	142.86	40.703	0.390	0.022	2.78	2.75	3.02
167	143.54	40.703	0.390	0.022	2.78	2.75	3.02
168	144.21	40.703	0.390	0.022	2.78	2.75	3.02
169	144.89	40.703	0.390	0.022	2.78	2.75	3.02
170	145.56	40.703	0.390	0.022	2.78	2.75	3.02
171	146.22	40.703	0.390	0.022	2.78	2.75	3.02
172	146.89	40.703	0.390	0.022	2.78	2.75	3.02
173	147.55	40.703	0.390	0.022	2.78	2.75	3.02
174	148.21	40.703	0.390	0.022	2.78	2.75	3.02
175	148.86	40.703	0.390	0.022	2.78	2.75	3.02
176	149.51	40.703	0.390	0.022	2.78	2.75	3.02
177	150.16	40.703	0.390	0.022	2.78	2.75	3.02
178	150.81	40.703	0.390	0.022	2.78	2.75	3.02
179	151.45	40.703	0.390	0.022	2.78	2.75	3.02
180	152.09	40.703	0.390	0.022	2.78	2.75	3.02
181	152.73	40.703	0.390	0.022	2.78	2.75	3.02
182	153.36	40.703	0.390	0.022	2.78	2.75	3.02
183	153.99	40.703	0.390	0.022	2.78	2.75	3.02
184	154.62	40.703	0.390	0.022	2.78	2.75	3.02
185	155.25	40.703	0.390	0.022	2.78	2.75	3.02
186	155.87	40.703	0.390	0.022	2.78	2.75	3.02
187	156.49	40.703	0.390	0.022	2.78	2.75	3.02
188	157.11	40.703	0.390	0.022	2.78	2.75	3.02
189	157.72	40.703	0.390	0.022	2.78	2.75	3.02
190	158.33	40.703	0.390	0.022	2.78	2.75	3.02
191	158.94	40.703	0.390	0.022	2.78	2.75	3.02
192	159.55	40.703	0.390	0.022	2.78	2.75	3.02
193	160.15	40.703	0.390	0.022	2.78	2.75	3.02
194	160.75	40.703	0.390	0.022	2.78	2.75	3.02
195	161.34	40.703	0.390	0.022	2.78	2.75	3.02

196	161.94	40.703	0.390	0.022	2.78	2.75	3.02
197	162.53	40.703	0.390	0.022	2.78	2.75	3.02
198	163.12	40.703	0.390	0.022	2.78	2.75	3.02
199	163.71	40.703	0.390	0.022	2.78	2.75	3.02
200	164.29	40.703	0.390	0.022	2.78	2.75	3.02
201	164.87	40.703	0.390	0.022	2.78	2.75	3.02
202	165.45	40.703	0.390	0.022	2.78	2.75	3.02
203	166.02	40.703	0.390	0.022	2.78	2.75	3.02
204	166.60	40.703	0.390	0.022	2.78	2.75	3.02
205	167.17	40.703	0.390	0.022	2.78	2.75	3.02
206	167.73	40.703	0.390	0.022	2.78	2.75	3.02
207	168.30	40.703	0.390	0.022	2.78	2.75	3.02
208	168.86	40.703	0.390	0.022	2.78	2.75	3.02
209	169.42	40.703	0.390	0.022	2.78	2.75	3.02
210	169.98	40.703	0.390	0.022	2.78	2.75	3.02

XLAW = live weight

XDUF = day of fattening period

ENMP = requirement of energy

CRPR = requirement of crude protein

LISI = requirement of lysine

DRMA = requirement of dry matter

DRMIN = min. intake of dry matter

DRMAX = max intake of dry matter

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