

How to make a future SUPER COW. 如何創造未來「超級乳牛」



The Calf - The future dairy cow

小牛—未來的乳牛

- Healthy calves → higher milk yield in 1st lactation

健康的仔牛 → 第一個泌乳期的牛奶產量更高

- High growth in the calf period is associated with reduced age at calving and higher milk yield in future lactation.

犢牛期的快速成長與產犢年齡的降低和未來泌乳期牛奶產量的增加有關。

- A healthy calf can grow 1500g in one day, a sick calf does not grow.

一頭健康的小牛一天能增重1.5公斤，然而生病的小牛不會成長。



High growth gives higher milk yield

大幅度增長可以提高牛乳產量

A large US study with nearly 800 calves showed that a milk feeding strategy that doubles the calf's birth weight at 4-5 weeks of age means more milk in 1st lactation compared to one traditional American calf, which grows 3-500 g / day in the milk feeding period.

美國一項近800頭犢牛的大型研究顯示，與一頭傳統美國小牛相比，他們嘗試一種泌乳策略—在4-5週齡時使小牛體重達到出生重的一倍，進而在第一次泌乳時得到更多的牛奶，意味著在哺乳期每天增加0.3-0.5公斤。

The increase in performance is calculated for just over 100 kg of milk in the first lactation for each increase of 100 g / day in the calf's growth before weaning. The interesting thing is also that approx. half of this effect is maintained in the second lactation. There is much that suggest that the high level of milk feeding in the very first weeks gives this effect.

斷奶前的小牛每天增重 0.1公斤，可計算為在第一次泌乳期增加超過100公斤牛奶的性能表現。有趣的是，這種效應大約在第二個泌乳期仍能維持一半的效果。很多跡象顯示，仔牛出生後早期幾週餵飼高量牛奶可以達到這種效果。

Khan, M.A., D.M. Weary & M.A.G. von Keyserlingk. 2011. Invited review: Effects of milk ration on solid feed intake, weaning, and performance in dairy heifers. Journal of Dairy Science 94:1071-1081

Diarrhea cost yield in 1st lactation

腹瀉將減少第一次泌乳的產量

- A study from Sweden shows that, cows, who had diarrhea as a calf, gave **344 kg ECM** less in first lactation than cows that wasn't sick as calf.

瑞典一項研究顯示，在小牛時期下痢而長大的母牛，在第一個泌乳期的能量校正乳量（ECM）比沒下痢的母牛減少 344 公斤。

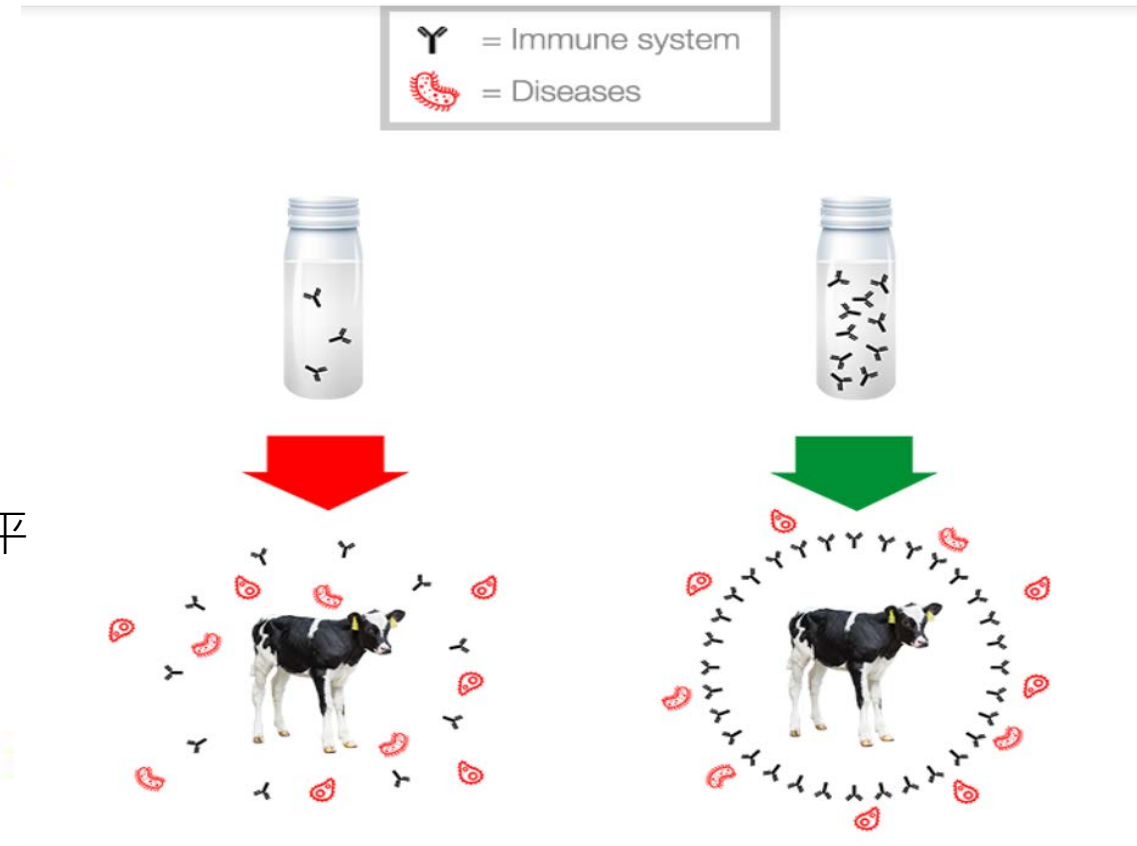
Svensson, C. & Hultgren, J., 2008. Associations between housing, management and morbidity during rearing and subsequent first-lactation milk production of dairy cows in southwest Sweden. J. Dairy Sc.91:1510-1518.

The healthy calf 健康的小牛

- Good colostrum management
良好的初乳管理
- Correct milk feeding
正確餵奶
- Good weaning strategy
良好的斷奶策略
- Housing
小牛住處
- Feeding
餵食



The calfs immune system 小牛的免疫系統



Colostrum amount 初乳量

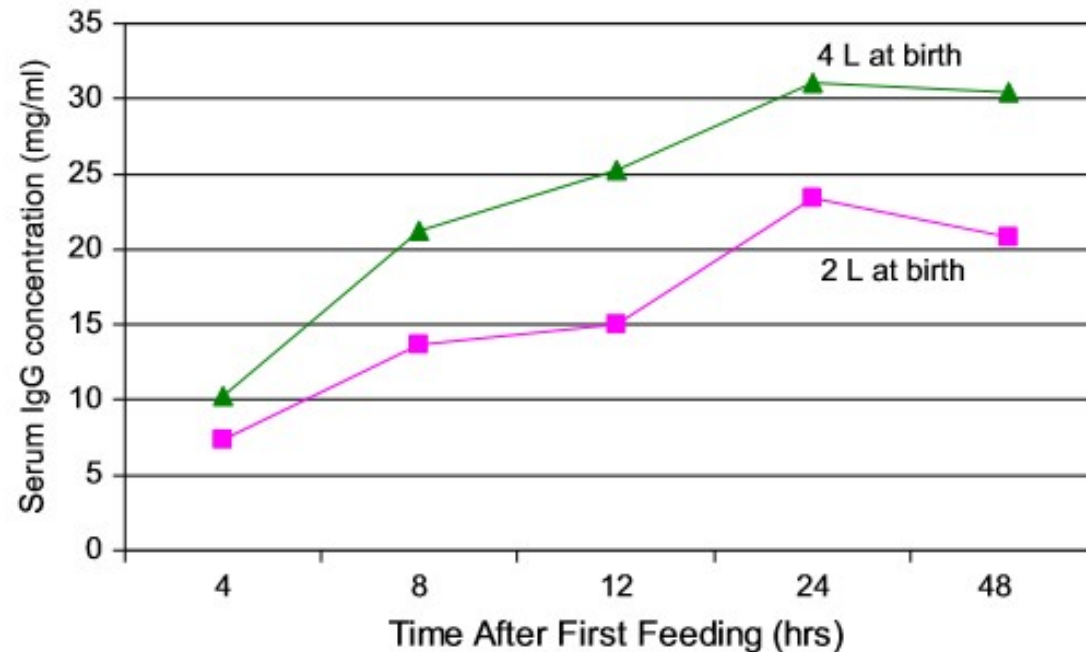
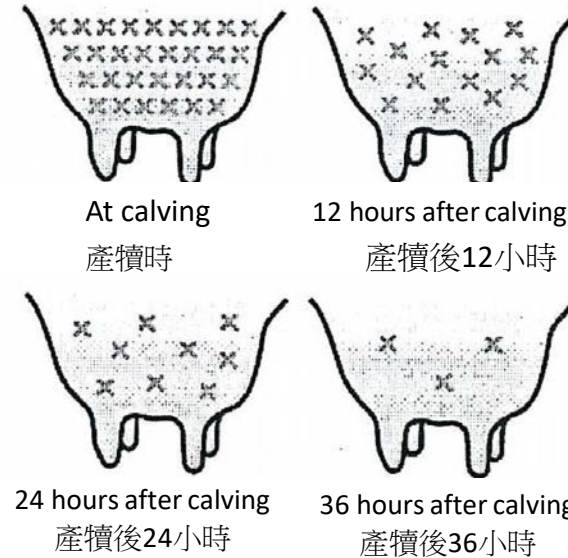


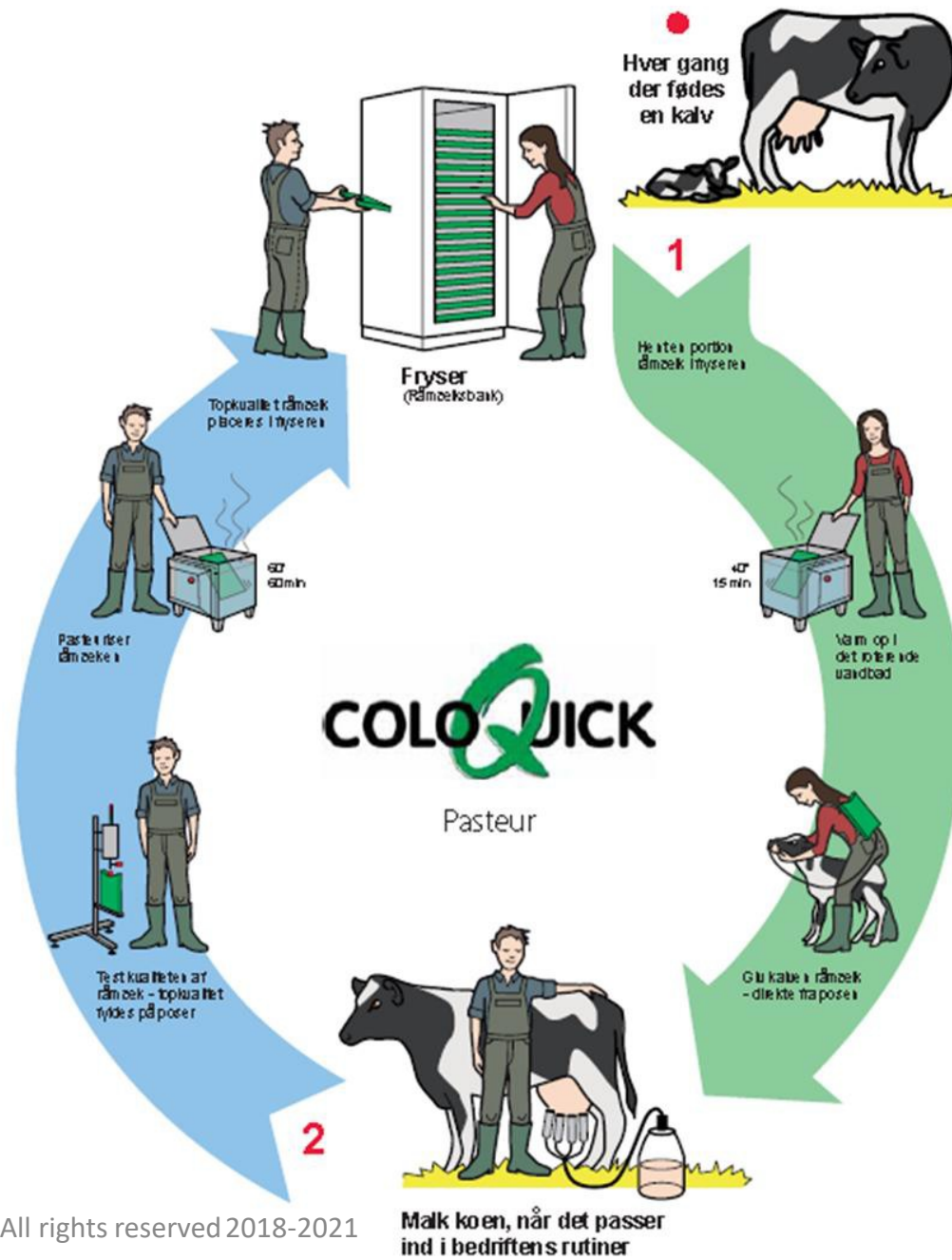
Fig. 2. Serum IgG concentrations in calves fed either 4 L or 2 L of colostrum at birth (all calves were fed an additional 2 L of colostrum at 12 hours of age). (Data from Morin DE, McCoy GC, Hurley WL. Effects of quality, quantity, and timing of colostrum feeding and addition of a dried colostrum supplement on immunoglobulin G1 absorption in Holstein bull calves. J Dairy Sci 1997;80:747-53.)

Antibodies in colostrum 初乳中的抗體

TABLE 1 Typical analysis of colostrum, transitional milk and whole milk from Holsteins

Component	Milking number			
	1	2	3	11
	Colostrum	Transitional milk		Whole milk
Total solid (%)	23.9	17.9	14.1	12.5
Fat (%)	6.7	5.4	3.9	3.9
Protein (%)	14.0	8.4	5.1	3.1
Antibodies (%)	6.0	4.2	2.4	0.09
Lactose (%)	2.7	3.9	4.4	4.9
Minerals (%)	1.11	0.95	0.87	0.74
Vitamin A (ug/dL)	295	190	113	34
Calories cal/L	1,520			570





Milk feeding 餵奶

- Milk from cow's 母牛的牛乳
 - Milk with Antibiotic 含抗生素的牛乳
 - High SCC (somatic cell count) 高細胞數
 - Bad quality colostrum 品質差的初乳
- Good quality milk powder 高品質的奶粉
 - Be careful with whey based milk replacer 使用以乳清為基礎的代乳品要特別小心



Milk amount 牛乳多寡

Large amounts of milk give the calves a good start with high growth in the milk period and with a two-stage milk feeding strategy, the calves can get large amounts of milk and yet achieve a high concentration of concentrate and gain after weaning. The strategy implies that the calves must be fed on two milk levels - a high level at the beginning of the milk period and a moderate at the end of the milk period.

大量的牛奶為小牛提供了良好的基礎，在奶牛時期迅速成長，並且如果採用兩階段的牛奶餵養策略，小牛可以獲得大量的牛奶，而在斷奶後仍能獲得高濃度的精料和增重。該策略意味著，犢牛必須以兩種牛奶量來餵養—剛開始時餵飼較乳量，而在結束時期給予適度乳量。

Recommendation 推薦:

- 0-4 週齡 weeks: 8-10 公升 liters of milk per day calf per day (每天/每隻小牛)
- 5-7 週齡 weeks: 5-6 公升 liters per day calf per day (每天/每隻小牛)
- Gradual change from high to moderate milk volume, 從多到中等的牛奶量逐漸減少
e.g. with 1 liter per liter. Day
- Only one milk feeding the last week before weaning. 斷奶前最後一週只餵一次奶

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Milk feeding 餵奶



Feeding 飼養

- High quality calf starter 高品質的仔牛教槽料
/concentrate ad libitum 精料任食
- Hay or straw ad libitum 乾草、稻草任食
 - To develop and utilize the rumen 為了發育與利用瘤胃
- Water ad libitum 飲水任飲
- Milk - 2 times a day 每天餵乳2次



So take care of the calf, because it
might be the future SUPER COW.

因此，要照顧好小牛，他們未來可能成為「超級乳牛」



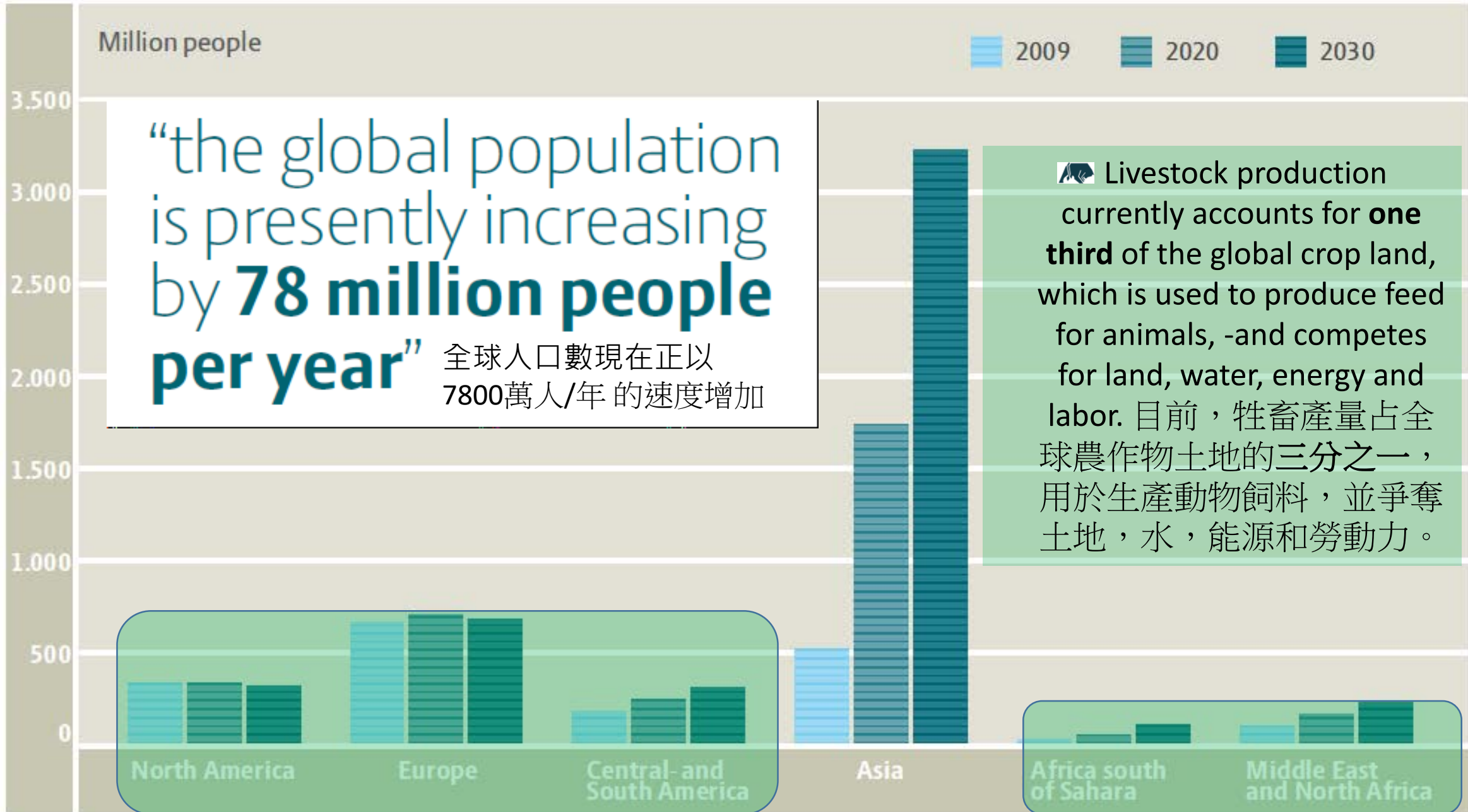
SUSTAINABLE SUPER COW ?

可維持的「超級乳牛」？



 Agriculture related
與農業相關的

Figure 2 – Middle-class population increases 2009-2030



 **HOW TO SECURE NEXT GENERATION OF MEAT/MILK PRODUCERS ?**

如何確保下一代肉類及奶製品的生產者？

 **WHAT KIND OF LEGISLATION CAN BE EXPECTED ?**

可以進行什麼樣的立法？

 **ENVIRONMENTAL IMPACT (AIR, WATER & SOIL)**

環境影響（空氣、水、土壤）

 **GLOBAL CONTEXT, CARBON FOOTPRINT ETC.** 全球背景、碳足跡等

 **ENERGY CONSUMPTION > / < PRODUCTION** 能源消耗與生產

RESPONSE-INDUCING SUSTAINABILITY EVALUATION

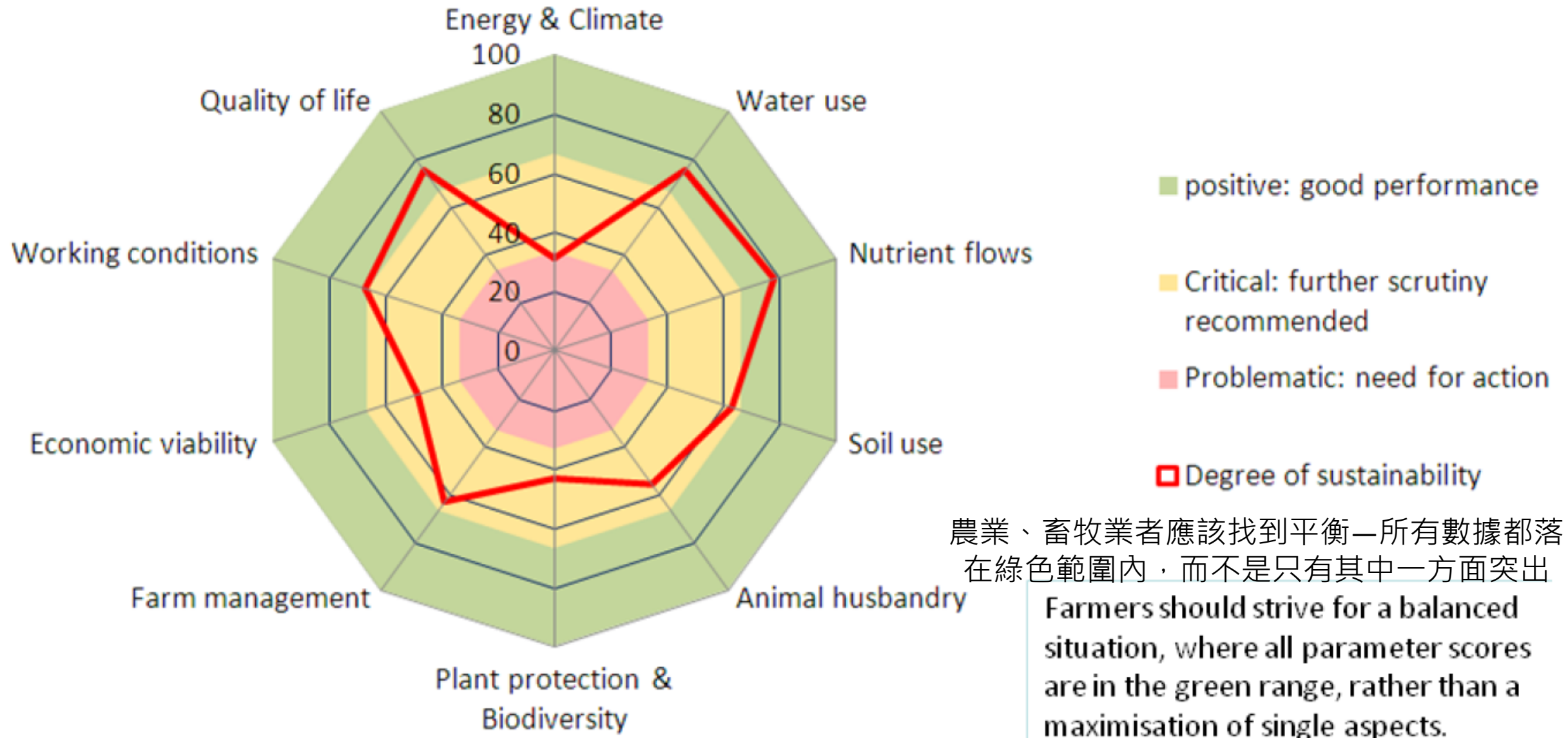


Figure 2. The RISE 2.0 sustainability polygon.

Loss of nutrients in modern Agriculture 現代農業中的營養流失



氨 Ammonia NH_3

甲烷 Methane CH_4

FAECES
糞便

CH_4 &
URINE 尿液

Runoff / immobilized
Phosphor 徑流/固定磷

硝酸鹽 Nitrates NO_3^-

- Spices, garlic oregano, etc. and also seaweed
Reduces Methane prod. 香料，大蒜奧勒岡以及紫菜可減少甲烷產生。
- Feed components, especially fat 飼料成分，尤其是脂肪
- Strategy, 策略
- TMR, mix, TMR、完全混合日糧
- Fibre content, and feed value. 纖維含量、飼料價值
- Design of stable and manure system 穩定和肥料系統的設計



EFFLUENTS 廢液

(GREY WATER) FROM 灰水來源

THE EUROPEAN UNION
The European Social Fund



THE EUROPEAN UNION
The European Regional
Development Fund



Investing in your future




- FARMYARDS 農場
- SILOS / STORAGEES 存儲
- ALL CONCRETE SURFACES 所有混凝土表面



ORGANIC WASTE FERTILIZER

有機廢物—肥料

COW BARN
牛舍

-  MINIMUM 9 MONTHS CAPACITY 至少9個月容量
-  COVERED TO AVOID EVAPORATION 覆蓋避免蒸發
-  COVERED TO AVOID RAINWATER 覆蓋避免雨水

SLURRY TANK 淤泥罐



FARM EFFLUENTS ARE VALUABLE 農場廢水很有價值
“SLURRY IS GOLD” 「糞泥是黃金」

Slurry application – Harbin/China 2016
糞泥應用—哈爾濱（中國）2016



Dribble bar application

Dribble bar application
滴流管應用

Late application in maize/corn no problem.
– Can boost growth
玉米後期施用沒有問題—可促進增長



BAT - BEST APPLIED TECHNOLOGY

最佳應用技術

Actions to reduce loss 減少損失的措施:

- Design of stable / housing system

穩定牛舍系統設計:

- manure cooling 糞肥冷卻
- acid treatment 酸處理
- air purification 空氣淨化
- scrapers on slatted floors 板條地板上固定的刮板
- solid floors 堅固的地板

- Storage of manure 糞便儲存:

- covered slurry tank 加蓋的糞泥槽
- slurry separation (mechanic, centrifugation, chemical precipitation) 糞泥分離（機械、離心、化學沈澱）
- **BIOGAS** 生物燃氣



BIOGAS POTENTIAL 生物燃氣的潛力



1 COW = 1 Liter of diesel / day

	BIOGAS /TON BIOMASS M³	EQUAL TO LITERS OF DIESEL
SLURRY – PIG	20-30	12-17
SLURRY –CATTLE	20-30	12-17
FIBER FRACTION	70-90	40-55
POULTRY MANURE	135-150	80-90
MAIZE SILAGE	90-100	55-60
SLAUGHTERHOUSE WASTE (Intestine)	40-60	25-35