Establishing a dedicated retailer-producer dairy supply chain in the Netherlands

A report requested by Netwerk GRONDig, Living Lab Fryslan and Milieudefensie, that specifically addresses the principles of:

Cost of Production linked milk pricing models

Farm sustainability standards

Blockchain technology platform

Final (amended) report

18th December 2019

Introduction

- The following report sets out the work undertaken in relation to the issues highlighted in the project proposal concerned with the establishment of a direct producer to retailer sustainable "Houdbare" milk supply chain in the Netherlands.

- Specifically the work addresses:
  - A payment model (potentially based on a cost of production approach)
  - The programme of farm standards
  - The use of Blockchain technology to provide the underpinning management platform

- The report addresses each of these aspects in depth, examining the principles and key concerns, taking an overview of the broader issues surrounding the effective and successful establishment of a direct supply group, before examining the specifics associated with the Houdbare Milk proposition.

- The draft material was presented to Diana Saamans and Louise van der Linden representing the Project Group (Netwerk GRONDig; Milieudefensie; Living Lab Fryslan) on 10th October 2019 and amended to accommodate a few immediate reflections following that meeting, and then further developed, notably to address the specific application of the described approach to the situation described by Netwerk Grondig and to accommodate further feedback in early December 2019.

- All of these amendments have been included in the following, final report.

Executive Summary

The report details:

- The considerable value that a dedicated producer / retailer milk supply chain can deliver to consumers and key stakeholders. The benefits (including stable milk prices, security of supply, brand protection and enhancement and a stronger consumer proposition), together with the challenges of managing such a group or relationship, are all examined.
- The essential importance of clearly defining each scheme component and ensuring excellent scheme governance – and how this can be delivered - are explored in depth.
- The Cost of Production pricing model, which is discussed in relation to alternative pricing models, then is explored via the 9 key questions that need to be addressed in configuring a successful CoP approach.
- The CoP implications for the Houdbare milk scheme, concluding with a recommendation for a budget-based CoP model, providing (a) that this approach will generate a competitive and compelling milk price and (b) that physical data for the participating farms will always be available.
- The Houdbare farm standards, analysing each of the component criteria and exploring their practicality and suitability for a standards scheme, and concluding with a recommendation for a staged "additional premium" payment for farms meeting and exceeding the defined standards.
- The linkage between the CoP model and the Houdbare standards, examining how the costs of scheme compliance could be met, and importantly the essential interaction between the two if meeting and exceeding the required standards is to be achieved.
- The role of Blockchain technology in providing the data recording and management platform for the proposed scheme – concluding that Blockchain is an appropriate, if not essential, technology and one that should be adopted, because of the current and potential advantages it will bring, but only if warranted by the size, value and complexity of the scheme.

Recommendations / next steps for the Houdbare milk scheme

Further to the comments in the Executive Summary above, the recommended next steps for the proposed Houdbare milk scheme developments would be to:

1. Understand the demand and level of interest from retailers as potential "drivers" of this scheme. The fundamental question - is there a retailer (or potentially a milk processor) that wants to fund a CoP model for a discreet group of farmers, producing milk to Houdbare standards?
2. Assuming there is, and there is therefore sufficient interest to justify the further development of the scheme, then the detail of its two fundamental components, the Houdbare Standards and the CoP model, need to be definitively established. In effect there are two parallel "product development and launch" projects that are required. Specifically, this means finalising for:

(a) The Cost of Production Model

The model itself, including:

- All farms or a representative sample of farms
- Budget or historic methodology
- Confirmation of cost categories
- Linkage (or not) to a premium for attaining the Houdbare Standards

Logistics and implementation

- Process for budgeting (who does it, when, what accounting system, who collects and supplies the data)
- Sources of industry costs data
- Audit and validation
- Communication of milk price changes
- Governance of the process

Recommendations / next steps for the Houdbare milk scheme

(b) The Houdbare Milk standards

The Standards themselves, including
- Finalisation of the categories and the measurement criteria
- Specification of the premia that might be paid (in addition to the CoP price) for attaining specified target levels of performance

Logistics and implementation
- The data submission process (when, what IT platform)
- Communication, roll-out, training, support
- On-farm audit process (by whom, when)
- Collection and collation of data

Further detailed recommendation are given in the relevant sections in the report:
- Cost of Production model: Slide 2.4.7
- Houdbare Standards: Slide 3.6.2

Promar's further recommendation for both aspects of the project is that a pilot study be carried out to properly test both farmer and retailer responses as well as the practicalities and logistics of the scheme. Although this incurs additional time and cost and delays the roll-out of the programme, it would greatly increase the likelihood of the programme being accepted and effective. This is evidenced by the UK experience, where many such retailer schemes have taken at 3-5 years to be accepted and to iron-out many of the initial weaknesses or failings – many of which could have been avoided if a thorough pilot study had been undertaken.

Report contents

1. Overview
    1. Purpose, benefits, objectives, challenges
    2. Characteristics of a successful retailer-led dairy supply chain
    3. Assessment of UK retailers in this regard
    4. Governance and management
2. Cost of Production
    1. Principles and model options
    2. Key components and questions regarding a CoP approach
    3. UK CoP model illustration
    4. Assessment of Netherlands costings – applicability for CoP model
3. Farm standards
    1. Overview
    2. UK dairy supply chain standards assessment
    3. UK dairy supply chain development illustrations
    4. Fundamentals of a successful dairy sustainability scheme
    5. Assessment of Houdbare milk scheme
    6. Summary and recommendations
4. Blockchain as a possible platform for a retailer – producer dairy supply chain
    1. Overview of Blockchain; uses and advantages in food supply chains; barriers to use
    2. 8 steps to establish a Blockchain network
    3. Network and provider examples; set-up and transaction costs
    4. Blockchain analysis and solution for the proposed retailer – supplier supply chain
    5. Summary and recommendations

1. Overview

1. Overview

Tasks as defined in the Proposal:

- Outline of the purpose, objectives, benefits and challenges associated with a direct aligned Retailer – Producer relationship
- Clarify the role and importance of: key stakeholders, governance, management, visibility, credibility, ownership of the models, ownership of data, data confidentiality, review periods and processes, access to and use of outputs
- Examine the relationship between the CoP milk price and attainment of expected standards
- Discussion of the Retailer-Processor-Producer relationship and the alternative Retailer-Producer direct relationship, in association with a "toll processor".

Report contents 1 - Overview

1. **Overview**
    1. **Purpose, benefits, objectives, challenges**
    2. **Characteristics of a successful retailer-led dairy supply chain**
    3. **Assessment of UK retailers in this regard**
    4. **Governance and management**
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    2. Key components and questions regarding a CoP approach
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    5. Summary and recommendations

Summary of the purpose, benefits, objectives, risks and challenges associated with a direct aligned Retailer–Producer relationship

Benefits

- Long-term security of supply
- Predictability of supply
- Protect and enhance brand reputation
- Predict and manage milk purchasing costs
- Build effective supply chain relationships with producers and processors
- Meet CSR requirements
- Establish competitive advantage
- Farmer confidence to invest and improve

Objectives

- Creation of industry-leading standards, refined and improved over time
- Consistent, predictable delivery against those standards by producers
- Ensure year-on-year improvement in on-farm and supply chain performance
- Visibility and insight provided through robust data
- Efficient functioning of the group

Risks

- Perceived negativity or wider industry antagonism created as a result of "haves and have nots"
- Increased costs (higher milk price and service costs) not matched by benefits delivered
- Lack of engagement by producers not "buying into" the retailer strategy and philosophy
- Unintended consequences

Challenges

- Balancing management cost and effort with beneficial outcomes
- Establishment of effective governance and managing stakeholder relations
- Establishing relevant farm standards schemes and a pricing model which deliver desired outcomes
- Operational effectiveness including mechanisms for assessing, rewarding and incentivising farms and the initial selection of farms
- Milk processor relationship, addressing, physical, commercial and contractual responsibilities

1.1.1 The ability to ensure long-term security and predictability of supply

1. Although the risk of milk shortage or the inability to obtain domestic supply is and is likely to remain low in the Netherlands, being able to acquire sufficient supply of the right standard and provenance, seasonality, quality and at a known and acceptable price is key and may become more of a challenge in the future as the demographics of dairy farming and the dynamics of supply and demand change in future.

2. Establishing a direct supply groups addresses this risk and provides greater assurance and that the required quantity of milk is known, predictable and available on a daily, weekly, annual and long-term basis.

3. Farmer commitment to the group, willingness and requirement to participate in standards and quality programmes, incentivisation through a defined (premium) milk pricing model and the close working relationship between all stakeholders, significantly increase this aspect of supply security.

4. The caveats mentioned above – the milk supply being of the right standard and provenance, of the desired quality (affecting the retailer's brand) and at a known and acceptable price (affecting the retailer's margin) - provide the further reasons for establishing a direct-supply group.

1.1.2 The ability to protect and enhance brand reputation

1. Brand reputation and brand value are critical for food retailers as they are for all businesses. They are difficult to build or rebuild and are easily damaged.

2. Food supply chains – very much including dairy – are particularly exposed or vulnerable, as:
   - They can be long, complex and opaque.
   - They can involve large numbers of low-paid manual workers.
   - Their products directly and immediately impact human health.
   - They can involve the husbandry of farm animals and impact significantly on local as well as global environments.

3. As such they almost invariably have moral, ethical and political as well as technical and economic dimensions. They can be high profile and sometimes controversial business activities.

4. By exerting an element of **influence, control and responsibility** over such supply chains, and by providing as much insight and visibility as possible, the retailer can:
   - demonstrate to customers, interested stakeholders and the wider community, the high standards that apply throughout the supply chain and the benefits being delivered to people, livestock and the environment.
   - understand what change is required to ensure the supply chain develops in a manner that is consistent with the retailer's own strategy and direction and with consumer agendas.
   - work with supply chain participants to influence, assist and, if needs be, demand, supply chain improvements to ensure current and future standards and objectives are met.
   - work closely with producers and processors to foresee and pre-empt possible threats and risks.

1.1.3 The ability to predict and manage costs and margin

1. An aligned, direct supply group provides the retailer with an opportunity to establish a discreet and bespoke milk pricing model.

2. The model may be based on actual or budgeted farm costs of production, movement in key commodity or input prices, (potentially linked to a standardised farm model) or it may be linked to market milk prices but with premiums, bonuses or adjustments, but the core benefit provided by a bespoke model is the ability to encourage and reward desired behaviours and outcomes, to assist with farm recruitment and retention, and to predict, manage and influence the cost of milk purchases.

3. In addition, by establishing a supply group that has the desired characteristics (location, scale and quality), the "cost to serve" ie the milk processors costs of collection, haulage, testing and processing, can be minimised, again offering the opportunity for improved, and potentially shared, margin.

4. As such, the pricing model can bring benefits to both parties (retailer and producer) and provide the glue that holds the supply chain together.

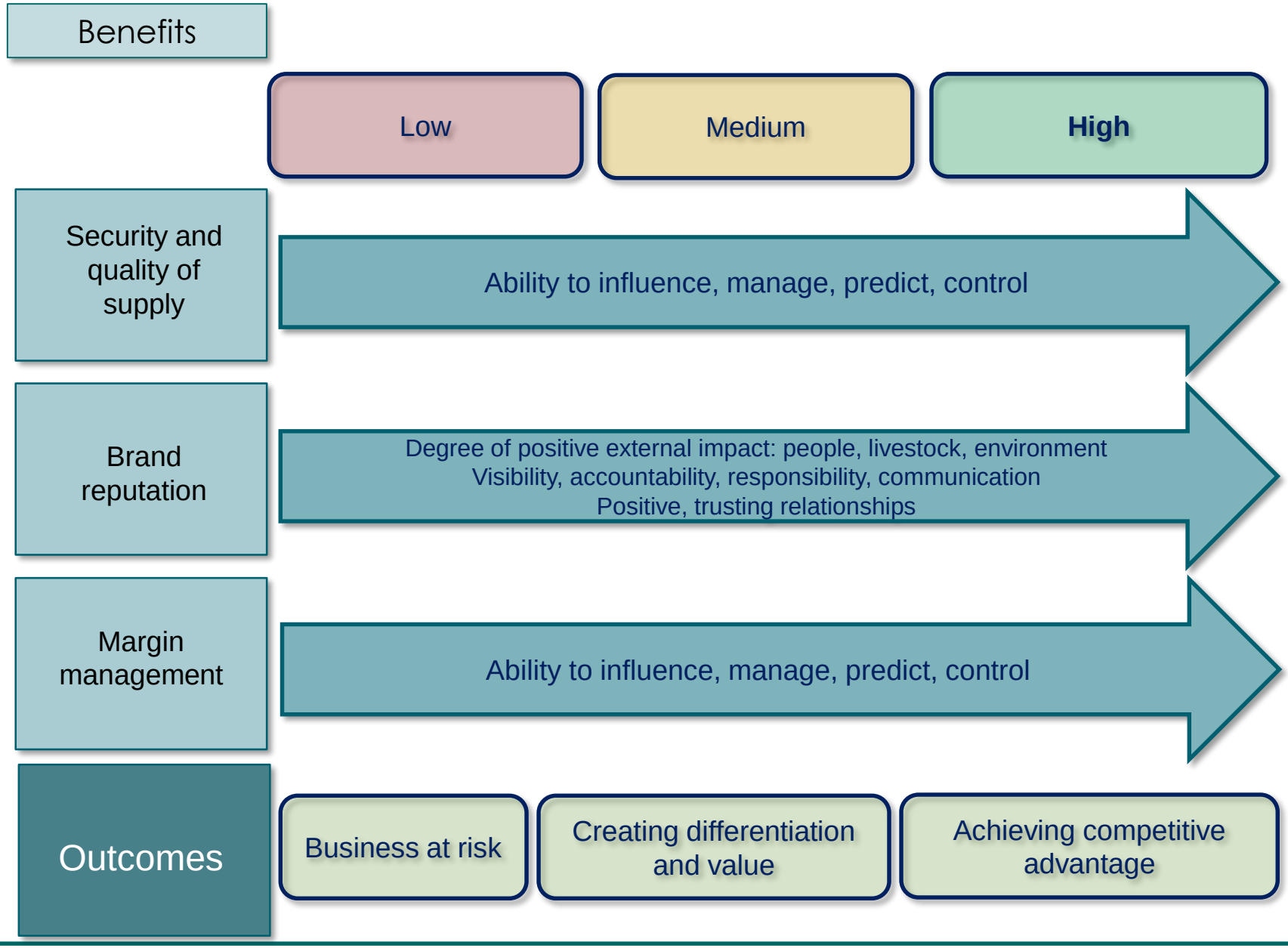
1.1 Benefits: in summary

1. In combination, the impacts on security of supply, brand reputation (and by definition, the people, livestock and environment affected by its activities) as well as the profitability of an effectively performing direct supply chain are significant and will help cement robust, long-term, trusting relationships that have the ability to drive further improvement, better and faster, in the future.

2. The establishment of farm production standards, that are subsequently met and exceeded by producers will assist the retailer comply with Corporate Social Responsibility requirements, notably being able to demonstrate "responsible sourcing" in the management of people, livestock and the environment.

3. The ability to use the beneficial impacts on supply, reputation and margin to establish and maintain competitive advantage.

4. And finally – and not inconsequentially – the confidence (on behalf of farmers) to invest that comes from participation in a defined supply scheme supported by a premium pricing mechanism (particularly the stable pricing that a CoP scheme offers). The technical support that invariably is provided by the scheme managers to assist in improving technically will deliver significant added benefits.


Benefits
Low
Medium
High
Security and quality of supply
Ability to influence, manage, predict, control
Brand reputation
Degree of positive external impact: people, livestock, environment
Visibility, accountability, responsibility, communication
Positive, trusting relationships
Margin management
Ability to influence, manage, predict, control
Outcomes
Business at risk
Creating differentiation and value
Achieving competitive advantage

1.1.4.1 Objectives

1. Having acknowledged the purpose and recognised the benefits of an aligned supply chain, establishment of measurable, actionable objectives is key, potentially including the following:

2. Creation of industry leading farm standards, refined and improved over time. These need to reflect the values and aspirations of the supply chain participants and influencers, (notably consumers), be strategic in their definition but must be measurable and practical in their application.
   - The reference to "strategic" is to emphasise that, especially in the absence of good governance, the introduction of standards that are for example, short-term in outlook, mutually contradictory, reflect individual stakeholder biases, or are difficult to measure objectively, can all too easily occur. "Group-think" and the reluctance to challenge dominant voices can result in poor decisions, the impact of which can easily undermine effective functioning of a supply group.
   - Maturity in thinking and in relationships, alongside good governance is therefore essential to ensure this situation is avoided.

3. Consistent, predictable delivery of these standards by producers
   - This is ultimately key in terms of meeting stakeholder expectations. This depends in turn on: standards which are desirable, practical, measurable and achievable; producers that are engaged and committed; incentives that encourage the right behaviours

1.1.4.2 Objectives, con't

1. Ensure year-on-year improvement in on-farm and supply chain performance
   - This requires standards which are designed in a manner which allows for and builds in continual improvement and are not just designed to ensure minimum expectations are met. There may well be a separate "Code of Practice" within the overall programme to ensure that minimum standards around key health and welfare criteria are met, but this needs to be supplemented by aspirational standards that are rewarded and incentivised.
   - Engagement with and involvement from key stakeholders in managing this process of development is essential
   - Good, robust data, allowing for analysis of outcomes and therefore making evidence-based, rather than subjective decisions is key.

2. Visibility and insight available to all relevant stakeholders provided through robust, accessible data
   - Objective, simple, easy to enter, easy to access, limited KPIs, allows for easy benchmarking, encouragement of benchmarking, real-time where possible
   - Blockchain potentially forming the data platform

3. Efficient functioning of the group
   - Good governance, simple management, high quality service providers, good communication, shared knowledge

4. Do these objectives help ensure the group is able to display the suggested 10 characteristics of an industry-leading supply chain?

1.1.5.1 Risks

1. Perceived negativity or wider industry antagonism created as a result of "haves and have nots".
   - This has been a significant issue in the UK – and continues to be. Approximately 15% of UK dairy farms are members of aligned retail supply groups with the vast majority therefore still on "processor-only" contracts and exposed to the volatility of open-market prices.
   - Processor-only contracts typically require Red Tractor production standards only which increases the brand reputational risk and provides no market differentiation.
   - The price advantage to retailer-aligned as opposed to processor only has typically been in the order of 10%-15% over the long-term.
   - This has led to an industry "exit rate" which is lower in retailer aligned groups than in processor-only whilst the level of profitability, investment and sustainability is greater.
   - The consequences for the coherence and dynamics of the dairy industry, for relationships in local communities and for wider dairy supply chains can be problematic.
2. Increased costs (higher milk price and service costs) not matched by benefits delivered.
   - This can stem from: poorly-conceived strategy and or objectives; ineffective group governance and management; lack of useful, meaningful data; a poorly structured milk pricing (cost of production) model or farm standards model.

Risks

1.1.5.2 Risks, con't

3. Lack of engagement by producers not "buying into" the retailer strategy and philosophy.
   - This is a noticeably widespread and persistent characteristic of supply groups – representing a long-term disconnect between farmers and their market / customers, along with, more specifically as far as retailer groups are concerned, poor communication throughout, the complexity of schemes and perhaps a sense of disenfranchisement – not feeling that the scheme is for them or that they can influence it.

4. Increased likelihood of unintended consequences
   - Stemming from, for example mutually incompatible production standards.
   - Insufficient review and assessment.
   - Ensuring that the milk pricing approach (especially if based on a Cost of Production model) does not simply encourage growth, continued output and higher cost systems where producing marginal litres is still economically rational but the long term sustainability of that approach is questionable

Risks

1.1.6.1 Challenges

1. Management cost and effort
   - Operating a direct supply group inevitably incurs management cost and effort. This can be significant, depending on the level of supplier engagement required, the extent of the data collected and used, the complexity of standards and pricing models, the promotional activity, the number of stakeholders and service providers involved. Evidence from UK aligned supply groups suggest that the costs and effort can be substantial – potentially precluding smaller organisations from adopting this approach – or requiring that they are very simple and lean.
   - The trade off between the value of the beneficial outcomes and the cost and effort required needs to be determined.
   - Regardless of business scale and relative costs, keeping systems, structures and processes simple is absolutely key. The natural tendency for systems to become more complex over time, is borne out by the UK experience.

2. Establishment of effective governance and the management of stakeholder relations
   - This is examined in the next section and its criticality cannot be overstated. It is probably the primary role of the retailer (assuming they are the main driver of the aligned supply chain) to build an effective, capable management and governance structure. Correctly established governance will substantially increase the likelihood of success.
   - Governance include, for example: the committee and management structures; farmer representation; the use of professional advice and guidance; the role and management of the service providers; the processes for determining and reviewing strategy, objectives and targets.

Challenges

1.1.6.2 Challenges, con't

3. Further to the governance structures, the correct initial establishment and on-going management of a number of operational issues are key, notably:

- The initial selection of appropriate farms. UK experience suggests this has been done historically on the basis of rational and efficient collection and haulage. Whilst this is understandable on behalf of the processors, in practice it often leads to the selection of inappropriate farms which then have to be removed and replaced over time. Prioritising the right farms is ultimately more important than collection efficiency. If offered a premium contract, most farms will take it, regardless of their understanding of, sharing of and compatibility with the aspirations and requirements of that grouping. The "right" farms are therefore best defined as those having an attitude and mindset that is compatible with achieving the overall supply chain's objectives and an engaged, positive approach.
- Establishing and maintaining effective and appropriate farm standards schemes and a pricing model that encourage and reward the right behaviours, are focussed on the desired outcomes, are simple to implement and measure and easy to communicate. Ensuring these two fundamental components of the aligned supply chain will work effectively, individually and together, are properly conceived and adequately tested before implementation is key.
- Integral to the standards scheme is the mechanism for assessing and rewarding performance, incentivising improvement dealing with under-achievement, including as necessary, removing farms from the group. Defining these processes to ensure they work fairly and effectively is also key.
- Clarification and definition of the role of and relationship with the milk processors to manage the physical processes associated with milk collection, haulage, testing, processing, packaging and distribution.
- Determination of commercial roles and responsibilities including payment to producers, the management of the milk production "schedule" (which defines the core farm payment structure, separate to but related to the bespoke supply chain standards scheme) and the handling of such issues as milk "balancing" (how under and over supply by the aligned producers is handled, both physically and financially).
- The efficient provision of relevant, meaningful, helpful data and insight. Often this can be lacking, untimely, untargeted, or difficult and expensive to collect and analyse. Determining the right metrics and the systems for capturing and sharing the data is critical.

Challenges

1.2.1 Summary: Requirements of a successful payment model and standards scheme

- Clarity of purpose and strategy – reflecting a clear demand and need
- Simple, practical objectives and targets
- Excellent, robust governance
- Effective, open management with simple operational systems and good data
- Regular, honest review, preparedness to change but remaining consistent where possible

1.2.2 Leading to 10 characteristics of an industry-leading dairy supply chain:

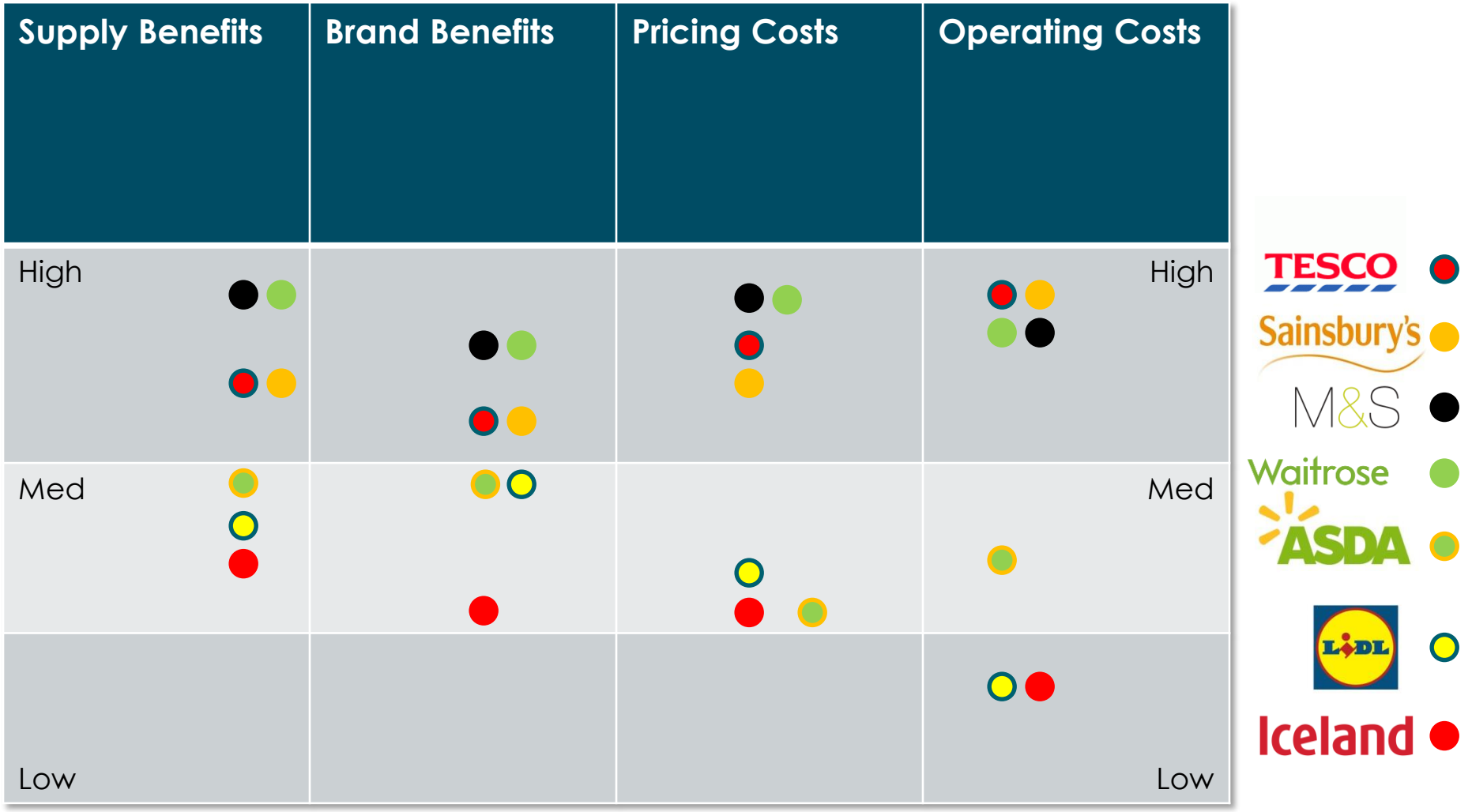
VISION Has a vision, strategy and a plan - built with and for all stakeholders	CONSUMER Puts the consumer first - recognises the imperative of meeting consumer requirements and builds them into the strategic and operational requirements as appropriate	SUSTAINABLE Is truly "sustainable". Demonstrates in all its actions that it is committed to: increasing efficiency; minimising waste; sourcing responsibly; mitigating risk and building resilience, and demonstrating environmental responsibility	PEOPLE Values people in all roles throughout the supply chain. Recognises that excellent performance requires capable, open-minded, energetic, skilled people. Encourages and supports training - technical and managerial	WELFARE Works to eliminate or minimise the key diseases and conditions that limit productivity, compromise animal welfare and pose on-going risks to animal and human health
FUTURE Is committed to R&D and the effective extension of best practice throughout its membership. Has an appetite for "continual improvement" and eye for the future	RISK Maintains a risk-based approach to supply chain management to identify key risks areas, estimate degree of exposure and adopts effective mitigation plans	BENCHMARKS Meets key critical technical parameters and benchmarks its performance: against others; against target; and within its own population	ENGAGEMENT Achieves high levels of positive member engagement, communicates actively and openly, demonstrates an inclusive approach and seeks to build shared values	DEMANDING Not accepting of poor performance or a disengaged attitude amongst suppliers

1.3.1 Comparison of UK retailer dairy supply chains

Supplier structure	Supplier relationships	Processor structure	Processor relationships	Payment mechanism
Segregated pool	Deep, engaged, agreed objectives	Multiple	Deep, engaged, agreed objectives	Cost price +
Nominated pool		Single		Fixed for period Market price + premium
None	None	None	None	Market price only

TESCO
Sainsbury's
M&S
Waitrose
ASDA
LIDL
Iceland

1.3.2 Current Outcomes for UK Retailers: costs vs benefits



1.4 Governance and management

Effective governance, trusting relationships and open communication between key stakeholders are essential for the success of retailer-processor-producer direct supply chains, but experience from the UK dairy sector suggests that this takes time to achieve and is not a "given".

Good governance will facilitate and encourage all the above by creating the right structures, environment and attitudes to allow for the:

- creation and acceptance of a shared vision
- establishment of agreed objectives
- setting of realistic targets

The appropriate governance and management structures further allow for the effective operational activity necessary to deliver the targets, objectives and strategies.

Even for well-established groups (eg Tesco, Sainsbury's, M&S, Waitrose), maintaining the effective functioning of these groups is a challenge. Changes in personnel, in the commercial priorities of the retailer, or in the wider industry environment for example, can exert pressures that can disrupt group dynamics and functioning.

A typical UK stakeholder / governance group would be made up of the following roles, carrying out their respective responsibilities, whilst the governance structure might comprise an overarching Management Committee with a subsidiary Technical and Standards committee reporting to it.

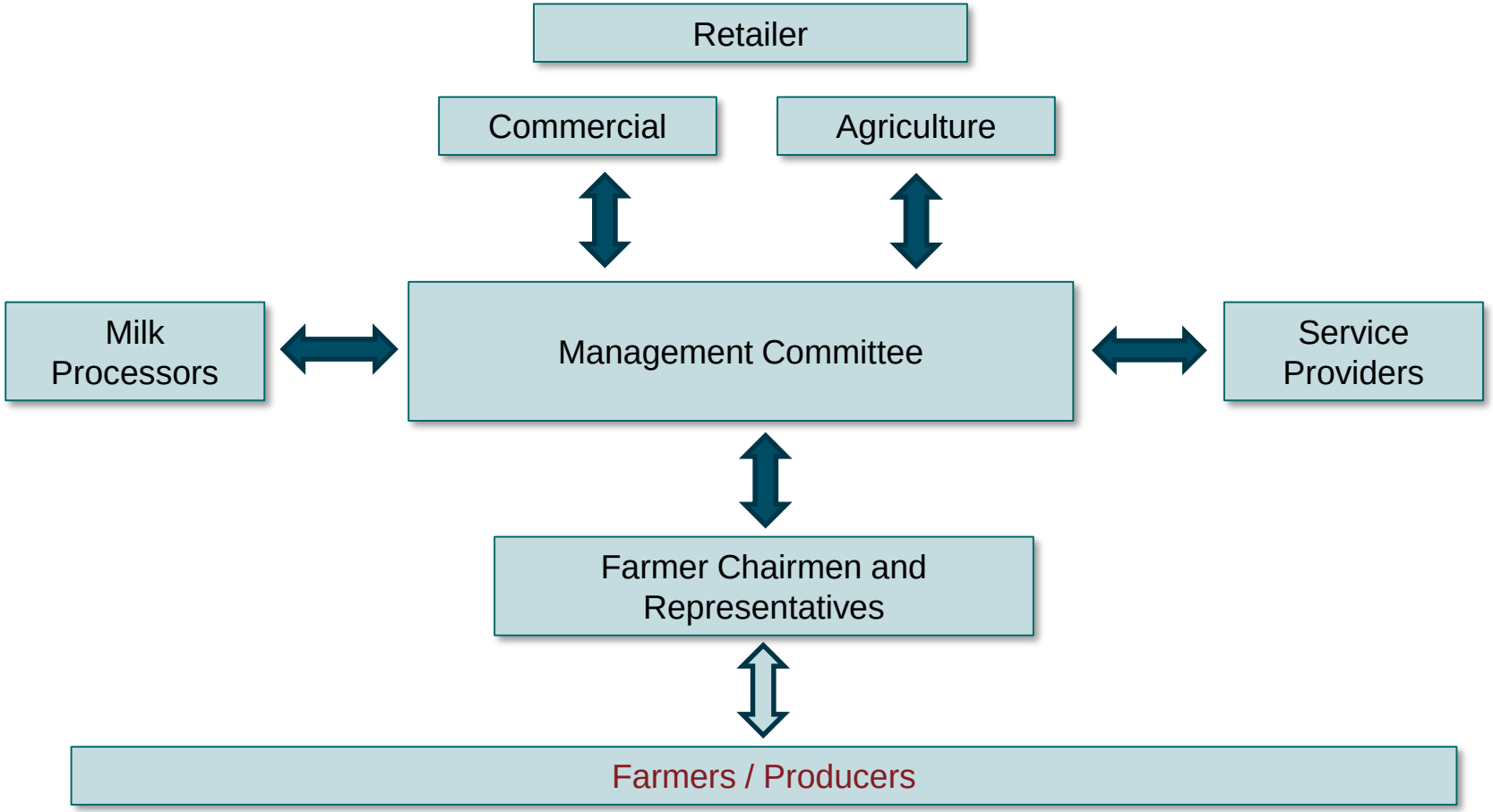
1.4.1 Typical governance structure – roles and responsibilities

Participant / organisation	Role	Responsibilities
Retailer – Agriculture	Agriculture Manager – Dairy	Overall responsibility for the strategic direction as well as the management, operational and communications activity of the supply group, including working with all key stakeholders
Retailer - Commercial	Dairy Category Buying Manager	Responsibility for all commercial aspects of the supply group, including the pricing mechanism and its suitability for the retailer and for the purchasing of support services
Processor(s)	Retail Group Manager(s)	Managing the commercial and operational aspects of the processor / retailer relationship – ensuring that retailer (as the processor's customer) receives the required service at agreed quality and price
Farmer Representatives	Committee Chairman	Representing the farmer members' interests and providing strategic and operational guidance to the retailer and committee.
Farmer Representatives	Committee Members	Representing the farmer members' interests and providing strategic and operational guidance to the retailer and committee.
Service Providers	Operations Managers	Responsible for delivery of all relevant services to the supply group, potentially including: pricing mechanism; audit; data collection and analysis; consultancy; communications.

1.4.2 Committee and management structures

Committee	Responsibilities
Management Committee	Agreeing strategy and objectives; setting governance rules, regulations and management activity; engagement of and with key service suppliers; making key decisions; overseeing communications
Technical & Standards Committee	Determination of standards; working with external agencies; commissioning of R&D; reviewing data and group performance; making recommendations to the Management Committee

1.4.3 Typical governance structure, focussed through a Management Committee



1.4.5 Governance challenges

1. Mutual dependency - the retailer is in effect the "senior partner" as the paymaster. However, relationships cannot be top-down - has to participative, inclusive and as far as possible equitable (between retailer and farmers) in influence for the long-term success of the group. Both parties are mutually dependent.

2. Unrealistic expectations - especially over timelines for change. Dairy farming takes time to change – something which retailers can find difficult to accept, and can expect more immediate results. The role of the management committee in allowing those realities to be heard is key in managing expectations.

3. Committee capability – ensuring that they have the skill sets required and are comfortable in this environment and role. Particularly being able to think strategically, holistically and see issues from others' perspectives. The recruitment of farmer representatives that have these capabilities and not simply be elected / selected because they are popular, known or opinionated can be a challenge but should be given significant consideration. An independent chairman (not representing the main stakeholders) could usefully encourage independence of thought and action.

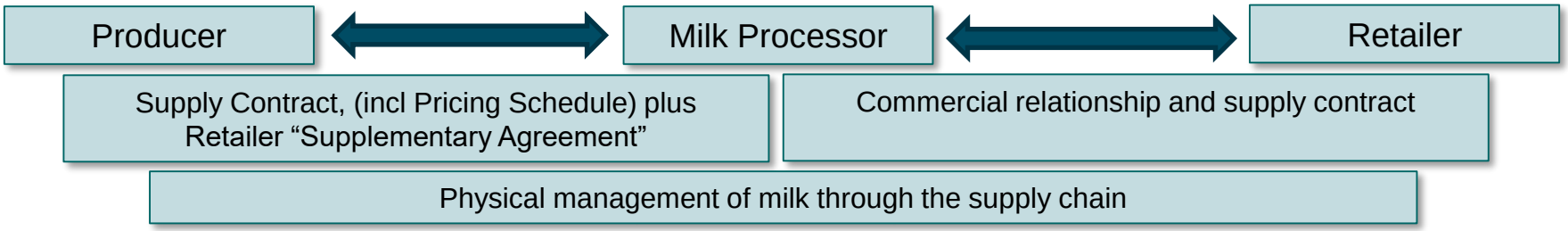
4. Mechanisms for rotating and refreshing committee members need to be agreed and ideally should result in a 3-5 year rotation and or maximum term.

5. Accommodating farm variation - in resources, attitudes, skills sets, systems – and therefore developing approaches, requirements and solutions that are not homogeneous or too generic in approach or that don't favour any particular system, unless that is required by the supply chain standards.

6. Clarifying the ownership, use and confidentiality of IP, data and models – ensuring that this is clear and agreed with all parties at an early stage of group development as inevitably these issues will be tested and challenged during use. Respecting farmer data confidentiality in particular, financial / accounting data, which will likely be involved in a CoP model, is key. It is generally accepted that the retailer will not have access to or sight of individual farm datasets – and the data platform (blockchain or otherwise) must therefore by configured to ensure this is the case, unless the supply chain participants agree otherwise.

1.4.6 Retailer-Processor-Producer relationship

1. As the previous governance structure schematic illustrates, the milk processors play a central role in the functioning of the aligned supply group.
2. It is the processor that holds the supply contract with the supplier (the basic supply contract plus retailer Supplementary Agreement which defines additional standards and payment characteristics), maintains the commercial relationship with the retailer, is responsible for all the physical management of the milk (collection, haulage, testing, processing, packaging, distribution) and manages milk payments to producers.
3. The processor (whether co-op or plc) in effect "owns" the key relationships and is therefore central to the functioning of the aligned supply chain.
4. It has been questioned whether the Houdbare Milk concept could be managed through a direct Producer to Retailer relationship with a "toll" processor acting as a contracted intermediary. Technically and commercially it should be possible but it is not a model that has precedent in the UK. The additional responsibilities that would need to be assumed by the retailer would likely stretch their management resource capabilities and the reduced "ownership" of the processor may limit its effectiveness.



2. Cost of Production linked payment model

2. Cost of Production linked payment model

Tasks as defined in the Proposal

- The critical importance of the specification and operation of a payment model is to drive the right behaviours, provide fair reward, but remain affordable and practical.

- This depends on defining key aspects of the model:
  - Retrospective (based on historic accounts) or forward-looking (based on a budget)
  - Costs based on that of the average producer or the more efficient producers
  - Defining which costs should be included – all or just specific key or "indicator" costs
  - Identification of those farm costs directly associated with meeting the required standards and participation in this dedicated supply chain
  - Mechanisms for apportionment of overhead costs, handling unpaid family labour, allowance for capital investment, allowance for a notional "profit"
  - Adjusting the milk price – when, how often, by whom
  - Relating the specifications (for e.g. milk quality, milk hygiene, seasonality) already defined by the milk processor to the CoP price mechanism
  - Defining additional outputs (e.g. to provide KPIs, benchmarking and supply chain insight) – how are these used and communicated

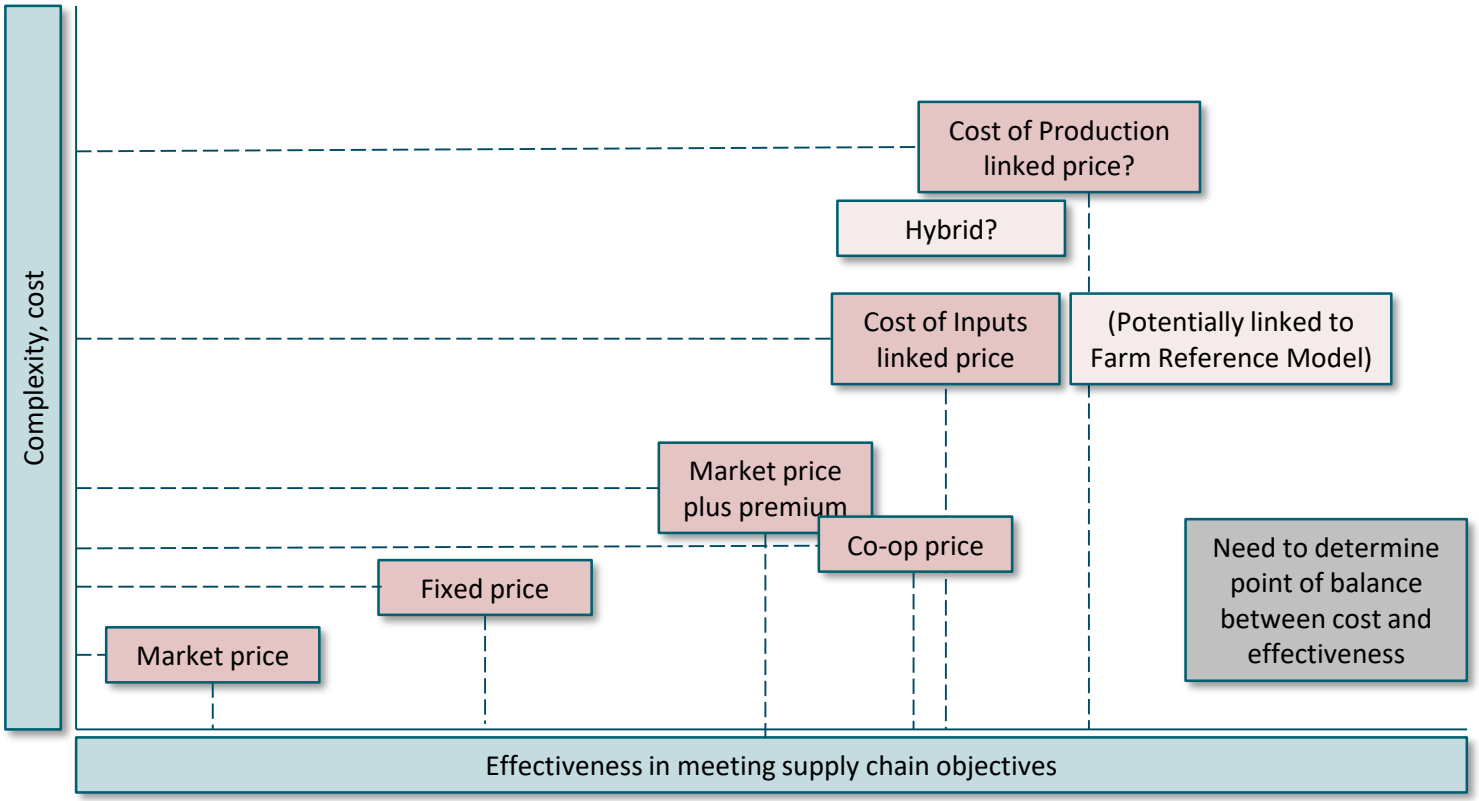
- Cost of Production data from Dutch dairy farms will be used for developing an illustrative CoP-based pricing model and for reviewing all the model components as described above.

Report contents 2 – Costs of Production Pricing Model

1. Overview
    1. Purpose, benefits, objectives, challenges
    2. Characteristics of a successful retailer-led dairy supply chain
    3. Assessment of UK retailers in this regard
    4. Governance and management
2. **Cost of Production**
    1. **Principles and model options**
    2. **Key components and questions regarding a CoP approach**
    3. **UK CoP model illustration**
    4. **Assessment of Netherlands costings – applicability for CoP model**
3. Farm standards
    1. Overview
    2. UK dairy supply chain standards assessment
    3. UK dairy supply chain development illustrations
    4. Fundamentals of a successful dairy sustainability scheme
    5. Assessment of Houdbare milk scheme
    6. Summary and recommendations
4. Blockchain as a possible platform for a retailer – producer dairy supply chain
    1. Overview of Blockchain; uses and advantages in food supply chains; barriers to use
    2. 8 steps to establish a Blockchain network
    3. Network and provider examples; set-up and transaction costs
    4. Blockchain analysis and solution for the proposed retailer – supplier supply chain
    5. Summary and recommendations

2.1.1 The critical importance of the correct choice of payment model

- Take a step back : payment model options include more than just CoP:



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2.1.2 Farmer payment models – possible options

Market price only	Fixed price	Market price (or basket price) plus premium	Cost of Inputs linked price	Cost of Production linked price
Non-aligned farms Co-op member farms	Non-aligned farms; Aligned group; Select as contract option	Nominated or Aligned group, segregated or non-segregated	Nominated or Aligned group, segregated or non-segregated	Aligned group, segregated or non-segregated
Indicative of nil or very limited supply chain relationship or commitment. No linkage to objectives Nil or limited impact on supply chain behaviour. Difficult for farms to plan and invest.	Used as a contract option – farms able to select to assign a % of their milk on fixed price. Can be linked to a nominated retailer (eg Lidl). Some complexity in having to review and determine fixed price. Some element of commitment and assists with farm planning.	Indicative of supply chain commitment. Used by eg The Co-op. Relatively simple to operate. Model uses market price or calculates average of an agreed basket of prices. Premium typically is fixed; may be dependent on achieving required standards.	Requires a tracker model, assessing cost of key inputs (eg feed, fertilizer, fuel), indexing, then applying to a milk price (based on production criteria). Eg M&S. High level of complexity in establishing and reviewing the tracker model and index, but then simple to apply. Could be associated with standard farm models Indicative of significant supply chain relations.	The most complex approach, requiring a complex model and logistics – collection, collation, analysis of data. May also involve a budgeting aspect. Eg Sainsbury's, Tesco. High level of cost and commitment. Transparent and fair to farmers. High level of PR value. Can "lock in" inefficiency unless accompanied by a scorecard type system.
Co-op supply chains, although typically receiving market-linked prices, demonstrate other distinctive relationship and financial commitments.				

2.1.3 Farmer payment models – possible options - considerations

1. Determining which of these approaches is the most appropriate pricing model needs to be considered in detail.

2. Examples of all of these exist in UK dairy and each has its role, benefits and disadvantages. Accepted practice perhaps suggests that a full CoP model, particularly if it incorporates a "forward budgeted" costs component, is the ideal most comprehensive approach.

3. It would be considered as fully reflecting the costs experienced by the farmers and providing a robust, comprehensive platform to support the relationship between farmers and retailer (thereby potentially maximising the likelihood of supply chain objectives being achieved), whilst also demonstrating the retailer's fair and understanding treatment of its suppliers, allowing for powerful consumer messaging.

4. But, is a full CoP approach necessary to achieve them, or could another, simpler model satisfy the requirements? In particular, could a cost of inputs linked pricing model eg tracking the cost of key farm commodities, perhaps applied to an agreed "standard farm model", deliver 90% of the benefits for a much reduced operating cost?

5. Are the benefits (commitment, confidence to invest, agreement to do what's required) in balance with its affordability?

6. The CoP models operating in the UK dairy sector today emerged at a time when the retailers were under significant consumer and media scrutiny over unfair purchasing practices. Cost of Production models were seen as a means of addressing these concerns and demonstrating a more responsible approach by retailers. They have since become an established approach – but they may not always be necessary.

7. Understanding the supply chain's objectives therefore and the rationale for an aligned, direct supply relationship is therefore critical in identifying the most appropriate approach.

2.2 Cost of Production payment model – key questions:

Assuming a full Cost of Production approach is adopted, the details of how that model functions become key.

Those issues listed below would be core to that consideration. Again, as per the adoption of the appropriate model in the first instance, determining the solution to these questions needs to be done in relation to the supply chain objectives and in agreement with all key stakeholders.

1. Retrospective or forward looking (actuals or budget)?	2. Which costs – all, variable, indicator costs?	3. Details of the model – apportioning overheads; unpaid family labour; allowance for cap-ex; inclusion of a notional profit?
4. Costs based on average or more efficient producers?	5. Reflection of costs associated with implementing supply chain requirements?	6. Operating the model – how often is it changed, updated etc?
7. Relationship between milk processor contractual components and supply chain aspirational standards?	8. Knowing what benchmarking KPIs are required and ensuring the data allows these to be generated?	9. Number of suppliers in the CoP model - full population or sample only?

2.2.1. Retrospective or forward looking (actuals or budget)?

Should the model adopt an historic CoP data only or a forward looking budget approach?

Retrospective CoP system

- Based on actual data, no element of forecasting – which by definition will never be perfect – is involved
- Simpler and lower cost to operate

Forward-looking CoP system

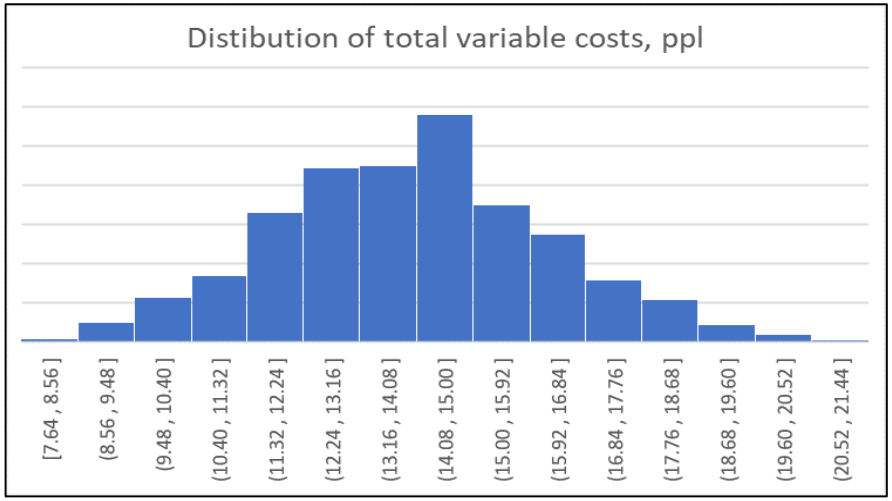
- Milk prices derived from a budget more accurately reflect the current costs facing suppliers (especially feed), and milk volumes – both of which may be significantly different over the possibly 18 months that might separate an actual vs a budgeted period
- Changes in milk price derived from a budget are easier to understand by milk producers
- Milk producers are better able to make decisions based on forward looking system
- The budget needs to be carried out by a credible, capable, independent third party who's conclusions, although must be challenged by the review process, must ultimately be trusted and adopted without interference.

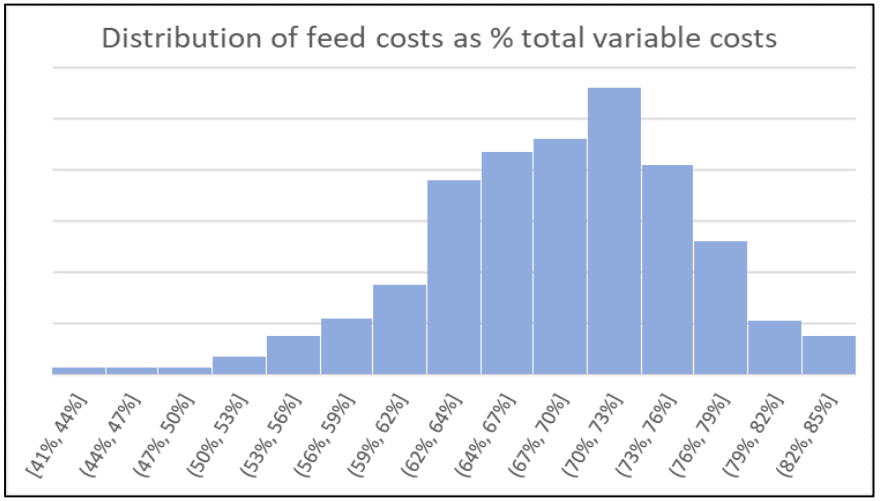
A hybrid system combining both historic accounts with budgets for certain figures e.g. feed prices offers the advantages of the above, but at the expense of creating a system that is confusing to communicate and understand.

2.2.2.a Which costs: total, variable, or indicator costs?

Defining which costs should be included – all, variable or just specific key or "indicator" costs – those that are easy to record yet have the most significant impact on overall farm costs, needs to be determined.

Long-term, large-sample analyses of UK dairy farm costs (eg Promar FBA costed farms) shows that overheads and variable costs are closely correlated, enabling variable costs to be used as an acceptable proxy for total costs. Even more simplistically, feed costs, which comprise some two-thirds of variable costs could be used as a single indicator cost in its own right. The graph below shows how variable costs are distributed across a typical supply group and the % share of those variable costs made up by purchased feeds (excluding how grown forage).





2.2.2.b Which costs: total, variable, or indicator costs?

- Including all costs makes it a true CoP model, ensuring it correlates directly with the resulting milk price and providing maximum transparency and reassurance of accuracy.
- It accounts for all the costs incurred by dairy farmers and is a tried and tested methodology.
- However, using just key or "indicator" costs only, can significantly reduce operating costs, particularly of data collection and whilst not providing the same degree of accuracy, it can deliver a very useful proxy, reflecting the changes in market prices for key commodities.
- It would also enable the use of a hybrid milk pricing system, using a percentage derived from CoP together with a market-related price.

A possible and interesting approach would be the development of a series of representative farms models, defined by agreed performance characteristics and levels of physical inputs to which are applied market-related indicator costs. These costs are then tracked and changed on an agreed frequency and for determined specification. For example:

Farm Model A Eg large farm, high yield, no grazing, employed labour	Farm Model B Eg small farm, medium yield, seasonal grazing, family labour	Farm Model C Eg Large farm, low yield, spring calving, extensive grazing, employed labour
Agreed output / input characteristics Feed use eg XXkg/ltr; Fertilizer application rate: XXkg/ha Labour use: XXhrs/cow	Agreed output / input characteristics Feed use eg YYkg/ltr; Fertilizer application rate: YYkg/ha Labour use: YYhrs/cow	Agreed output / input characteristics Feed use eg ZZkg/ltr; Fertilizer application rate: ZZkg/ha Labour use: ZZhrs/cow

Market prices for: eg Feed (compound, blend, key straights); Fertilizer; Wages – applied to the models to adjust performance outcomes and therefore an imputed "total cost of production" figure

2.2.3.a Details of the model – apportioning overheads; unpaid family labour; allowance for cap-ex; inclusion of a notional profit?

The mechanisms for handling key aspects of the model – eg apportioning overhead costs, valuing unpaid family labour (UFL), allowing for capital investment, inclusion of a notional "profit" - are critical, potentially complex can be contentious, and need to be resolved at the outset.

Overhead Costs

- The apportionment of overhead costs is dependent on the complexity of the farms within the supply group, in relation to the number of farming and other enterprises.
- The costs and practicalities of providing truly "actual" apportioned overhead costs means this is highly unlikely to be realistic, even just for key costs such as labour and machinery. It is also difficult for third parties to collect such data as there are few ways in which the accuracy of the resulting data can be questioned, leading to scope for the data being provided to not be truly reflective of reality.
- Therefore, if developing a system to include overhead costs, it is recommended that a "standard mechanism" is used. There are several possible ways of doing this, but one based on "percentage of turnover" or similar has proven relatively robust within existing CoP systems – it is simple and easy to communicate.

2.2.3.b: Details of the model –apportioning overheads; unpaid family labour; allowance for cap-ex; inclusion of a notional profit?

Unpaid Family Labour

- Labour provided by family members is generally not included in a set of Profit and Loss accounts (although this is dependent on business structure) and, as such, if using a total CoP system to pay for milk, needs allowing for.
- It is a complex figure to assess accurately and it clearly varies significantly from farm to farm.
- Surveys of suppliers are possible (and an earlier UK survey forms the basis of a leading retailer scheme in the UK. Our experience suggests that it is difficult to provide robust survey methodologies, particularly if participants have an incentive to respond in certain ways. (eg allowing for farmers' tendency to state availability to work as opposed to actual hours worked).
- Alternatively it is possible to derive a theoretical figure (based on research studies) in combination with the paid labour cost.
- The UFL model needs to take in to account the nature and value of the work done. (See diagram below). Typically this is assessed as having 3 levels, each with a different ascribed value and is calculated for each member of the family team.
- This total, then applied to the average farm at the heart of the payment model can be indexed going forwards using representative salary change figures as published by relevant industry bodies.
- If a Standard Farm model approach is adopted in conjunction with a Cost of Inputs payment model, the UFL calculation could be avoided in part by the use of a standard number of labour hours / cow or labour minutes per litre although the management / director contribution of the farming family still needs to be recognised.

Level 1: Manual farm labour - wage rate 1	x	No. of hours assigned	=	Value of UFL 1
Level 2: Skilled labour - wage rate 2	x	No. of hours assigned	=	Value of UFL 2
Level 3: Management or Director activity - wage rate 3	x	No. of hours assigned	=	Value of UFL 3
			=	Total Value of UFL

2.2.3.c: Details of the model –apportioning overheads; unpaid family labour; allowance for cap-ex; inclusion of a notional profit?

Capital Investment

- This is most easily achieved through the inclusion of a figure to represent "net depreciation". Promar use standard depreciation rates for different classes of capital assets, and these can be allocated as per other overhead costs to reflect the allocation of capital reinvestment between enterprises.
- If using a system based on a budget, then upcoming capital investment requirements (with grant availability netted off if relevant) can be allowed for, in the event of new legislative or supply group driven requirements, for example.

Notional "Profit"

- The lack of a profit allowance can be quoted as a disadvantage of a CoP derived milk price as there is the potential for some to believe that it (by definition) leads to zero profit for the average (CoP) supplier. However,
  - the inclusion of an allowance for capital investment provides a built-in profit margin to reinvest back into the business
  - the Unpaid Family Labour allowance can be considered to be additional to all profit-related costs as it replaces "private drawings" (a non-trading item).
  - Milk income is generally not the only source of income on dairy farms, meaning that there is the potential for additional profit both from within the dairy enterprise, through calf sales for example, as well as from other farming and none farming enterprises, and subsidies. Dairy businesses typically benefit from these profit contributions in addition to that provided through a CoP based milk price.

2.2.4.a Costs based on average or more efficient producers?

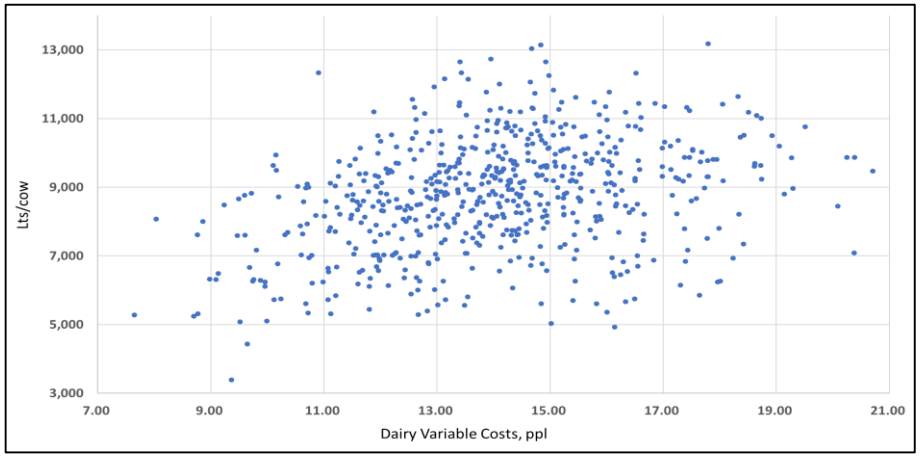
Should the Cost of Production that underpins the milk price be costs based on that of the average producer or the more efficient producers in the group.

This is an interesting consideration and has been considered by retailers (and associated processors). Using average producer (defined as the average litre produced by the group) has several advantages, notably:

- The milk price reflects the average CoP within the group making it very straightforward to understand and communicate
- There is no "arbitrary" decision to make about which litres are or are not included

Those farms that have lower than average costs benefit from a "generous" price, whilst those with higher costs than average should be incentivised to reduce costs and benefit further from the model, driven by a rational profit motive. Evidence suggests however that this doesn't happen and that most farms do not change their system or approach as a result of the milk price to drive costs down and profits up.

- In fact, the CoP system can lock in inefficiency and perversely, act as an incentive, not to reduce costs. This is seen across most of the UK CoP-based supply groups – they typically have higher costs than industry averages.



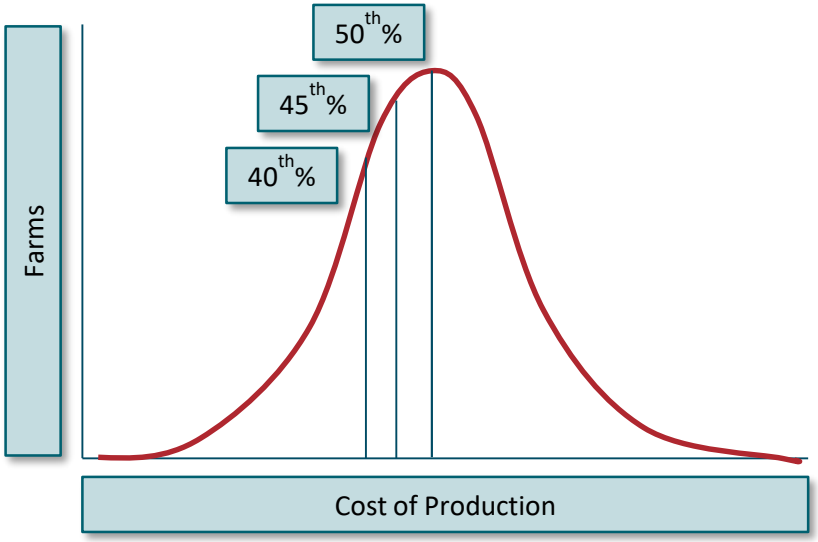
As the graph to the left indicates, showing the Variable Costs per litre across the farms in a UK retailer supply group, the range is considerable for any given yield (or system type).

A plot of total costs would show the same distribution. The key question for the supply chain is how to incentivise those with higher costs than average (and which are keeping the average high) to reduce those costs, but whilst also ensuring that the required standards for the group are met.

2.2.4.b Costs based on average or more efficient producers?

Using more efficient producers as the benchmark on which to determine the milk price

- In theory this should drive farmer efficiency improvements as the milk price is based on producing a litre of lower cost than average, eg the 45th percentile point as opposed to the 50th percentile point (or average) – acting therefore as an aspirational target.
- However, there is no evidence to demonstrate that this will happen in reality. It has been considered by some retailer models, but not adopted to date.
- It does provide flexibility to vary the methodology dependent on prevailing circumstances.
- However, there are considerable methodological, communication and trust issues incurred by taking this approach and it raises questions such as:
    - What percentile point should be chosen? Who's decision is it? Might it change year on year?



- The counter argument to using a non-average CoP reference point is that a "balanced scorecard" system, operating in parallel to the pricing model, used to assess, score and rank farms according to their performance against the defined standards will be more effective in outcome and allows the CoP model to remain simple, transparent and trustworthy.

2.2.5. Reflection of costs associated with implementing supply chain requirements?

Identification of those farm costs directly associated with meeting the required standards and participation in this dedicated supply chain.

- A well functioning CoP model will incorporate and fully recognise the costs associated with meeting the required farm standards, implementing certain protocols, or ensuring infrastructure demands are met.
- The transparency that this provides removes a key obstacle to farmer participation, in as much as the milk payment model already contains the costs of delivering those standards.
- It encourages improvements to those standards to be delivered within as short a time frame as is practical and can be used to assist in marketing the milk to existing and potential customers.

An alternative approach adopted by another UK retailer (M&S) is the inclusion of premiums for attainment of Animal Health & Welfare standards and Farm Standards (both are based on audited schemes) and attracted premiums (in a tiered approach) in addition to a premium milk price (based on the processor's standard schedule with commodity price trackers built in.

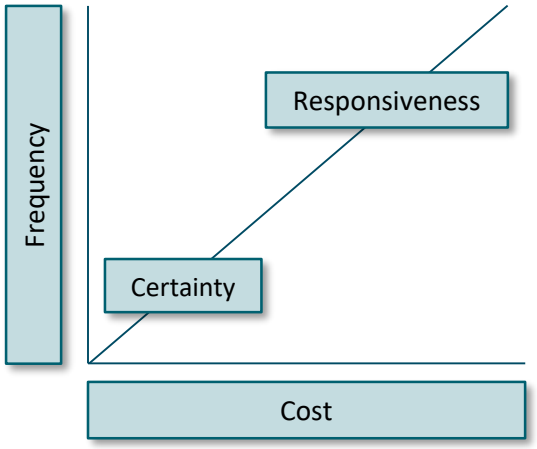
In effect:

Processor price + retailer (Cost of Inputs) premium + Retailer H&W premium + Farm Standards premium

2.2.6. Operating the model – how often is the milk price changed?

- Lack of frequency of change (e.g. annual) results in maximum certainty of future milk price to the suppliers, but delivers minimum responsiveness to changing CoP.
- Increased frequency improves that responsiveness, but means more work/cost/communication, and less certainty of upcoming milk prices for suppliers.
- The options of price changes two or four times a year appear to be the most realistic options in terms of the balance between maximum responsiveness and minimum cost and complication.
- Farm accounts for taxation purposes are annual so reflecting updated figures within a full CoP system is only going to be possible when these become available. This will also depend on the financial year ends of the participating farms.

- A system based on budgets is likely to require the use of a third party, but updates based only on the prices of certain inputs (e.g. feed) could be done through a simple mechanism, if there was a transparent methodology of updating those figures.



Payment mechanism	Frequency
Market price only	Monthly
Fixed price	1 – 3 years
Market price (basket price) plus premium	Monthly
Cost of Inputs linked price	Quarterly
CoP linked price - historic	Annual
CoP linked price -budget	Quarterly

2.2.7.a Relationship between milk processor contractual components and supply chain aspirational standards

- A CoP price mechanism calculates the cost of producing the average litre within the supply group.
- However, to generate a realistic milk pricing schedule, various other factors will need to be overlaid over that figure, which typically include:

- Milk constituents
  - Butterfat %
  - Protein %
  - Lactose %
  - Urea
- Milk Hygiene
  - Somatic Cell Counts
  - Bactoscan
- Tests for:
  - Freezing point depression
  - Antibiotic contaminations
  - Other contaminants
- Supply
  - Milk volume
  - Transport costs
  - Seasonality of production
  - A & B litres
  - Provision of a milk forecast

- Evidence demonstrates that that applying these production factors into a milking price schedule on top of a starting point of CoP it is possible to achieve an average milk price that is very close to the average CoP.
- In other words, for example, an "average" supplier that meets the average or target specification for the production factors defined by the schedule, might meet the quoted Cost of Production price.
- Farms that exceed these specifications (eg supply greater volumes or have higher constituent values) will receive a higher than average price.

- The responsibility for the milk pricing schedule addressing all these aspects of production (ie not the farm standards nor the CoP model), typically sits with the milk processors and are layered on top of / managed in addition to, the core CoP pricing model.
- The retailers tends not to get involved in the management of these issue, though may work with the processor to determine the appropriate production factor criteria, bonuses or penalties.

2.2.7.b Relationship between milk processor contractual components and supply chain aspirational standards

To illustrate the interaction of the Retailer CoP base price (calculated as 30.40ppl for the "average" farm) and the Processor milk payment schedule, using just a few representative criteria for two example farms:

Farm A		PPL
		CoP Base price
		30.40
• Milk constituents		
• Butterfat %	4.00	+0.5
• Protein %	3.33	+0.0
• Lactose %		
• Urea		
• Milk Hygiene		
• Somatic Cell Counts	180	+0.5
• Bactoscan	25	+0.5
• Tests for:		
• Freezing point depression		
• Antibiotic contaminations		
• Other contaminants		
• Supply		
• Milk volume, lts/day	4000	+0.6
• Transport costs		
• Seasonality of production		
• A & B litres		
• Provision offorecast		
Total		32.50ppl

Farm B		PPL
		CoP Base price
		30.40
• Milk constituents		
• Butterfat %	4.10	+0.10
• Protein %	3.25	-0.02
• Lactose %		
• Urea		
• Milk Hygiene		
• Somatic Cell Counts	220	-0.15
• Bactoscan	35	-0.5
• Tests for:		
• Freezing point depression		
• Antibiotic contaminations		
• Other contaminants		
• Supply		
• Milk volume, lts/day	2000	+0.0
• Transport costs		
• Seasonality of production		
• A & B litres		
• Provision offorecast		
Total		30.13ppl

2.2.8. Knowing what benchmarking KPIs are required and ensuring the data allows these to be generated?

- Dependent on the system used to collect the data for the CoP system it is likely that additional data, over and above that required for the CoP system, can be collected. Some of this data is crucial to the derivation of a CoP budget, but much of it can be used productively by the farmers in the supply chain to help manage their business in such ways as to assist them reduce their own CoP.

- The figures most likely to be of value for KPIs/benchmarking are those most comparable across the range of farms within the supply group, which are likely to be the dairy cow and forage variable costs.

- Benchmarking/KPIs using other figures, particularly overhead costs, is best achieved through working with the farmers' advisors, and/or through the provision of third parties to aid interpretation.

- Much of the supportive data can also be aggregated to provide insights into the supply chain in which the supplying farmers are involved, whether this be data impacting environmental performance (e.g. soya/palm usage) or data generating carbon footprints. It is also possible to analyse the correlations between the data collected and other metrics (e.g. animal health data) to provide insight into how effectively the group are meeting other likely requirements, and to generate plans.

2.2.9. Number of suppliers in the CoP model - full population or sample only?

- Most CoP models assume that all farms in a given supply group participate and contribute their production costs to the calculation of the average CoP.
- However, should this not be possible or desirable, for whatever reason, then using a sub-sample is possible.
- Determining a representative sub-sample requires agreeing key criteria: accessible (across all farms in consistent way), robust, valid. Eg:
  - number of cows
  - milk yield
  - cow breed
  - seasonality of calving / production
  - milk production "system"
- A sample of 20%-30% of the total group size would be adequate to properly represent costs and performance across the group, depending to a degree on the homogeneity of the farms and could represent a very cost effective approach to determining an adequately robust outcome for the payment model.
- Incentivising (through financial subsidy) those representative farms would likely be necessary, covering the costs and effort involved in participating in the provision of detailed farm costings.

2.3.1 Example of a UK retailer (Tesco) Cost of Production linked pricing model

Principles:

- Transparency - a pricing mechanism clear to all stakeholders
- Fairness- a fair price for milk and to reward progressive producers driving industry forward
- Sustainability- recognize industry changes and ensure the supply group is future-proof, including better management of risk

Components

- Milk price derived from a budget, based on average Cost of Production of all farms in the group. Is positioned as a "cost tracker" methodology.
- All farms fully costed using Promar Farm Business Accounts (FBA) accounting system (see next slide)
- Milk price is adjusted 4 x year (budget updated 2 x per year and Feed, Fert and Fuel commodity price adjustments made in the interim quarters).
- The budget is an estimate of what (Promar) believe will happen to costs of production and milk output in a defined period. (eg the first budget is done in September 19, using actual figures April 18 - March 19, for the period Apr 19 – March 20).
- The budget assumptions are applied to an "average farm" which is defined from group data.
- The budget is always reviewed against actual (when available to ensure budget accuracy

Relationships

- Milk processors play leading role in managing suppliers.
- No direct link between milk price received and attainment of standards. Standards (and right to participate in the group) determined by a separate "balanced scorecard" system.

2.3.2 FBA farm accounts structure – used as basis for CoP model

Gross Margin Dairy	+	Gross Margin Youngstock	+	Gross Margins Livestock	+	Gross Margins Arable	+	GM/ Income Other

-	Forage (variable) costs
-	Overhead & Resource costs (including depreciation)
=	Profit

-	Capex	-	Loans	-	Private	-	Tax	

=	Cash
>	Net Worth

NB: accounting methodology: the inputs and costs recorded through the above (FBA) system are calculated on the basis of their actual use within the accounting year, not on their purchase or payment dates
The above approach ensures data is consistently recorded and coded on all farms.

2.3.3 Budget outcomes

- The budget process generates outcomes in a format similar to that illustrated to the right (illustrative values only).
- The milk price is based on the "Total all Costs" CoP figure at the base.
- The format follows the standard Promar FBA accounting and budgeting approach closely.
- The process provides clear, visible data which can be interrogated and the assumptions challenged by the Committee.
- When agreed, a "milk price change" communication is prepared and circulated.

Milk output (lts)		2,500,000	
Costs	**£ Total**	**ppl**	
Feed	250000	10.00	Taken directly from the respective gross margins
Vet and Med	25000	1.00	
Dairy office	12500	0.50	
AI and semen	12500	0.50	
Youngstock rearing costs	50000	2.00	
Bedding	25000	1.00	
Sundries	12500	0.50	
Forage	37500	1.50	
Total Dairy & Forage Variable Costs	**425000**	**17.00**	
Wages	62500	2.50	Taken from the Overhead and resource costs in the accounts, adjusted for Dairy's share of total farm output
Machinery repairs	25000	1.00	
Fuel	12500	0.50	
Electricity	12500	0.50	
Contract & Hire (general)	12500	0.50	
Vehicle tax and insurance	2500	0.10	
Farm insurance	12500	0.50	
Office & administration	12500	0.50	
Miscellaneous	2500	0.10	
Water	2500	0.10	
Council Tax	2500	0.10	
Farm property repairs	25000	1.00	
Rent	25000	1.00	
Bank Interest & charges	25000	1.00	
Total Paid Overhead Costs	**235000**	**9.40**	
All Cash Costs	**660000**	**26.40**	
Depreciation	37500	1.50	Taken from Resource costs in the accounts
Family Labour	62500	2.50	Formula based on previous research
Total Non-cash costs	**100000**	**4.00**	
Total all Costs	**760000**	**30.40**	

2.3.4 Technical data requirements

- Headings requiring technical data items are highlighted with *

Key requirements for technical data to enable accurate budgeting:

- Stock numbers- average cows and youngstock, plus annual movements
- Saleable milk output (including usage on the farm)
- Feed usage by cows and youngstock (per annum), preferably with split of concentrates and roughages.
- Bedding- quantities used by cows and youngstock (not essential).
- Fertiliser and purchased animal manure applications to each forage type per crop (grass, maize etc).
- Fuel usage- quantity per annum by key types of fuel- gasoil, road diesel, road petrol (not essential).

Milk output (lts)*		2,500,000	
Costs	**£ Total**	**ppl**	
Feed*	250000	10.00	Taken directly from the respective gross margins
Vet and Med	25000	1.00	
Dairy office	12500	0.50	
AI and semen	12500	0.50	
Youngstock rearing costs*	50000	2.00	
Bedding*	25000	1.00	
Sundries	12500	0.50	
Forage*	37500	1.50	
Total Dairy & Forage Variable Costs	**425000**	**17.00**	
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Fuel*	12500	0.50	
Electricity	12500	0.50	
Contract & Hire (general)	12500	0.50	
Vehicle tax and insurance	2500	0.10	
Farm insurance	12500	0.50	
Office & administration	12500	0.50	
Miscellaneous	2500	0.10	
Water	2500	0.10	
Council Tax	2500	0.10	
Farm property repairs	25000	1.00	
Rent	25000	1.00	
Bank Interest & charges	25000	1.00	
Total Paid Overhead Costs	**235000**	**9.90**	
All Cash Costs	**660000**	**26.40**	
Depreciation	37500	1.50	Taken from Resource costs in the accounts
Family Labour	62500	2.50	Formula based on previous research
Total Non-cash costs	**100000**	**4.00**	
Total all Costs	**760000**	**30.40**	

2.4.1 Illustrative Netherlands data

The financial data provided is detailed and comprehensive. The layout and accounting methodologies are different from those used in UK farm accounts, but an approximate conversation into a UK format generates an output very recognisable and very useable for a CoP model based on actual data.

There are a number of key issues to understand if the data were to be used for a CoP model.

Firstly – is this level of detail required? Referencing back to the question concerning purpose, objectives, benefits and costs is key in determining which type of payment model is required.

If it is concluded that a full CoP approach is required, then these operational questions are relevant:

- Which farms provide it?
- How is this data recorded?
  - Eg farms' own recording systems; survey work (eg university); use of standard accounts package managed by 3rd party?
  - On-line or on-farm, hard copy
- How often?
- How is it validated, by whom?
- How soon after collection is it available?
- Who aggregates the data and calculates the average?
- If using a method based on a budget see next slide

	€/kg milk
Milk sales	35.31
Other milk income	2.74
Livestock income	2.25
Land-use income	3.83
Other income	2.57
Total Income	**46.69**
Feed costs	10.00
Other dairy variable costs	2.92
Contractors costs for feeding	0.15
Forage variable costs	1.77
Forage contract costs	2.99
Total Variable Costs	**17.83**
Wages	0.68
Mach repairs and costs	2.77
Fuel	1.01
Electric & water	1.01
Farm insurance	0.74
Administration	2.07
Miscellaneous	0.78
Farm repairs	1.24
Rent - paid	2.06
Interest & charges	0.80
Leasing costs	0.24
Total Overhead costs	**13.42**
Depreciation	7.40
UFL (?)	13.92
Rent imputed	2.80
Total non-cash costs	**24.12**
Total trading costs	**38.64**
Loan repayment	5.40
Cap Ex	2.18
Total non-trading costs	**7.58**

2.4.2 Illustrative Netherlands data: technical data

- The provision of technical data, other than annual saleable milk volume (including saleable milk used on the farm), is not necessary for a COP system based on actual costs alone.
- However, if it is based on a budget, or a system requiring the costs of inputs to be applied to base data, then it would be necessary to collect sufficient technical data to enable an accurate budget to be generated, or to apply those updated costs of inputs to.
- Headings requiring technical data to be collected are highlighted with *.
- Theun has now kindly provided the technical data that is collected and is therefore available for analysis as part of the actual figures, and also for the budgeting.
- This appears to cover more than the requirement of the essential technical data required to prepare Cost of Production budgets.
- It is worth noting that Cost of Production systems would not need to include notional costs for fresh herbage and silages grown on the farm, or for notional costs for the slurry/manure produced on the farm that was applied to herbage/silage crops. The costs of the purchased nutrients applied to herbages/silages would be included, as would the costs of harvesting them, as well as the costs of spreading the slurry/manure.

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Loan repayment	5.40
Cap Ex	2.18
Total non-trading costs	**7.58**

2.4.5 Data Consistency and Quality

- Using a single system to generate the figures for all participants, as is used for the Tesco CoP system, would be the most desirable solution in terms of data quality, training and support, ease of processing etc. One advantage of that system is that the option exists to utilise the same dataset for generating the tax computation for the farm business, so avoiding any duplication.

- Another example system is Dairybase in New Zealand which is the main system used for benchmarking dairy farmers' performance. Data can be entered through many different channels by many different users, but in a consistent and clearly documented way.

- It is vital that, if a system is being used where data is entered by those who potentially benefit from the outcomes of that data entry, there is a robust auditing process. Using bank reconciled figures provides much of this robustness of approach.

- If using a stratified sample then the selection criteria should include an assessment of the ability of the potential participants to provide data of sufficient quality, and in a timely fashion.

2.4.6 Overall Milk Price

- It is vital that the milk price resulting is sufficiently attractive both to recruit and retain suppliers, in relation to the alternative milk prices available, and reflecting the relative CoP of producing milk to the Houdbare standards, in relation to organic milk, for example.

- The average conventional and organic milk prices of Friesland Campina, the dominant milk buyer in The Netherlands, for the last five years has been as per below (unweighted, simple averages, based on 4.41% butterfat, 3.47% protein and 4.51% lactose)- all prices shown in €cents per kg milk:

	2015	2016	2017	2018	2019 (to Nov)	Average
Conventional	30.7	28.4	38.0	36.0	35.6	**33.7**
Organic	47.8	47.7	49.1	47.5	47.6	**47.9**
Annual Top Ups	3.49	3.30	1.27	0.46	Not Available	

- The conventional milk prices above illustrate the volatility of milk prices paid using market returns, and of the potential attraction of a CoP based milk price.

- Interesting and important to note the recent (Dec 19) announcement by Friesland Campina that implies that milk pricing based on a "basket" of reference prices is realistically no longer viable due to the complexities caused by the number and variation of premia in the reference milk prices. This potentially adds further value to instigating a distinct, independent CoP-based milk price.

2.4.7 Promar Recommendations regarding Payment Model for Houdbare Milk

Recommendations:

1. Use a Cost of Production system to generate basic milk price using budgets carried out by an independent and reputable third party based on the actual technical and financial data collected. The illustrative data provided indicates that the required data fields are available assuming that data collection system is used going forward.

2. The initial farm milk price should be adjusted to be competitive, using other elements of milk contract (if necessary).

3. Use a stratified sample of farms (at least initially) rather than all farms in the group. This will (a) keep costs down and (b) focus on the participation of those most likely to provide good quality and timely data.

4. Set up a protocol to review the milk price two or four times per year. If reviews are conducted quarterly, it is recommended that the two interim quarters (Q2 and Q4) only reference the components, notably feed prices, for reasons of simplicity and cost.

5. That the milk price calculation always includes any additional costs resulting from delivering the required farm standards – these should be incorporated automatically by the CoP model.

6. The additional admin and accounting costs incurred by the selected participants in providing the CoP data should be met separately through a direct payment to them. (ie will be outside of the CoP model).

3. Farm sustainability standards model

3. Farm sustainability standards model

Tasks as defined in the Proposal

- Defining key aspects of the model:
  - Key components, accommodating relevant stakeholders' requirements
  - Appropriate metrics and KPIs
  - Mechanisms for linking each component into a coherent whole to create a "balanced scorecard" system
- Examining how these components and expected performance levels relate to legal requirements and other farm assurance standards already in place
- Managing compliance with minimum standards (especially concerning animal health and welfare)
- Mechanisms for ensuring continual improvement in relation to defined standards
- Communicating the results and using the results to drive change and improvement
- Understanding the consequences for not meeting agreed standards and how this process is managed
- This aspect of the report will focus on sustainability standards (including those addressing animal welfare and environmental criteria) that are relevant to the Netherlands dairy industry. These will be detailed by the Project Group and made available to Promar at the outset of the project.

Report contents 3 – Farm Standards

1. Overview
    1. Purpose, benefits, objectives, challenges
    2. Characteristics of a successful retailer-led dairy supply chain
    3. Assessment of UK retailers in this regard
    4. Governance and management
2. Cost of Production
    1. Principles and model options
    2. Key components and questions regarding a CoP approach
    3. UK CoP model illustration
    4. Assessment of Netherlands costings – applicability for CoP model
3. **Farm standards**
    1. **Overview**
    2. **UK dairy supply chain standards assessment**
    3. **UK dairy supply chain development illustrations**
    4. **Fundamentals of a successful dairy sustainability scheme**
    5. **Assessment of Houdbare milk scheme**
    6. **Summary and recommendations**
4. Blockchain as a possible platform for a retailer – producer dairy supply chain
    1. Overview of Blockchain; uses and advantages in food supply chains; barriers to use
    2. 8 steps to establish a Blockchain network
    3. Network and provider examples; set-up and transaction costs
    4. Blockchain analysis and solution for the proposed retailer – supplier supply chain
    5. Summary and recommendations

3.1 Farm sustainability standards model - overview

1. Retailer aligned groups have evolved and adopted a range of farms standards over the years, developed in conjunction with milk processors and farmer representatives.

2. They have primarily focussed on animal health and welfare criteria, which are in many cases set out in a discreet Livestock Code of Practice, that exists within an overall farm standards framework.

3. This has been in response to a combination of legal requirements (enshrined within a Code of Practice), consumer expectations, and for protecting the retailer's brand reputation.

4. In more recent years, the emphasis has broadened to accommodate a more holistic "sustainability" approach, consistent with the changing consumer agenda and companies' CSR requirements.

5. Ensuring that the criteria are simple, relatively few in number, practical, measurable and non-contradictory is essential. Examples exist of UK dairy supply chains standards programmes that do not meet these requirements – and which once established, can be difficult to change.

6. Developing the standards with a range of relevant industry experts is important, to ensure technical appropriateness and credibility, but care needs to be taken that they are not "over-engineered".

7. Typically a Code of Practice will define minimum acceptable performance whilst a standards programme will set out aspirational targets and be used to incentivise changes in behaviour and continual improvement.

8. Most retailer supply chains have consistent themes, but marginal differences have evolved as a response to different strategic priorities, to create points of difference, and in some instances as a reactive response to external (often consumer) challenges.

9. It is only more recently, and not consistently across the industry that standards programmes have become associated with the CoP model and are used to directly improve economic efficiency that otherwise may be compromised by the CoP approach.

3.2 What do existing UK schemes do?

Retailer	Supplier	Direct Supply Group	QA Standard	Dedicated Code of Practice to Supply	Animal Health & Welfare Standards	Environmental Standards	Fam staff management standards	Carbon Footprinting	No Live Animal Exports	Grazing Practice	Calf Rearing System & Scheme	Milk Payment adjustements	CoP Monitored & Measured
TESCO	Muller Arla	Direct with segregated milk supply	AFS RT + Tesco LCoP + QVIS	✓	✓	✓	×	✓	✓	×	✓	✓	✓
Sainsbury's	Muller, Tomlinsons, Arla	Direct with segregated milk supply proposed	AFS + JS standards	✓	✓	✓	×	✓	✓	×	✓	✓	✓
ASDA	Arla	Direct but not segregated	AFS RT + Arla 360	✓	✓	✓	✓	×	✓	×	✓	×	×
MORRISONS	Arla	Direct but not segregated	AFS RT + Arla 360	✓	✓	✓	✓	×	✓	?	✓	×	×
The co-operative	Muller	Direct but not segregated	AFS RT + Co-op Standards	✓	✓	✓	×	✓	✓	✓	✓	✓	×
Waitrose	Muller	Direct with segregated milk	AFS RT + Waitrose standards	✓	✓	✓	✓	✓	✓	✓	✓	✓	×
M&S	Muller	Direct with segregated milk	AFS RT + RSPCA + M&S standards	✓	✓	✓	✓	✓	✓	×	✓	✓	?
Iceland	Muller Medina	Non aligned	AFS RT	×	×	×	×	×	×	×	×	×	×
ALDI	Arla	Aligned	AFS RT + Arla 360 + Aldi Dairy Farm Partnership	✓	✓	✓	✓	×	✓	×	✓	×	×
LIDL	Muller Graham's	Aligned	AFS RT	×	×	×	×	×	×	×	×	✓	×

3.3.1 Example of the evolution of a payment and standards scheme showing importance of a balanced scorecard to drive standards and cost efficiency improvements

Cost Tracker milk payment programme introduced

Addresses consumer concerns and PR negativity about farms being paid less than CoP and being driven out of business

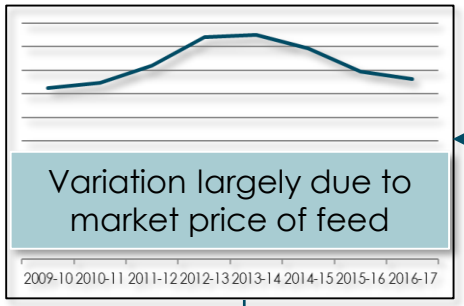
Livestock Code of Practice introduced to ensure that farms meet minimum expectations with regard to key animal health and welfare criteria

This works successfully, key LCoP standards are defined and (to some extent) assessed. Farms required to enter quarterly metrics on a DHI system

PR position improves
All farms benefit from a CoP linked milk price
Typically pays a price 10% above long-run market average

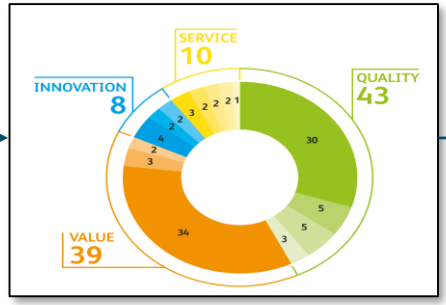
However, in reality, knowledge of actual health & welfare performance is lacking; incentive to improve them is low

Equally there is no focus on improving efficiency and reducing the cost base within the CoP framework. The CoP average price remains unchanged over 10 years



Variation largely due to market price of feed

A Balance Scorecard is introduced after 10 years to drive performance improvement across a range of criteria, including Carbon (as a measure of efficiency)



Removing farms from group and reward for top performance is built in to the Scorecard system, managed through independent scoring and assessment programme

Direct measures of cost efficiency are brought in as Carbon Footprint does not drive behavioural change and is not direct enough in impact

3.3.2 Conclusions from this example

The key issues emerging from this process are:

1. Simply having a Livestock Code of Practice (LCoP) in place will not result in standards being met and improving over time unless there is rigorous and independent audit additionally undertaken, together with guidance, technical support and effective use of the data.
2. The data must be robust and used to provide insight and underpin change.
3. The audit process and auditors need to be specialist and highly credible.
4. Not achieving standards or demonstrating continual improvement must have consequences for producers (financial or contractual)
5. Using a balanced scorecard approach to drive improvement in the Cost of Production and other criteria can work, but it must be well structured, measurable and practical.
6. Focussing on a few "iceberg" indicators can be more effective in driving farm improvement than a plethora of minor standards.
7. Adoption of other cross-industry schemes is possible (eg RSPCA standards for animal welfare; eg LEAF standards for Integrated Farm Management; eg Arla 360 for sustainable dairy production). All these can play a valuable role and in many circumstances could be considered perfectly adequate to meet supply chain and consumer requirements. It can be argued that they do not provide a distinctive point of difference, but they avoid the need for additional scheme development and management and represent a cost-effective, credible solution.

3.3.3 Headlines from example UK retailer LCoP and "Sustainability" standards schemes

Retailer A

Livestock Code of Practice
Typical areas of specification:
Lifetime assurance
Welfare at slaughter
Veterinary Involvement
Behavioural opportunities
Responsible use of antibiotics
Animal health
Biosecurity
Recording requirements
Under these headings a LCoP will set out minimum standards and recommendations for, eg:
Calf disbudding
Calf rearing
Pain relief
Mobility and lameness
Skin lesions
Body Condition Score
Culture and sensitivity testing for AB use
Medicine residue testing
Selective Dry Cow Therapy
Biosecurity plan
Control of infectious diseases

Balanced Scorecard	
Quality	**Points**
DHI	30
Milk Quality	5
Farm Cleanliness	5
Red Tractor	3
Biosecurity	3
Value	
Carbon Footprint	20
Dairy Variable Costs	10
Milk Supply	3
Innovation	
Environmental Management	4
Future Proofing	3
TSN Engagement	2
Sequestration	2
Staff Training & Development	2
Service	
Public Engagement	2
TSDG Conference	1
Cross-sector Initiatives	1
Workshops	3
TSDG Scholar / committee	1
Total	100

Retailer B:

Combines a comprehensive CoP with separately audited H&W and Farm standards, reflected in a RAG scorecard with milk price premiums applied accordingly.

Dairy Farm Code of Practice
Dairy cleanliness
Milk storage
Milk collection area
Milking parlour
Cow cleanliness and Milk inspection
General hygiene
Chemicals
Milking equipment
Housing, shelter and handling facilities
Feed and water
Calf management & calving facilities
Animal health & welfare
Animal medicines and biosecurity
Casualties & fallen stock
Traceability & integrity
Livestock transport
Vermin control
Environmental protection
Staff & contractors
Documents & Procedures
Ethical labour and responsible employment
Sustainability indicators
Supplemented by
Health & Welfare standards - audited and scored RAG
Farm Standard - audited and scored RAG

3.4. Farm standards – developing the case from first principles

All retailers and all supply chains almost universally will establish their farm standards scheme to ensure that it addresses these seven sustainability goals.

This is defined by sourcing milk that is produced:

1	2	3	4	5	6	7
To the highest standards of animal health and welfare	From premises that look the part, are fit for purpose, are cared for and well invested	Efficiently, with a focus on keeping production costs down wherever possible	Profitably, to allow for investment, high farm standards, a decent quality of life for the farming family and long-term sustainability	In a manner that protects and enhances the local and global environments	That cares for and develops the people (staff) involved	That respects and works with the local community

To achieve this requires that the supply chain defines:

- What the specific standards are in each category, why they are needed and to what use they will be put
- How they can be measured and recorded
- How they can be audited and verified
- What data and results will be generated
- What guidance and support will be provided
- What consequences apply for not reaching targets
- How will these standards be reviewed and evolved

Current focus on Sustainability standards - retailers and processors

In an alternative but closely related approach to the seven foundations listed above, most UK retailers are currently focussing on the six topics listed below. There is clearly considerable overlap of the two approaches:

Animal Health & Welfare	This remains core to all scheme standards with a particular focus on: reducing antibiotic use; disease control or eradication (BVD, IBR, Johnes); reducing lameness and mastitis; calf management; and ceasing male calf euthanasia – retailers and processors developing alternative, non-veal calf, market outlets; improving infrastructure and facilities to create high welfare environments.
People	Has now become a high-profile component of milk schemes, embracing as a minimum, compliance with human rights and anti-modern-day slavery legislation, but now also being more demanding in regard to staff training, development, management, succession.
Environment & Natural Resources	Typically given little consideration previously, now is taken much more seriously and will become more so in next few years. The dairy farming sector to date has a poor record in this area. In addition to meeting legal requirements for water, nutrient and soil management, schemes are now reacting to consumer-led demand for improvements in: biodiversity and habitat improvement; woodland planting; reducing waste; carbon sequestration.
Community	Engagement with the community (eg farm visits, open days, blogs, in-store visits) are encouraged within most schemes. As progress is made against all key criteria and therefore the "story to tell" gets stronger, this will likely remain an important feature.
Resilience & reinvestment	Schemes encouraging farmer training, sharing best practice, use of KPI's etc, recognising that incentives and penalties alone won't always change behaviours and performance.
Research & Development	R&D programmes exist in most retailer-led schemes, typically linked with Universities and focussed on the criteria being measured above: health, welfare, waste, efficiency etc.

Future focus on Sustainability standards - retailers and processors

The six categories of sustainability activity described above are consistent with the Promar sustainability "4-R's" model:
Responsible Sourcing; Managing Risk; Building Resilience; Unlocking Revenue

Tesco (through their Sustainable Dairy Group QVIS scheme; M&S (Select Farm Sourcing Standards and Milk Pledge Plus), Sainsbury's (Dairy Development Group), Morrisons, Aldi and Asda (Arla 360), the Co-op (sustainable dairy group), all have adopted similar approaches which address the 6 or 7 topics (depending on which model above is adopted).

In every case they rely heavily on their supplying processors, together with other 3rd-party service providers to develop and implement the detail of these schemes.

In particular, ceasing calf euthanasia on-farm and developing new market outlets for calves, together with making rapid progress towards disease eradication are high on every retailer's agenda.

In each case, there is considerable dynamism being shown to further develop and improve their schemes and ensure that they provide some differentiation and competitive advantage. In particular, those areas that are expected to remain or become core to the various schemes in the immediate future are:

Environment (local): Increasing biodiversity and providing habitat; water; soil and air quality, including ammonia emissions and particulates	Environment (global): Carbon footprint Feed sourcing footprint Reducing resource-use impact. Reducing plastic and packaging usage	Animal Welfare (including grazing and housing systems; calf management and rearing); disease control and minimising antibiotic use	Developing staff skills and capabilities; ensuring training is commensurate with needs. Engaging with consumers and the wider supply chain.

Embracing technology and data to underpin and report on changes and improvements; links to R&D programmes

The Houdbare approach is largely consistent with the above issues, although "people" and "R&D" are notably absent. It may be that this is justified given the principles of the Houdbare scheme, however some acknowledgement of them could strengthen it and make more holistic.

3.5.1.1 Farm standards: Houdbare (Sustainable) Milk – initial comments

Purpose: to deliver sustainable production at farm level, covering three aspects of production. It intends to deliver outcomes that are in excess of regulatory or mandatory requirements and recognises the need to demonstrate a robust rationale and the ability to meet consumer demands.

Animal Welfare	Input Use	Environmental Impact

Initial comments and overview

1. Elements of the scheme are innovative and imaginative and propose an interesting approach to delivering sustainable production.

2. The various criteria described conform with certain aspects of the 7 point model described in the previous slide (notably characteristics 1,2 and 5). It does not, presumably deliberately, attempt to address all components. This is valid, but additional items could be included to strengthen the scheme and deliver a more holistic sustainable outcome.

3. It is not clear what is the logic or rationale for the selection of these specific criteria as opposed to many others that could be included. Do these criteria provide scheme differentiation? Are other criteria include within legal regulatory standards?

4. It is arguable that there are elements of the proposed scheme (largely Animal Welfare) that could be set up as a Livestock Code of Practice, although having a simple, single, three-category scheme is perhaps simpler to communicate.

5. Each of the key components needs to be tested in terms of being: practical, measurable, able to audited, non-contradictory. The following slides provide a framework for doing this and an initial assessment.

6. It is important to understand whether the scheme is being "pushed" (by farmers / industry) or "pulled" (by consumer demand). Piloting the scheme to understand how practical it is and whether it drives the right behaviours is essential.

3.5.1.2 Farm standards: Houdbare (Sustainable) Milk – initial comments, con't

Purpose: to deliver sustainable production at farm level, covering three aspects of production. It intends to deliver outcomes that are in excess of regulatory or mandatory requirements and recognises the need to demonstrate a robust rationale and the ability to meet consumer demands.

Animal Welfare	Input Use	Environmental Impact

Initial comments and overview, con't

7. The link with a payment model is still to be fully determined. There are **three** components to that need to be assessed and finalised:

   (a) The costs of meeting the standards (additional capital, set-up, and infrastructure costs).

   (b) The costs of adopting different (potentially less productive) farming practices.

   (c) The financial consequences of exceeding, meeting or failing to meet the required standards.

   In a full CoP payment model – and as assumed will be the case for the Houdbare scheme - items (a) and (b) are covered by the model, by definition. ie the costs incurred are straightforwardly reflected in the milk price determined. If the model embraces a budget component, then this will reflect the future costs that the farms will be exposed to.

   Point (c) on the other hand is not covered and **there must therefore be an alternative, parallel scheme** to reward, encourage and penalise those that do not meet the standards.

   Setting up a **"Balanced Scorecard"** approach that is run in parallel with the CoP model is therefore essential. Two simple ways of doing this would be as per the following illustrations:

3.5.1.3 Houdbare (Sustainable) Milk – possible Balanced Scorecard approach

Illustration of a milk price premium scheme that operates in parallel with the CoP model.

To make this work the key requirements are:

1. Definition of "Exceeds", "Meets", "Below" and "Significant non-conformance". In each case there will be a minimum threshold and a range of performance outcomes.
2. The methodology for measuring, assessing and auditing needs then to be determined. Self-scoring (results uploaded to the Blockchain platform), along with automated data collection via connected devices, together with external 3rd-party audit would be the likely approach.
3. The timeframe for each assessment period needs to be agreed. Typically this will be annual.
4. Spot check, unannounced audits should be a core part of the programme.

Illustrative Balance Scorecard approach and rewards	Animal Welfare	Input Use	Environmental Impact
	Additional Premium, €/ltr	**Additional Premium, €/ltr**	**Additional Premium, €/ltr**
Exceeds standards	1.0	1.0	1.0
Meets standards	0.5	0.5	0.5
Below standards	0	0	0
Significant non-compliance	Suspension from scheme	Suspension from scheme	Suspension from scheme

Any given farm will receive in this example a max premium of 3 €/ltr and a min of 0 €/ltr depending on their performance across the 3 components. This is in addition to the CoP-derived base price.
Clearly the values shown here can be amended as appropriated.

3.5.1.4. Houdbare (Sustainable) Milk – alternative "QVIS" approach

An alternative approach – that adopted by Tesco and the TSDG through their QVIS system - could be replicated. This is potentially more complex but still requires that standards, methodologies, auditing , timeframes and consequences for performance levels are determined.

In a QVIS-type approach:

- Each component of the scheme is given a weighting according to its relative importance.
- Each farm is then given a score for their level of compliance with that aspect of the scheme.
- These scores are added together to give a total score allowing every farm to be ranked within the supplier population.
- Depending on the ranking, rewards, incentives or penalties can then be applied, as per the example below.
- Not having any incentives and setting up the scheme solely to measure and rank farms, with only those in the bottom tiers being affected is possible, but not necessarily motivating or as effective in driving behavioural change.

	Animal Welfare	Input Use	Environment	Total	
	Total score: 30 points	**Total Score: 30 points**	**Total score: 40 points**	**Total Score: 100 points**	**Reward?**
Exceeds standards	25-30	25-30	33-40	83-100	3€/ltr
Meets standards	13-25	13-25	17-33	43-83	1€/ltr
Below standards	6-13	6-13	9-17	21-43	0€/ltr
Non-compliant	0-6	0-6	0-9	0-21	Suspension / Exclusion

3.5.1.4 (b) Determining the level of milk price premia

The example milk price premia shown on the preceding slide, are illustrative only but are consistent with the type of payment seen in UK dairy payment schemes where premia for meeting or exceeding standards are paid in addition to a CoP payment model.

These types of premia are **not** designed to reflect implementation costs because – as previously indicated – this will vary significantly from farm to farm depending on their specific situation - but they are intended to provide a reward and incentive for participating and improving (which in turn provides additional downstream value to the supply chain). Remember that the costs of implementation are covered by the CoP model.

Nonetheless, UK examples suggest that up to 2ppl (in relation to a base milk price of c.30ppl – ie c.5-6% of the milk price and worth up to £20000 for each 1mlts produced) will provide a very attractive incentive and will typically be seen by the farmer as fair and reasonable reward for any effort and inconvenience caused – in addition to any actual additional costs covered by the model.

Higher levels of premium (approaching 10% of the milk price) would typically be seen as unnecessary, unjustified and unaffordable, whilst lower figures (2-3%) will have little incentive impact.

The incremental approach as illustrated on the previous slide (which might in a UK situation be 0.5ppl for "meet" and 1.5ppl for "exceeds" (as a combined total bonus across all categories) would be a reasonable, practical, approach.

NB: within the Tesco supply group, those farms that are Arla co-op members (as opposed to Arla Directs or Muller suppliers) are allocated a bonus for being TSDG suppliers of approx. 1.5ppl on top of the Arla milk price, as opposed to receiving the full TSDG CoP milk price (due to application of their cooperative rules). This figure has been calculated as being a fair reflection of the additional costs and the extra effort involved.

3.5.1.5 (a) Houdbare (Sustainable) Milk – initial comments

Either of these two approaches to measuring performance and driving change – along with other variations on these themes - are workable.

The non-QVIS approach is probably simpler and clearer to understand by farmers. The QVIS scoring and ranking approach only has real validity if there is a meaning to the particular score.

Of much greater importance is the support and feedback provided by the assessors, consultants and auditors that are an essential element of the scheme, to ensure that the farms to understand how they can improve their level of performance and that there are some consequences for doing so, or not doing so.

Our recommendation would therefore be the former of these two options – ie the non-QVIS approach – and then focus on ensuring that the following tests are met, notably:

- The criteria are clear, simple, robust and meaningful
- The scoring and auditing is effective, accurate and credible
- The assistance and support provided drives real and sustained change.

In relation to these tests, the following 10 slides assess each of the individual criteria but do not attempt at tis stage to build a fully-formed scoring model. As indicated on the following slide, this requires further investigation outside the scope of this report.

3.5.1.5 (b) Houdbare (Sustainable) Milk – Promar assessment of proposed criteria

- The following slides review each of the proposed Houdbare criteria in terms of practicality, scoring and auditing.

- Against each proposed standard, comments have been made that question, seek to clarify or challenge the proposition.

- Further analyses are required to determine:
  - the performance criteria for each of Exceeds, Meets, Below and Non-compliant.
  - how the scoring system will reward and encourage continual improvement as opposed to being solely a static audit of the current status.
  - the details of the scoring system – eg to include allocated points, weightings, rolling average or current performance numbers; incorporation of "change" as opposed to "absolute"?
  - can any of the criteria be considered as "recommended" as opposed to "required"?
  - which standards will drive extra cost on farm (or reduce output), and by how much – although this will vary significantly from farm to farm. This is needed to determine the most appropriate payment model, the level of costs likely to be incorporated in the model and the degree of acceptability to farmers.

The above represents a piece of work outside the scope of this current paper, as many aspects of it would need to be done in conjunction with supply chain stakeholders (including using veterinary expertise where relevant) and with greater understanding of how farmers will respond to the proposed criteria and any associated incentives or penalties.

In the attached slides, "Ease of Auditing" is categorised High, Medium, Low (HML). The basis for this analysis is:

- High: data readily available and robust, objective measurement, simple to confirm farmer statements
- Medium: data less easily available, less robust, more subjective measurement, difficult to confirm farmer statements, includes difficult calculations
- Low: little or no data or hard to access, very subjective measurement, difficult to confirm farmer statements

- Those criteria categorised as "L" may need to be re-considered as by definition the data will be questionable.

3.5.2 Houdbare standards, Animal Welfare,1 - assessment

Animal Welfare							
Item	**Description**	**Criteria**	**Rationale**	**Measurements**	**Assessment**	**Ease of auditing, HML**	**Comments**
Box (cow cubicle)	Availability	1 cubicle per cow	Cow welfare	No. cubicles / max no. cows	Farmer data entry, audit.	H	Should a surplus (eg 5%?) be considered? This allows for cow preference and social dynamics.
Box (cow cubicle)	Size, comfort of lying	Room for different positions	Cow welfare	Specify cubicle dimensions.	Farmer data entry, audit. Photo / video evidence.	M	Should "lying time" be used as a proxy for cow comfort (or in addition to this assessment)?
Box (cow cubicle)	Cubicle base type, comfort of lying	Bedding or matrass, cubicle size matched to animal size. Prevent injuries by cubicle separators	Cow welfare	Specify acceptable types and minimum quality.	Farmer data entry, audit. Photo evidence.	M	Need to determine relationships between cubicle and cow size.
Brush (cow brushes)	Opportunity for brushing	1 brush per 60 cows	Cow welfare / behavioural enrichment	No. brushes / max no. cows	Farmer data entry, audit. Photo / video evidence.	H	Is this a minimum standard? Type, siting and effectiveness of brush type?
Calves	Staying with mother	Keep with cow for maximum of 6 hours	Cow & calf welfare / calf health		Farmer data entry, audit.	L	Is this based on scientific evidence?
Calves	Colostrum	Providing colostrum as soon and as much as possible to maximize disease prevention	Calf health	Specify minimum quantities and time frame.	Farmer data entry, audit.	L	Need to specify quantities and times?
Calves	Housing	Individual housing, animals must be visible to each other. Housing in groups earliest after two weeks, good health is required.	Calf welfare	Specify housing dimensions. Quantity must exceed max no. calves in any two-week period.	Farmer data entry, audit. Photo evidence.	H	Single calf hutches, even with close proximity is not meeting highest industry standards nor reflecting latest research. Group housing considered higher welfare.

HML: High, Medium or Low

3.5.3 Houdbare standards, Animal Welfare, 2 - assessment

Animal Welfare							
Item	**Description**	**Criteria**	**Rationale**	**Measurement**	**Assessment**	**Ease of Auditing, HML**	**Comments**
Productive Lifespan	Replacement dairy cows	Minimum lifespan after first calving is 4 years.	Cow welfare, consumer expectation	Average age at culling.	Milk Recording Organisation records.	M	Assume KPI refers to average. There will be individual cows that are culled younger than 4 years. Should Mortality Rate also be measured?
Disease Control	Closed system	No inflow of replacement stock from other farms.	Cow health, disease control	Nil cows purchased or transferred in from other farms.	Farmer data entry, audit. Farm purchase and movement records	H	Are purchased animals allowed if disease losses? If heifers reared on another farm under same ownership acceptable?
General Health & Welfare	Check-up	General check-up every six months by vet. In case of injuries and other problems an actions plan is required and executed in subsequent year	Cow health, welfare.	No. of vet visits per year	Dates of vet visits - provided by vet.	M	Assume vet is required to submit a report (in agreed format?) identifying actions / SWOT. Action plan should be produced for all farms. If injuries are noted, they should be addressed immediately.
Dehorning	Removal of buds	Pain mitigation before and after	Calf welfare, consumer expectation	Specified standards and protocols for application of anaesthetics	Farmer data entry, audit. Evidence of written protocol.	M	Farmer and all staff to attend mandatory training.

3.5.4 Houdbare standards, Animal Welfare, 3 - assessment

Animal Welfare							
Item	**Description**	**Criteria**	**Rationale**	**Measurement**	**Assessment**	**Ease of Auditing HML**	**Comment**
Drinking	Cows - access to water	1 trough per 20 cows; (1 per 25 cows in case of larger troughs)	Cow welfare, health (legal requirement?)	No. of troughs / Max no. of cows	Farmer data entry, audit. Photo evidence.	H	Need to include size of trough, refill rate, cleanliness
Drinking	Calves - access to water	At all times, starting after 3 days	Calf welfare, health	Farmer records	Farmer data entry, audit. Photo evidence.	M	Need to specify clean water, how often changed? Access to long fibre?
Feeding	Cow feed space	1 feed space per cow	Cow welfare,	No. of feed yolks / max no. of cows. Specify cm of feed space per cow if individual yolks not used.	Farmer data entry, audit. Photo evidence.	H	Feed space can vary according to system type, feeding frequency etc. Need also to assess rumen fill?
Floor	Surface type	No slats; solid floor; separate dung collection. To be realised in new buildings (not retro-fitted).	Cow welfare, consumer expectations		Farmer data entry, audit. Photo evidence.	H	Accept that retro-fit may not be practical. However, if slatted system exists, should a solid floor loafing area be provided? Cows need opportunity to walk on solid floor.
Floor	Space per cow	6m2 / cow	Cow welfare, cow behaviour, consumer expectations	No. m2 of walking and bedded area / max no. cows.	Farmer data entry, audit.	H	Is this a minimum standard or should a more challenging aspirational target be set.

3.5.5 Houdbare standards – Animal Welfare, 4 - assessment

Animal Welfare							
Item	**Description**	**Criteria**	**Rationale**	**Measurement**	**Assessment**	**Ease of Auditing HML**	**Comment**
Grazing	Cows - access to pasture	Minimum 180 days x 8hrs/day (except for drought or wet conditions).	Consumer expectations	No. of days and avg hours per day grazing in 365 day period.	Farmer data entry from cow calendar; audit; Time stamp photo evidence through grazing season	M	How are drought or wet conditions defined? By whom? What are protocols in these circumstances?
Grazing	Youngstock - access to pasture	Determined by bearing capacity of soil. Youngstock should not graze when soil bearing capacity is too low and risk of poaching or reduced feed intakes	Consumer expectations	No. of days and avg hours per day hours grazing in 365 day period.	Farmer data entry from cow calendar; audit; Time stamp photo evidence through grazing season.	M	How is soil bearing capacity measured? By whom? What are protocols in these circumstances?
Transport	Minimum age or weight	2 weeks when in good health, otherwise wait until in good health.	Calf welfare, consumer expectations	Age of calves when transported	Farmer data entry; audit. Photo record of calf health assessment by vet.	M	How is "good health" (or not) assessed? Is a vet certificate required?
Transport	Time or distance	Max 4 hrs or 250km	Cow and calf welfare, consumer expectations	Kms and hours transported. Destination recorded	Farmer data entry; audit. Photo record of transport certificate.	L	Cull cows and calves? Are any dispensations allowed? What if no suitable destinations within these parameters?

3.5.6 Houdbare standards – Farm Inputs, 1 - assessment

Farm Inputs							
Item	**Description**	**Criteria**	**Rationale**	**Measurement**	**Assessment**	**Ease of Auditing HML**	**Comment**
Feed - concentrates	Proportion of ration	<20% of feed intake	Sustainability, consumer messaging	Total kg concs per cow per year / total fresh weight of all feed consumed. Or energy calculation on total yield?	Farmer data from feed records; data download from feeding system; Audit	M	Assume is fresh weight not DM. How is the total kg of forage determined? Use Milkminder-type costings. Could Feed rate (kg/ltr be used instead? Set target at eg max 0.3kg/ltr?
Feed - concentrates	Origin of ingredients	100% European, only human inedible co-products from food and drink industry. No restrictions in case of own crop production.	Sustainability	n/a	Farmer data entry; photo record of feed supply certificates	M	Will these criteria be possible to prove in all cases. Is a list of approved products required?
Feed - concentrates	Soya or Palm products	n/a	Sustainability, consumer expectations	n/a	Farmer statement that no soya or palm products used. Photo record of feed supply	M	Might be difficult to achieve absolute confirmation that concentrates and blends contain no soya or palm.
Feed - concentrates	GMO	100% non-GMO	Sustainability, consumer expectations	n/a	Farmer statement that no GM products used. Photo record of feed supply certificates	M	Assuming no soya or imported maize products are used such that GM free can be verified.
Crop protection	Prohibited products	No Glyphosate in case of green manuring. No application of chemical pesticides in grassland	Sustainability, consumer expectations	n/a	Farmer statement that no Glyphosphate or chemical pesticides products used. Audit through farm accounts.	M	
Energy	Electricity	Strive to reduce energy use below average (Max 50kwh/1000kg milk)	Sustainability, reduce CO2 footprint	Total KWh per year / total milk output per year	Farmer data entry from farm records; audit.	H	What does "strive" mean? What are implications if target is not met? Should a 3-year period of reduction be allowed?
Energy	Electricity	100% green electricity	Sustainability	n/a	Photo record of contract with electricity supplier.	H	Allow one year to switch to 100% green contract?
Energy	Gas	No gas permitted in new sheds	Sustainability	n/a	Farmer statement that gas is not used in new sheds; audit.	H	Why is gas being used? Should it be removed in existing sheds?

3.5.7 Houdbare standards – Farm Inputs, 2 - assessment

Farm Inputs							
Item	**Description**	**Criteria**	**Rationale**	**Measurement**	**Assessment**	**Ease of Auditing HML**	**Comment**
Land-bound systems	Relationship between land in use and livestock numbers	All cattle manure to be applied to own land	Sustainability, soil and water management, consumer expectation	Tonnes manure applied	Farmer statement that no manure exported; audit	M	Could Stocking Rate also be used? (Total LSU / Total land in use)
Land use	Exchange for bulbs	Not allowed	Sustainability, soil management	n/a	Farmer statement that no land is used for growing bulbs; audit; photo record of field records.	H	SFP requirements
Nutrients	Input / output balance	Nutrient management system	Sustainability, soil and water management	Total kg NPK inputs and outputs calculated	Detailed farm records and NPK calculator required. Output used for farmer data entry; audit	H	Calculators already available (in eg Milkminder)
Nutrients	Phosphate	Allowance for neutral P balance at farm level	Sustainability, soil and water management	Total kg P inputs and outputs calculated	Slurry and manures must be tested for P content and DM. Field application records required; Farmer data entry; audit	H	Calculators already available (in eg Milkminder)
Nutrients	Nitrogen	Max 75kg/ha	Sustainability, soil and water management	Total Kg N (organic and inorganic) / total land in use	Slurry and manures must be tested for N content and DM. Field application records required; Farmer data entry; audit	H	Calculators already available (in eg Milkminder)
Nutrients	Manure digestion	Not relevant		n/a			
Roughages	Sourcing policy – distance	<50km distance	Sustainability, local production	Km travelled	Farmer statement that the feeds have originated within 50km of farm; audit; photo record of delivery ticket.	M	
Emissions	GHGs	Flexible	Sustainability	n/a	Not measured?		If all other highlighted measures are adhered to, then CO2 footprint will be minimised

3.5.8 Houdbare standards – Farm Inputs, 3 - assessment

Farm Inputs							
Item	**Description**	**Criteria**	**Rationale**	**Measurement**	**Assessment**	**Ease of Auditing HML**	**Comment**
Permanent Pasture	Area of permanent pasture	Minimum 85% of the total farm area. No exchange of PP with arable land (incl maize silage). Grassland renovation only by no-tillage systems. For biodiversity reasons and preventing loss of soil organic matter	Sustainability, soil management biodiversity	PP area as % of total farmed area.	Field records; Farmer statement; audit	H	
Crop rotation and co-operation with arable farmers	Area	Temporary pasture (ley) maximum 3 years, preferably using a grass-red clover mix. To prevent leaching of nitrate. No exchange for bulbs allowed. Preference for growing leguminous concentrate replacers As these provide protein, don't, need synthetic fertilizer N and provide a flowering crop. This will contribute to biodiversity.	Sustainability, soil management, biodiversity	Period of production of any short-term leys.	Field and rotation records; Seed mix records; Farmer statement; audit	H	

3.5.9 Houdbare standards – Biodiversity and Natural Landscape, 1 - assessment

Biodiversity and natural landscape							
Item	**Description**	**Criteria**	**Rationale**	**Measurement**	**Assessment**	**Ease of Auditing HML**	**Comment**
Habitat for farmyard birds	Access to buildings	Assessment by ecologist. Food safety regulations still apply. In case of insufficient opportunities a plan of action to be made and executed in following year.	Biodiversity, consumer messaging	Professional, subjective assessment	Annually?; Report provided; farmer data entry; audit	M	This is not a binary decision. Should there be minimum standards?
Habitat for farmland (and woodland) birds		Participation in Farmers Nature Cooperation scheme. Plan for farmland bird protection required, developed with Co-operative.	Biodiversity, consumer messaging	Professional, subjective assessment	Annually? Report detailing agreed plan provided; farmer data entry; audit	H	
Pets	Cats	Keeping cats inside and feeding them. To prevent predation of younger birds.	Biodiversity		Farmer statement of compliance; farmer data entry; audit	L	Very hard to monitor and audit. What are consequences of not complying? Could an outcome measure (eg bird population) survey be used? What about cats role in killing vermin?
Farmyard and farmland landscape	Trees, shrubs etc	Presence of farm yard vegetation (woodland; tree cover, hedgerows?) - region specific. Assessed by ecologist (or specialist within Co-operative). If not sufficient, action plan to be executed in following year.	Biodiversity, consumer messaging	Professional, subjective assessment	Annually; report provided; farmer data entry; audit	M	This is not a black and white decision. Should there be minimum standards?

3.5.10 Houdbare standards – Biodiversity and Natural Landscape, 2 - assessment

Biodiversity and natural landscape							
Item	**Description**	**Criteria**	**Rationale**	**Measurement**	**Assessment**	**Ease of Auditing HML**	**Comment**
Herb-rich pasture	Increasing water table in wetland pastures	To be organised with Co-operative when applicable.	Biodiversity, soil and water management	Monthly? Water table depth profile	Professional, measured, assessment. Farmer data entry; audit.	M	What are the impacts on farm productivity? Will this be compensated within the CoP model?
Field margins	Management	Arable farming: no crops on margins, growth of wildflowers, region specific. Grassland: no manure or synthetic fertiliser on field margins. Leaving over in case of cutting, open for grazing. Species to be defined by Co-operative.	Biodiversity. Soil management		Farmer statement; field records; farmer data entry; audit; time stamp photo records.	M	Are there impacts on farm productivity? Will this be compensated within the CoP model?
Landscape features	Hedgerows, ditches etc	2-5% of farmed area; region specific landscape structures. Active maintenance of all features.	Biodiversity, consumer messaging	% of total farmed area represented by hedges and ditches.	Farmer statement; field records; farmer data entry; audit; time stamp photo records.	M	Why as broad a range as 2-5%? What's the incentive to increase this year on year? Any requirements to how well managed or how biodiverse-rich they need to be? What constitutes "active" maintenance?
Landscape features	Ditches around farmyard	Present. Flexibility for replacing in case of farmyard extension. Replanting in year subsequent to extension. No cutting in breeding season.	Biodiversity, consumer messaging		Farmer statement; field records; farmer data entry; audit; time stamp photo records.	M	What constitutes "present"? Are minimum standards required?

3.6.2 (a) Farm standards: Houdbare – Sustainable Milk - summary

Overall, the proposed standards and approach defined for Houdbare milk are workable and should ensure high standards of dairy production that will meet consumer expectations, but there are concerns about how straightforward they are to audit and further thought needs to be given to the linkage of the individual criteria into an holistic whole.

A strategic gap analysis versus the seven sustainability goals would be worth undertaking to determine, strategically, why certain aspects are not addressed and if those gaps need to be filled. The current focus on Animal Welfare, Farm Inputs and Environment may be sufficient to provide Houdbare Milk with a competitive market position, but presenting a more complete and holistic set of standards may carry greater value.

A tactical GAP analysis highlights certain areas of Animal Welfare management that are currently not addressed, for example:

- Antibiotic use (cows and calves) – maximum allowable use
- Youngstock housing and management
- Mastitis and Somatic Cell Counts – maximum allowable incidence
- Mobility and Body Condition Scoring – defining minimum standards
- Staff training; written protocols; record keeping – defining expectations to demonstrate management capability

There is a need to specify the standards determining each of Exceeds, Meets, Below, Non-compliant.

There is a need to specify the overall scoring system – weightings, totals, link to points or payment

Further work is required to conclude how the data will be collected, collated and audited. The assumption, expressed in the above tables, is that much of the data can be entered by the farmer on the (Blockchain) platform, together with automated data capture from connected devices. This is highlighted in the previous slides.

The role of 3rd party auditors remains critical. Even though much of the data can be collected automatically and with photo-evidence helping to provide verification, an objective audit will provide essential scheme robustness and credibility.

3.6.2 (b) Farm standards: Houdbare – Sustainable Milk - summary

Key next actions:

1. Conclude the proposed Houdbare Standards:

- Confirm all components of the Houdbare Standards – workshop with agreed stakeholders
  - Principles - keep the number to a minimum to simplify uptake and implementation; don't replicate anything that is already in other farm compliance scheme; ensure all standards have a purpose, are measurable, and will drive change
- Test, review and amend the proposed standards through a pilot project
- Finalise a Houdbare document that details every aspect – content and implementation – of the scheme:

Houdbare Standards – section name							
Item	**Description - of specified activity**	**Criteria – of what is expected**	**Rationale – for the inclusion of this standard**	**Measurement – of performance**	**Differentiation between "Exceeds, Meets, Below, Non-compliant"**	**Assessment methodology**	**Audit process details**

2. Develop a "business case" proposal

- To accompany the technical proposal, develop a "business case" document, drawing on the "Benefits" and other principles set out in this report. Use this to determine the interest amongst retailers

3. Establish an Implementation & Operations Plan, to include:
   - Roles and responsibilities,
   - Resources, systems, processes
   - Support and communications
   - Timeframe and roll-out
   - Governance and scheme management procedures
   - Costs

4. Blockchain technology

4. Blockchain technology

Tasks as defined in the Proposal

- Overview
  - Summary of the applicability (or otherwise) of Blockchain technology to this project, illustrating how Blockchain can facilitate the desired supply chain model (i.e. a direct relationship between the retailer and the producers, contracting out to a toll processor as required)
- Analysis of, mapping of and response to the key questions outlined in the Netwerk Grondig project plan:
  - What scope and functionality does Blockchain offer to record the agreements and transactions within the proposed retailer-producer dairy supply chain
  - Specifically, which transactions can be recorded by Blockchain (covering both Cost of Production and Farm Standards activities)
  - Outlining the advantages and disadvantages of handling transactions and managing supply chain activity and relationships with Blockchain
  - Determining the level of support among retailers and dairy farmers for using Blockchain within this system
  - What should a Blockchain solution look like for this concept
- Additional analysis: the report will build on these issues and provide an overview of the potential and practicalities of a Blockchain solution in this project:
  - What Blockchain technology solutions are already available, and if so, could they be adapted to this project
  - What Blockchain providers could be brought in to support the project
  - What does the process of building a Blockchain solution look like

Report contents 4 - Blockchain

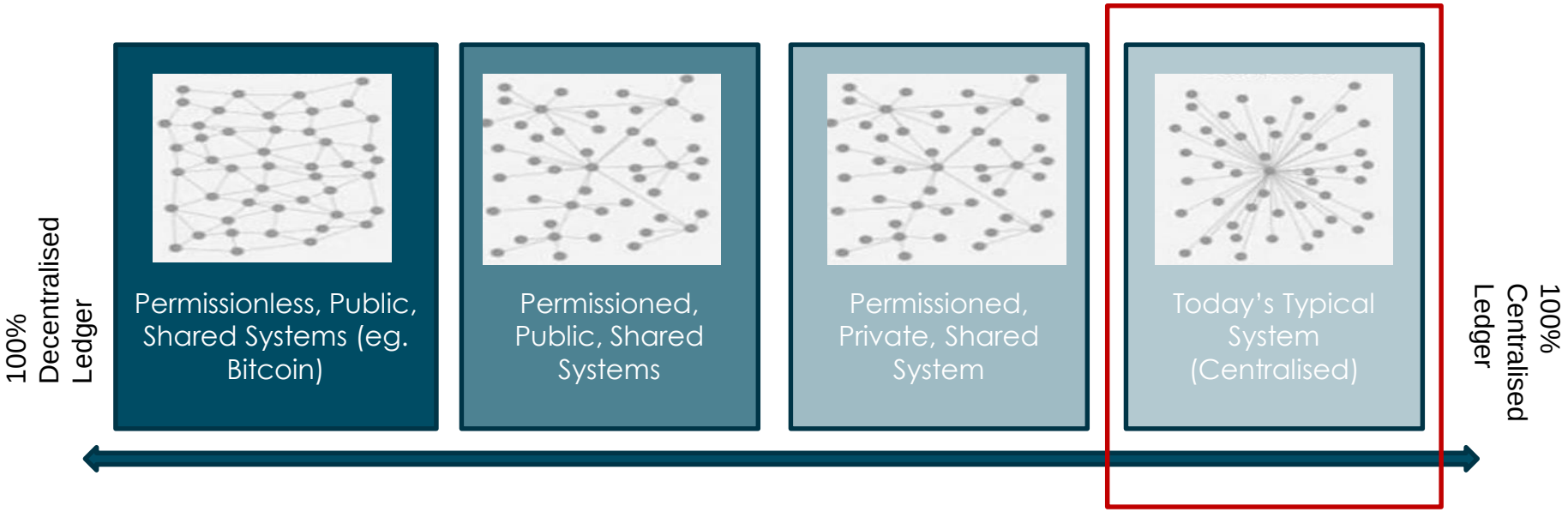
1. Overview
    1. Purpose, benefits, objectives, challenges
    2. Characteristics of a successful retailer-led dairy supply chain
    3. Assessment of UK retailers in this regard
    4. Governance and management
2. Cost of Production
    1. Principles and model options
    2. Key components and questions regarding a CoP approach
    3. UK CoP model illustration
    4. Assessment of Netherlands costings – applicability for CoP model
3. Farm standards
    1. Overview
    2. UK dairy supply chain standards assessment
    3. UK dairy supply chain development illustrations
    4. Fundamentals of a successful dairy sustainability scheme
    5. Assessment of Houdbare milk scheme
    6. Summary and recommendations
4. **Blockchain as a possible platform for a retailer – producer dairy supply chain**
    1. **Overview of Blockchain; what it is; types of network**
    2. **Benefits of Blockchain, uses and advantages in food supply chains; barriers to use**
    3. **Establishing a Blockchain network; set-up and transaction costs examples; possible suppliers**
    4. **Blockchain analysis and solution for the proposed retailer – supplier supply chain**
    5. **Summary and recommendations**

4.1.1 Overview: what is Blockchain Technology?

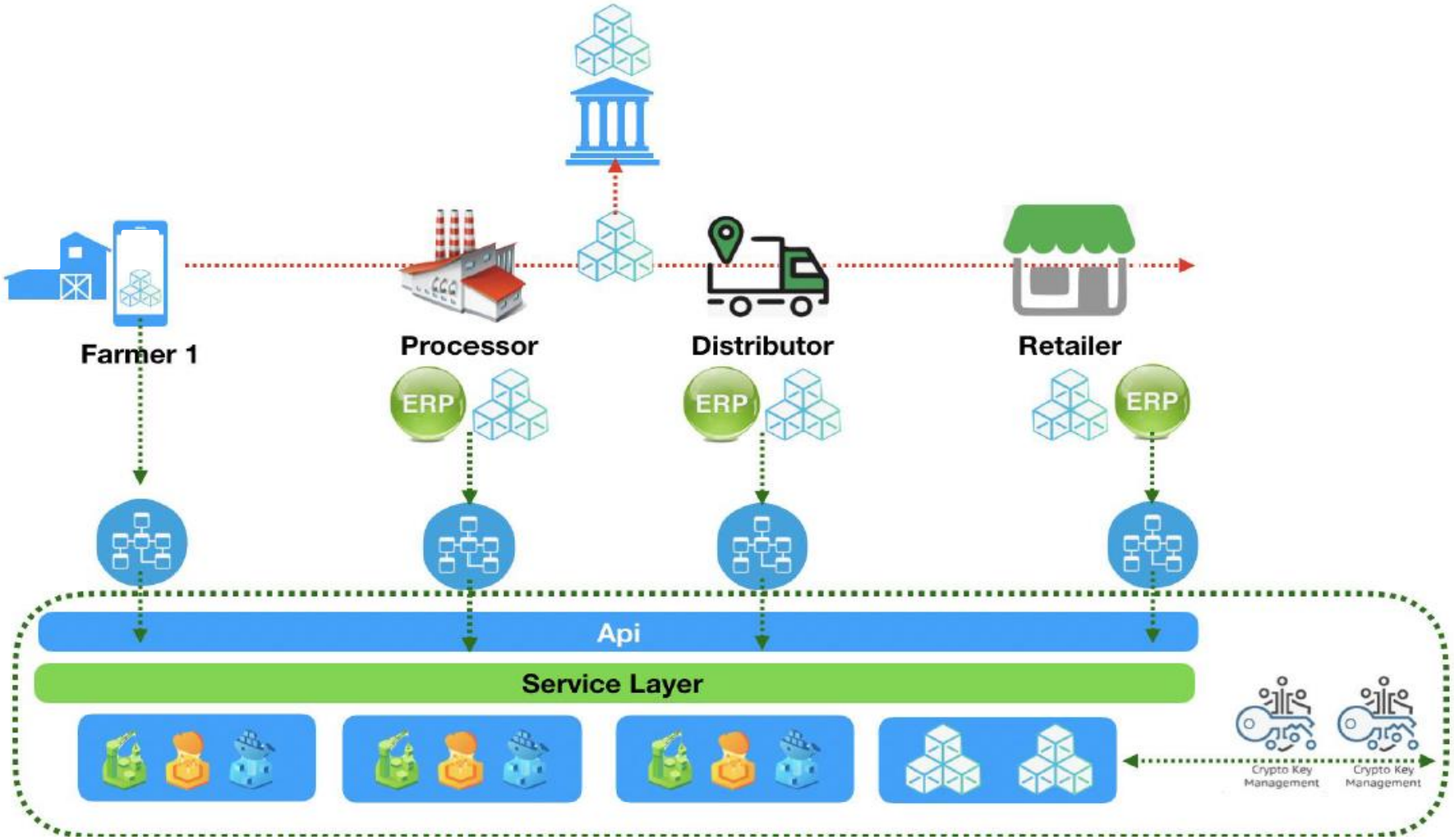
Blockchain Technology is a distributed ledger system (online database) that enables visibility and connection of information about the supply chain, from producer to the consumer, which is "immutable" (cannot be changed) and which is visible to all permissioned users.

The transactions are sealed using encrypted 'keys' ensuring the ledger to be verifiable and permanent.

There are different types of Blockchains available: private, public and hybrid(consortium). To achieve the desired supply chain platform a permissioned private also known as 'Hybrid' blockchain would be most appropriate for the Houdbare scheme (embracing farm standards, CoP and physical milk supply) .



Blockchain creates a continuous list of records and transactions which are secure, distributed and encrypted. The chain supports the recording of transactions be recording of transactions between multiple parties efficiently and in a verifiable and permanent way.



4.1.2 Types of Blockchain networks

All data types collected for the supply chain in question can be recorded through a blockchain system. There are multiple ways the data can be recorded depending on how the blockchain is configured:

1. Public or permission-less blockchain - are decentralized and are visible to the public. Anyone can join or leave the blockchain and anyone can verify and append transactions to the blockchain. This type of blockchain facilitates participants who may not know each other to conduct transactions.

2. Hybrid – a semi- private blockchain which is decentralized. Also known as a "consortium" formed by a group of members which control the blockchain. Verifying and adding records to the blockchain is based on a consensus mechanism by a pre-selected set of objectives i.e. KPI's known as 'nodes'.

3. Private - this is controlled by a centralized entity. Only those with specific authentication and permission can be part of this network and thereby can verify and add records to the blockchain.

4. Smart Contracts - self-executing agreements that are triggered on the basis of predefined and agreed events (for example a certain butterfat % has a market price of X ppl; or meeting a particular farm standard triggers a premium payment of Y ppl). The "smart" in a smart contract comes from the fact that the clauses in the contract are evaluated and the appropriate code executed without human intervention

There is no limit to the amount of data recorded. However the capabilities of the blockchain are determined by which network is chosen. Each network is different and some may charge. A table of blockchain networks can be seen on the next slide. There are 6 networks described to illustrate the difference in ability i.e. transaction per second difference.

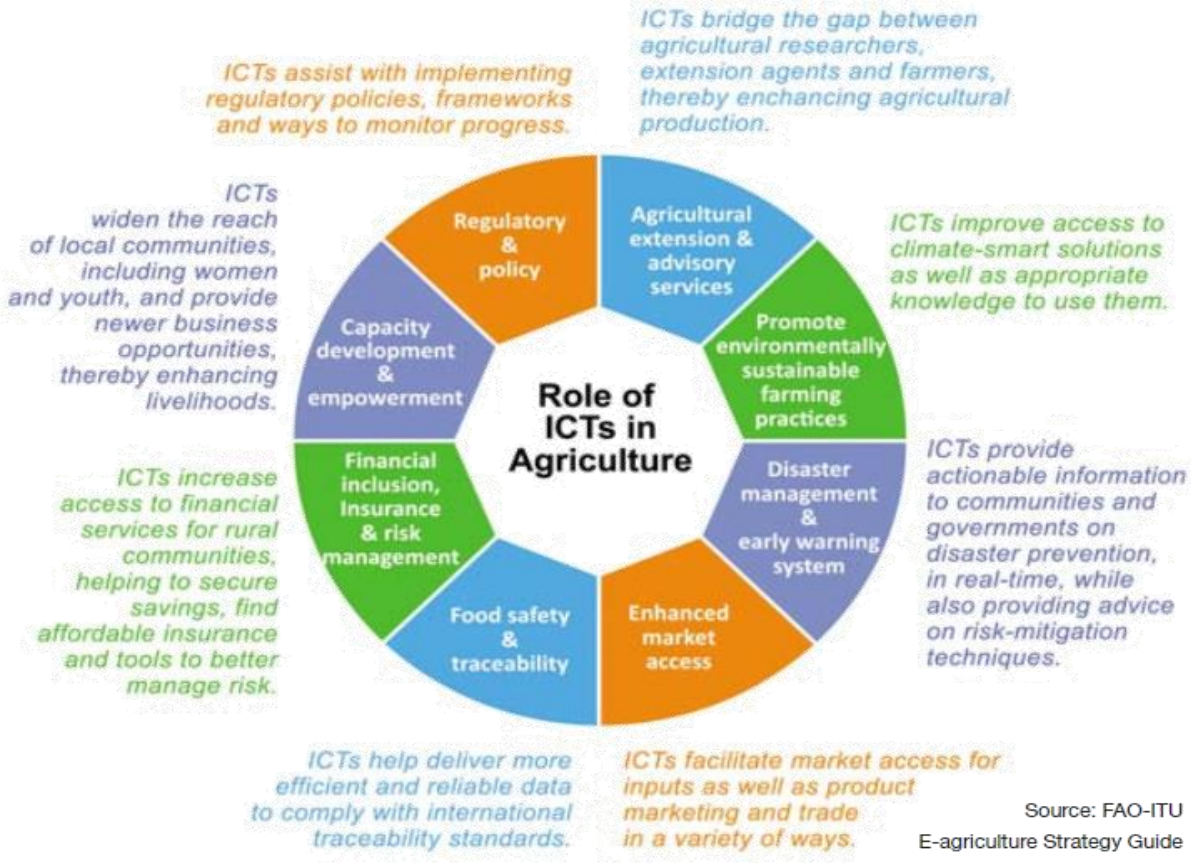
Similarly the algorithm used can also effect the capabilities of the blockchain examples include 'Proof-of-Stake or Hyperledger'.

4.1.3 Blockchain network examples

Example of Companies	Primary Focus	Developers	Tokens	Speed of Transactions (Transactions/sec)	Coding Language
Bitcoin	Digital Cash System	Community of code developers	Bitcoin	7	C++
Ethereum	Smart Contracts	Ethereum Foundation	Ether	15	Solidity
Ripple	Connection of payment systems	Large venture based start up	Ripples (XRP)	1500	JavaScript
NEO	Smart Contracts	On-chain	Neo, GAS	1000+	C#, NET
Steller	Unbanked	Community of code developers	XLM	1000	JavaScript
Hyperledger Fabric	Smart Contracts	Linus Foundation	N/A	Up to max 700	Golang
EOS	Smart Contracts	Community of code developers	EOS	3000+	C++

4.1.4 The role and possibilities of Blockchain solutions

Blockchain technology works well with information and communication technologies (ICTs). The agricultural industry is rapidly adopting digital solutions to address agriculture challenges. These technologies range from the traditional mobile phone, television, radio and the internet to the Internet of Things(IoT), big data analytics and information systems, drones and remote sensing using geographic information systems (GIS), mobile applications, and machine learning and artificial intelligence (AI).



Source: FAO-ITU
E-agriculture Strategy Guide

Examples of new technology applications

Internet of things: Checking soil health, introducing the traceability of products

Big data analytics: Customized weather and agriculture advisory services, e-agriculture marketplace information, disaster alerts

Blockchain: Smart contracts, improved supply chain monitoring, food safety, insurance

Drone and GIS based applications: Land use mapping, crop monitoring, productivity estimation, weather advisory services

Articial intelligence: Plant disease detection, weather prediction, climate change analytics

4.2.1 Benefits of Blockchain technology in the supply chain

Farmer: Prove the farm is not a source of outbreak, antibiotic usage, KPI's, ease of connectivity, and enable insights from benchmarking.

Manufacturer: Instil trust between retailers, suppliers and consumers, automation and reduce manual certification.

Wholesale and Distributed: Conduct targeted recalls, enable internal data sharing, supply chain efficiency.

Food logistic companies: Ability to meet compliance standards, reduce manual processes, increase efficiency of forecasting.

Retailer: Assurance to customers of safe and transferable food, conduct target recalls quickly, enable insight from data.

Customer: Increased transparency, reduced risk of food fraud, increased trust.

Certification & Regulation: Reduce fraudulent activities, increase renewal speed, reduce unnecessary testing an identify contamination.

4.2.2 Advantages and disadvantages of Blockchain in a producer – retailer model

Advantages	Disadvantages
Saves Time Transaction time from days to near instantaneous	Data Consistency and Safety,
Removes Cost Overheads and Intermediaries	Finance – Resource cost of people and training
Removes Risk Tampering, fraud & Cyber Crime	Time
Increases Trust Through shared processes and recording	*"…you will spend a lot of time cleaning information and managing those databases "*
Increases Transparency Distributed ledger allows supply chain transparency	

** It should be noted the disadvantages present can be overcome*

4.2.3 Barriers to Blockchain uptake

Lack of Trust among users	Regulatory Uncertainty
Ability to bring networks together	Intellectual property concerns
Separate blockchains not working together	Governance and Audit/compliance concerns
Inability to scale	

Based on a mixture of desk research and Interviewee responses.

4.3.1 Establishing a Blockchain solution

The consensus opinion from interviewees and industry experts suggests a 'Hybrid' blockchain would be suited to deliver the desired outcome for the retail – producer aligned relationship as proposed by Netwerk Grondig.

Whilst a blockchain platform is not strictly necessary for the supplier-retailer platform, it offers an opportunity in the future and first-mover advantage in to the technology.

There are typically considered to be eight steps in building a blockchain solution. The process underpins the structure, running, maintenance, and capabilities of the blockchain system, and consequently, the decision to use a third-party company or in-house system.

The eight steps are:

1. Determine the Blockchain algorithm
2. Determine the Blockchain network
3. Design the Blockchain Nodes (identify who can access / control the blockchain)
4. Configuration
5. Create the application programming interface
6. Create the admin and user interfaces
7. Adding any additional features (eg for KPI generation)
8. Undertake a pilot study

4.3.2 Blockchain costs: set-up, transactions costs and support

Matt Singth, CEO of Blockstation, views on implementation costs and support levels needed:

There is usually no cost to use networks and no network running costs. However this may depend on farm infrastructure. The network runs from existing computers. Although there could be additional hardware cost:

"Some cost at times to implement transactions and access data."

"Setting up is one level, maintaining is another level."

"Would be a quote to build something and build an interface that farmers could use."

The level of support is still being researched however there would need to be initial support for set up, and transitional phase:

"Hardware components, IOT enabled devices, need help to set up and if something breaks. Someone to make sure and is always looking to see if network is efficient and whether software need updating. A consulting partner is needed for upgrades."

The end-user interface is equally as important. The farmer needs an easy-to-use interface so the support amount is reduced.

The interface is the biggest challenge to blockchain and adoption. A pilot study is typically used to reduce likelihood of any problems and create a user-friendly system i.e. a mobile app.

Blockchain could also be developed using existing infrastructure e.g. excel sheets, or current databases.

4.3.3 Blockchain solution, concept and third party providers

Viant www.viant.io	Viant is a blockchain-based platform for modeling business processes, tracking assets and building the supply chains of the future. Leveraging cryptographic security and smart contracts, Viant provides organizations verifiable insights as assets are managed and propagated through the entire supply chain.
Filament www.filament.com	Filament lets you build a connected business without becoming an expert on security, scalability, or network stacks. Blanket a factory in sensors, or control the streetlights of an entire city – Filament's standalone networks span miles and last for years, all without WiFi or cellular connection. The Filament Tap lets you deploy a secure, all-range wireless network in seconds. Taps can talk directly to each other at distances of up to ten miles, and since each Tap has BLE, you can connect them directly to your phone, tablet, or computer. With built-in environmental monitoring, a USB port for your own sensor or device, and a battery life of up to 20 years, it's the perfect grab-and-go connectivity solution
Ambrosus ambrosus.com	Combining high-tech sensors, blockchain protocol and smart contracts, we are building a universally verifiable, community-driven ecosystem to assure the quality, safety & origins of products.
Provenance Provenance.org	Provenance uses blockchain technology to track products through the supply chain: materials, ingredients, and impact, to provide consumers with greater transparency about a product's authenticity and origin. Its use of the technology – in the format of a real-time data platform – allows the end user to see each step of the journey the product has taken: where it is, who has it, and for how long? Producers can benefit from this increased authenticity when telling the story of their goods.

4.3.4 Blockchain solution, concept and third party providers, con't

Full Profile fullprofile.com.au	Full Profile is enabling real-time transactions for farmers through "smart contracts" that run on blockchain. Because pre-approved logic can be built into a blockchain—as long as all parties have opted in—payments can be made immediately following the transfer of asset ownership. Full Profile has estimated that supply chain risk, inefficiencies, and insolvency cost the Australian grains industry AUD 1 billion, a significant proportion of which can be recouped through blockchain solutions.
Arc-net arc-net.io	Arc-net connects every step of a product's journey to deliver supply chain transparency and product security. The Arc-net toolset provides an easy to use scalable platform, powering the strategic insights that unlock profit.
Agriledger Agriledger.com	Small co-operatives are currently by far the best way to improve efficiency in developing countries and help farmers retain a bigger share of their crop value. Co-ops presently rely on paper-based records, verbal promises, and complicated agreements; this frequently causes critical problems because of a lack of transparency, restricted access to price data, lying, graft, and corruption. AgriLedger is a mobile app that records and transacts incorruptible truth using blockchain technology. It is a complete framework of integrated services for delivering an even playing field to farmers and co-ops. This solid framework of trust allows everyone to know they are working, buying, selling, and sharing things according to a cryptographic "book of truth" that is utterly incorruptible.

4.4 A Blockchain solution for the proposed Houdbare milk scheme

A blockchain solution for the Houdbare Milk supply chain would need to embrace three related flows of data and transactions:

1. Farm Standards

2. Milk traceability & supply chain data

3. Cost of Production (and / or market) data

4.4.1.1 Data flow 1: Farm Standards, option 1

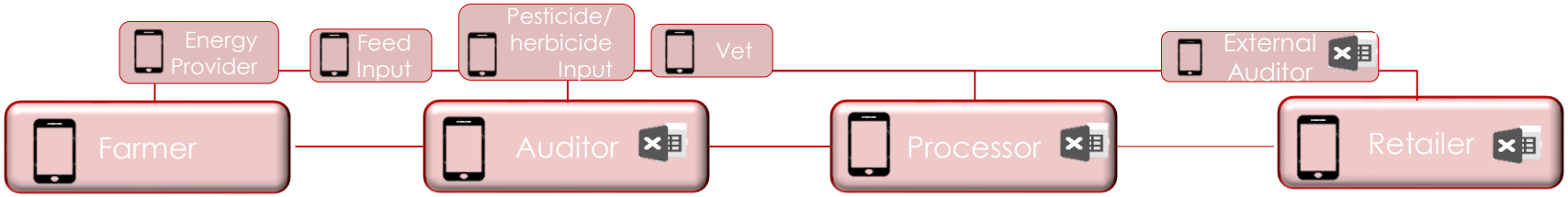
There are two possible blockchain information flows we propose for the Farm Standards component of the Houdbare Milk scheme (shown below and next slide).

The advantage of blockchain is the ability to replicate information, which therefore means the stakeholders (who are permissioned on the system) can see information easily.

Diagram (a) illustrates a fully replicated flow of data.

The information required will be captured via an App which uploads to the Blockchain database. Information can be downloaded to excel if required. The App should be accessible from a smart phone, laptop or tablet device for simplicity and consistency of data input.

a

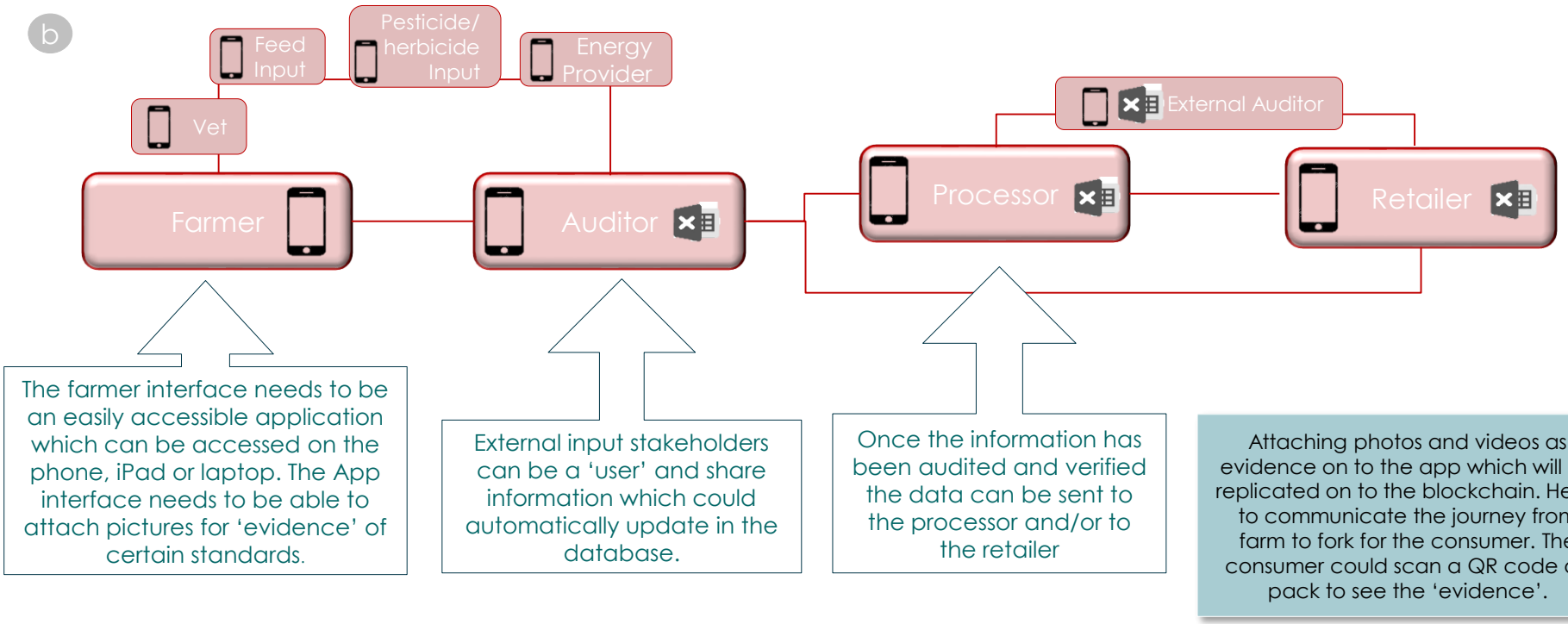


Attaching photos and videos as evidence on to the app which will be replicated on to the blockchain. Helps to communicate the journey from farm to fork for the consumer. The consumer could scan a QR code on pack to see the 'evidence'.

4.4.1.2 Data flow 1: Farm Standards, option 2

Diagram (b) illustrates a more reliable approach as the information presented to the processor and retailer is checked by the auditor before being made immutable on the blockchain.

As with (a), information will be captured via an App.



4.4.1.3 Data flow 1, Farm Standards data capture (Animal Welfare 1)

Animal Welfare					
Item	**Description**	**Criteria**	**Evidence**	**Permissioning the transaction before it uploads on to the blockchain?**	**Opportunity to automate?**
Box (cow cubicle)	Availability	1 cubicle per cow	A time stamped photo could be provided by the Farmer and attached. Likewise the amount of cubicles and cows on farm at anytime.	Farmer Auditor	N/A
Box (cow cubicle)	Size, comfort of lying	Room for different positions	Manually captured and entered on to a application. Attach a video for evidence.	Farmer Auditor	N/A
Box (cow cubicle)	Floor type, comfort of lying	Bedding or mattrass, cubicle size matched to animal size. Prevent injuries by cubicle separators	Manually captured and entered on to a application. Could use a picture for evidence and enter the floor type and animal size /or average animal size.	Farmer Auditor	In the future could use AI technology in cameras to determined the surface material.
Brush (cow brushes)	Opportunity for brushing	1 brush per 60 cows	Manually capture the amounts of brushes on farm and the amount of cows housed on farm at anytime. Possible could attach a time stamped video for proof.	Farmer Auditor	N/A

Inputting farm standards data on a blockchain system would consist of the farmer predominantly collecting the data on a user friendly app which can be accessed by a smart phone, tablet device or laptop. The data will be held on a 'icloud' database. The database is non-amendable once the transactions are verified by the stakeholders. Additionally all farm standards can be recorded on the database.

A farm standards platform does not need to be on a blockchain system, however the opportunity with automation offers potential with a blockchain platform in the long term. Automatic collection of data and the ability to almost instantly replication the data collected on all devices is the main advantage in the long term.

4.4.1.4 Data flow 1, Farm Standards data capture (Animal Welfare 2)

Animal Welfare					
Item	**Description**	**Criteria**	**Evidence**	**Blockchain permission**	**Opportunity to automate?**
Calves	Staying with mother	Keep with cow for maximum of 6 hours	The farmer would have to say Yes/No manually on the app. And double checked by a Auditor or video surveillance as 'proof' of the time period.	Farmer Auditor	N/A
Calves	Colostrum	Providing colostrum as soon and as much as possible to maximize disease prevention	The farmer would have to manual input how long it was before the colostrum was given. Could link up to milk powder amount bought and amount of calves on the farm at any given time.	Farmer Auditor	N/A
Calves	Housing	Individual housing, animals must be visible to each other. Housing in groups earliest after two weeks, good health is required.	The farmer would have to input manually on the app if calves can see each other. And attach a picture as evidence. If there is not group housing, a picture and reasoning needs to be submitted to the app.	Farmer Auditor	Potentially sensors with EID tags which can tell you which calves are in which group pens.
Productive Lifespan	Replacement dairy cows	Minimum lifespan after first calving is 4 years.	Input the data manually on to the app. Could have a list of dates of birth linked to the government database therefore when a cow is no longer in the herd. It would automatically update if this action has been performed.	Farmer Auditor	Link up to a management tool such as 'Herdwatch'.

4.4.1.5 Data flow 1, Farm Standards data capture (Animal Welfare 3)

Animal Welfare					
Item	**Description**	**Criteria**	**Evidence**	**Blockchain permission**	**Opportunity to automate?**
Disease Control	Closed system	No inflow of replacement stock from other farms.	Yes/No input to the app and the system could be linked up to a herd management app such as 'Herdwatch' so this action could be automated by knowing where each animal has originated from. Or a picture of cattle passports can show where the cow has come from.	Farmer Auditor Government Record	Link up to a management tool such as 'Herdwatch'.
General Health & Welfare	Check-up	General check-up every six months by vet. In case of injuries and other problems an actions plan is required and executed in subsequent year	The Vet should be able to access the system and update yes/no that he has done the correct checks and when he has done them and what he has done. If there are any problems are picture should be taken as proof. The farmer should enter that yes/no a vet has been.	Farmer Auditor Vet	N/A
Dehorning	Removal of buds	Pain mitigation before and after	Manually captured and entered on to a application. Enter the amount of dosage, which animals and day.	Farmer Auditor Vet	N/A

4.4.1.6 Data flow 1, Farm Standards data capture (Animal Welfare 4)

Animal Welfare					
Item	**Description**	**Criteria**	**Evidence**	**Blockchain Permission**	**Opportunity to automate?**
Drinking	Cows - access to water	1 trough per 20 cows; (1 per 25 cows in case of larger troughs)	A farmer should manually insert information in to the App; amount of cows on the farm at anytime and amount of troughs on the farm. A picture of this could be uploaded and a picture should be uploaded if the action is not performed.	Farmer Auditor	N/A
Drinking	Calves - access to water	At all times, starting after 3 days	A farmer should manually input how many claves have had water and if yes/no they had access after 3 days and what date.	Farmer Auditor	N/A
Feeding	Cow feed space	1 feed space per cow	A farmer should manually input yes/no whether this has been confirmed.	Farmer Auditor	N/A
Floor	Surface type	No slats; solid floor; separate dung collection. To be realised in new buildings (not retro-fitted).	The data should be manually inputted and a picture should be taken as proof on to the App.	Farmer Auditor	N/A
Floor	Space per cow	6m2 / cow	The data should be manually inputted, so should the distance of the shed and amount of cows on the site at anytime	Farmer Auditor	N/A
Grazing	Cows - access to pasture	Minimum 180 days x 8hrs/day (except for drought or wet conditions).	Manually captured and entered on to a application. Attach a time stamped picture as proof of poaching. As well as a date of when they was not grazed outside.	Farmer Auditor	N/A

4.4.1.7 Data flow 1, Farm Standards data capture (Animal Welfare 5)

Animal Welfare					
Item	**Description**	**Criteria**	**Evidence**	**Blockchain Permission**	**Opportunity to automate?**
Grazing	Youngstock - access to pasture	Determined by bearing capacity of soil. Youngstock should not graze when soli bearing capacity is too low and risk of poaching or reduced feed intakes	Manually captured and entered on to a application. Attach a time stamped picture as proof of poaching. As well as a date of when they was not grazed outside.	Farmer Auditor	N/A
Transport	Minimum age or weight	2 weeks when in good health, otherwise wait until in good health.	Input yes/no on to the app. Also should link up to what calves have been born so when inputting which calves or cows have been moved using the ID number it will automatically insert if this action has been taken. And vet's approval of 'good health'.	Farmer Auditor	Cattle could possible have EID tags and sensors on the loading ramp/ or wand to automatically detect which animals are being loaded and the age of the cattle.
Transport	Time or distance	Max 4 hrs or 250km	A farmer could answer yes/no in the app. And possible the starting location and finish location including breaks.	Farmer Auditor	Could use a tracking device to automatically send a GPS signal which can send to the blockchain.

4.4.1.8 Data flow 1, Farm Standards data capture (Farm Inputs 1)

Farm Inputs					
Item	**Description**	**Criteria**	**Evidence**	**Blockchain Permission**	**Opportunity to automate?**
Feed - concentrates	Proportion of ration	<20% of feed intake (total DMI?)	A farmer could take a picture of the feed ingredients which will give an indication what is used which would automatically answer this action.	Farmer Auditor Feed Merchant	N/A
Feed - concentrates	Origin of ingredients	100% European, only human inedible coproducts from food and drink industry. No restrictions in case of own crop production.	A farmer could take a picture of the feed ingredients which will give an indication what is used which would automatically answer this action.	Farmer Auditor Feed Merchant	N/A
Feed - concentrates	Soya or Palm products	N/A	A farmer could take a picture of the feed ingredients which will give an indication what is used which would automatically answer this action.	Farmer Auditor Feed Merchant	N/A
Feed - concentrates	GMO	100% non-GMO	A farmer could take a picture of the feed ingredients which will give an indication what is used which would automatically answer this action.	Farmer Auditor Feed Merchant	N/A

Inputting farm input data will predominantly be by the farmer in terms of feed, however using an AI technology or a blockchain platform could potentially automate this process and speed up data collection – through automated data feed from the supply company or application of optical character recognition (OCR) technology to input receipts.

The data will be inputted on a user friendly system which accessible on a smart phone device, table or laptop. The data will be held on a icloud system.

4.4.1.9 Data flow 1, Farm Standards data capture (Farm Inputs 2)

Farm Inputs						
Item	**Description**	**Criteria**	**Who is capturing the data?**	**Evidence**	**Blockchain Permission**	**Opportunity to automate?**
Crop protection	Prohibited products	No Glyphosate in case of green manuring. No application of chemical pesticides in grassland	Farmer Could be Crop protection Merchant	Manually captured and entered on to a application	Farmer Auditor Crop Protection merchant.	Possible in the future with sensors from the precision spraying equipment. When collaborating what is being sprayed it could replicate to the blockchain. Automating the response.
Energy	Electricity	Strive to reduce energy use below average (Max 50kwh/1000kg milk)	Farmer Energy provider	Could take a picture of the meter reading.	Farmer Auditor Energy Provider	Automate to update automatically with energy provider records
Energy	Electricity	100% green electricity	Farmer Energy provider	Could take a picture of the renewable energy or video yearly of the process.	Farmer Auditor Energy Provider	N/A
Energy	Gas	No gas permitted in new sheds	Farmer	Links with above action. But would have to be manual yes/no input on system.	Farmer Auditor Energy Provider	N/A

Inputting crop protection and energy data could potential be captured by other stakeholders than the farmer. The farmer will have access to this data almost instantaneous due to the replication ability of the blockchain platform.

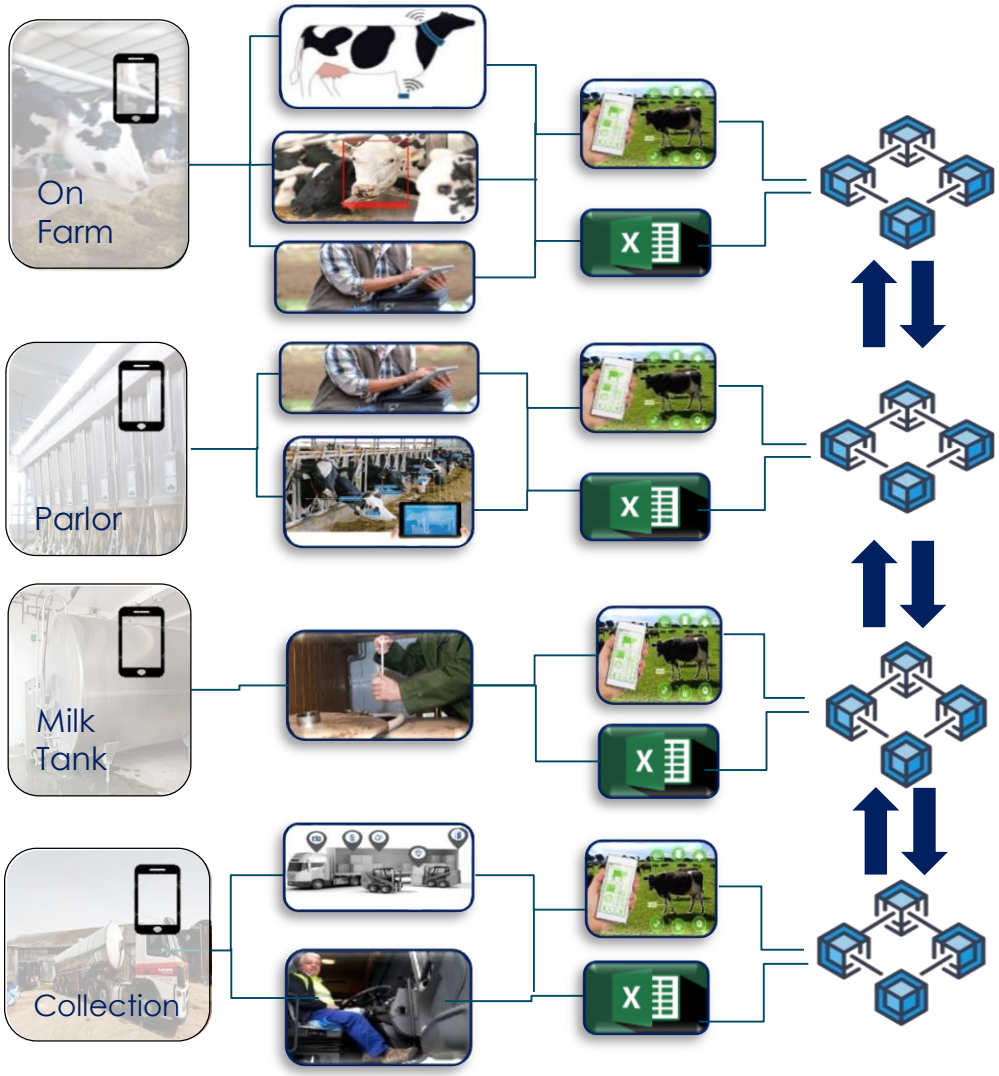
4.4.1.10 Data flow 1, Farm Standards data capture (Biodiversity & Landscape 1)

Biodiversity and natural landscape						
Item	**Description**	**Criteria**	**Who is capturing the data?**	**Evidence**	**Blockchain Permission**	**Opportunity to automate?**
Habitat for farmyard birds	Access to buildings	Assessment by ecologist. Food safety regulations still apply.	Ecologist	Picture evidence of bird species and farmyard conservation.	Ecologist Farmer Any farm auditors Auditor	N/A
Habitat for farmland (and woodland) birds		Participation in Farmers Nature Cooperation scheme.	Farmer or Co-operation	Attendance sheet will be the evidence.	Farmer Co-operative Auditor	If the evidence is on a excel sheet it can be synced up to automatically fill this answer.
Pets	Cats	Keeping cats inside and feeding them.	Farmer	Picture or video evidence	Auditor or Farmer	N/A
Farmyard and farmland landscape	Trees, shrubs etc	Presence of farm yard vegetation (woodland; tree cover, hedgerows?) - region specific. Assessed by ecologist (or specialist within Co-operative).	Ecologist Farmer Farm Auditor	Picture or video evidence	Ecologist Farmer Farm Auditor	N/A
Herb-rich pasture	Increasing water table in wetland pastures	To be organised with Co-operative when applicable.	Co-operative Farmer Ecologist	Picture or video attached with a summary of what species. By a ecologist audit.	Ecologist Farmer Auditor	If you take a picture of the pasture. AI technology could identify which plant species is in the sward. This can automatically fill out this section.

4.4.1.11 Data flow 1, Farm Standards data capture (Biodiversity & Landscape 2)

Biodiversity and natural landscape						
Item	**Description**	**Criteria**	**Who is capturing the data?**	**Evidence**	**Blockchain Permission**	**Opportunity to automate?**
Field margins	Management	Arable farming: no crops on margins, growth of wildflowers. region specific. Grassland – no manure or synthetic fertiliser on field margins. Leaving over in case of cutting, open for grazing.	Farmer Ecologist Auditor	Photo or video evidence of the management as well as a attached management plan.	Farmer Ecologist Auditor	Could automate with other sections if precision spreading manure or spraying it could link with the sensor technology. Likewise pictures could link up with AI technology.
Landscape features	Hedgerows, ditches etc	2-5% of farmed area; region specific landscape structures.	Farmer Ecologist Auditor	A picture could be provided of types of hedgerows ect.	Farmer Ecologist Auditor	N/A
Landscape features	Ditches around farmyard	Present. Flexibility for replacing in case of farmyard extension.	Farmer Ecologist Auditor	A picture could be provided of ditch condition i.e. to make sure there is no poaching/bank collapse or that dredging is required. Likewise a electronic map could be built to illustrate where the ditches are.	Farmer Ecologist Auditor	N/A

4.4.2.1 Data flow 2: Milk traceability and supply chain data, 1



Example of milk traceability and supply chain data information flow

The physical flow of milk through the supply chain is the second stream of data that can be held in the Blockchain system.

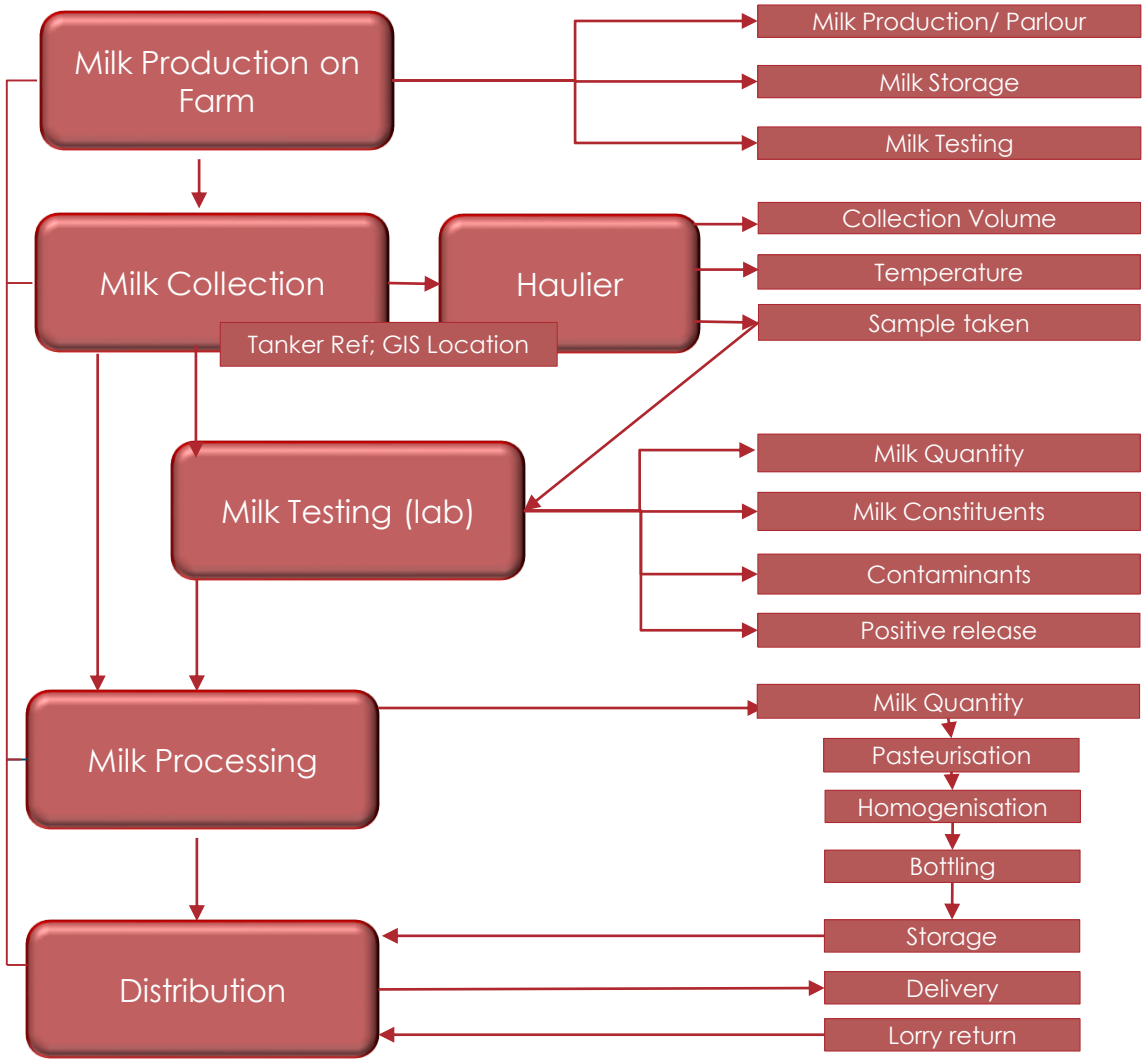
Each existing process (eg milk produced in the parlour; milk held in the bulk tank; milk collected from the bulk tank; milk delivered at the dairy; samples tested at farm and in the lab) – which are currently typically recorded and held on separate systems, could now be held in the one Blockchain database and linked to the CoP and Farm Standards information.

All the data associated with the physical flow and handling of milk, its status, its location, its source would be recorded at each stage of the supply chain via manual or scanned entry in App via phone, Ipad or laptop (with download capability to excel) or via connected devices (eg milk temperature and washing cycles in bulk tank; milk constituent and milk contaminant test results from the lab).

The blockchain algorithm replicates the data at each stage allowing each permissioned stakeholder to have visibility of the flow, status, location, quantity and quality of milk at all stages in the supply chain.

Each transaction of the milk flow will need to be verified by the stakeholder protocol to ensure data reliability.

4.4.2.2 Data flow 2, Milk traceability and supply chain data 2



Automation in the dairy sector is improving. The objectives would be to establish the Blockchain platform with links to connected devices at all stages (bulk tank; tanker; lab; dairy reception; weighbridge; unloading; silo storage; dairy lab; pasteurising; bottling; storage). Minimal manual intervention of data entry required.

Traceability is guaranteed and maintained through the supply chain via batch and reference numbers recorded and checked at each stage – being held and made visible to all permissioned stakeholders by Blockchain.

4.4.3.1 Data flow 3, Cost of Production (and market data) and pricing changes

Process defined by quality control and data validation

The processes outlined here can be performed through a conventional database, however the speed of communication can be increased by blockchain.

Physical collection of CoP data
on farm and / or via on-line accounting software

Data entry by
1)Farmer; 2)Independent farm Secretary or
3) 3rd Party data collectors (one organisation working with all farms)
Mix of on-farm and on-line data entry

3rd party data processor
Process ensures uniformity and provides quality control.

Budget Processor
The data is sent to the budget processor to determine the CoP-based milk price. This step cannot begin until all farms have provided data. Therefore requires strict deadline.

Aggregated Budget
Budget and assumptions checked by relevant stakeholders. Amendments and finalisation. Agreement of milk price to apply for next future period.

Present to final committee
The data is final at this point

Price details communicated to farmers and applied to next milk payments

Individual farm CoP data uploaded to Blockchain platform from accounting software

Draft and final data sets recorded via Blockchain

Market pricing and costing tracker data auto feeds into Blockchain

Budget workings, assumptions and draft figures held in permissioned node on blockchain

Final milk price communicated via Blockchain platform – to all farmers and other permissioned stakeholders

Blockchain platform

4.5 Blockchain Summary & Recommendations

Handling transactions on a Blockchain System

As described, there are significant advantages to a Blockchain system (immutability, increased trust, increased information exchange, transparency, immediacy etc). These need to be weighed against the disadvantages (eg understanding and complexity, potential scalability, governance and set-up costs).

There are essentially three, linked data stream associated with this project – described in this document – all of which can be delivered by conventional databases and data entry routes. However, a Blockchain approach would offers significant long term opportunities, future-proofing and efficiencies, through the interaction with connected devices, greater speed of transaction and the almost instantaneous information exchange (post-verification).

Blockchain Technology Companies

Until the scale of the opportunity is fully understood (impacting on quantity of data to be handled, the degree of system complexity and capability required, and the potential levels of returns, margins and investment), it is not possible to make a definitive recommendation as to the appropriateness of a Blockchain solution or not. Our default assumption is that a Blockchain platform **should** be used to make the most of its potential and to look to the future – prioritising efficiency, openness, visibility, flexibility and recognition that interaction with connected devices and minimising manual data entry is key - **unless** the scale of the opportunity, when confirmed, dictates otherwise. At that point, it is recommended that a 3rd party provider of Bockchain platforms is consulted. Examples of the these are listed in the document. Amongst these, *NSF International, Blockstation, Geora*, *Authenticate* and *Breedr,* all of whom were interviewed could make suitable partners.

Building a Blockchain solution

The 8 steps to building a Blockchain system outlined in this document will define the structure, running, maintenance, and capabilities of the blockchain system required. The 3rd party provider will determine the algorithm, network, node design, configuration, interface etc. The main requirement for the platform should be consistency of the information being entered, the ease of the end user interface (i.e. a app) and the accessibility by permissioned users.

The flowcharts earlier in this document illustrate how a Blockchain solution could address the three component data flows (cost of production, milk traceability / processing and farm standards). These outline how a potential solution for a Blockchain platform could provide the data management required and what the platform structure might look like. However, a pilot project (the 8th step) is essential to fully understand the likely shape of the eventual solution.

Conclusion, recommendations and actions

The report concludes that the Houdbare Milk scheme is a valid and workable farm standards proposition but to progress to the next stage of acceptance and implementation, a number of issues / actions need to be undertaken that build on the evidence and insight provided in the report:

1. Clarify the "drivers" for the proposed Houdbare Milk scheme and to confirm that there is a consumer-led demand for the values it espouses and delivers.
Action 1: carry out a brief market research study with consumers and, as planned, arrange discussion events with key retailers.

2. Specify in further detail the Houdbare standards and criteria, finalising the necessary operational details and practicalities.
Action 2: undertake a focused second-phase project to finalise arrangements for: measures (and bandings) for each criteria; data capture methodology; scoring methodology; assessment and audit operations; etc (as laid out in the report).

3. Confirm that a Cost of Production model is the preferred approach for determining the milk price (as opposed to alternative options as set out in the report) and develop the model components in detail.
Action 3: in conjunction with Action 2 above, undertake a focused second-phase project to finalise arrangements, to include: data capture; data aggregation and validation; budgeting methodology

4. Conclude whether the project intends to adopt a Blockchain solution for this application, basing that decision on the issues highlighted in this report and on the outcome of Actions 1-3 above.
Action 4: Engage with a Blockchain consultant and network developer to scope out a solution – depending on the outcomes to actions 1-3 above.