D3.4: Final Version of Reference Sustainable Business Model Archetypes

WP3 – Sustainable Collaborative Business Model Innovation

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Document Information

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Definitions, Acronyms and Abbreviations

Acronym/Term	Explanation
GMO	Genetically Modified Organisms
NGO	Non-Governmental Organization
PGI	Protected Geographical Indication
PDO	Protected Designation of Origin
SCBMI	Sustainable Collaborative Business Model Innovation
SDGs	Sustainable Development Goals
SIP	Sustainable Innovation Pilots

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Executive summary

Farmers are put under pressure to produce more and higher quality food at a lower cost in an environmentally and socially sustainable manner. However, farmers might struggle to benefit from implementing socially and environmentally sustainable practices due to two, related, main reasons:

- *Power imbalance*: an increasing power imbalance in favour of other supply chain actors such as retailers (e.g., large supermarket chains) reduces profit margins and, consequently, the economic ability of farmers to adopt sustainable business models.
- *Market access*: most food products are now routed through (regional) distribution centres and several processing stages, which increase the distance between the farmer and the market. Consequently, farmers struggle to benefit from the willingness of consumers to pay premiums for sustainable products produced through sustainable business models.

Collaborative business models offer a promising avenue to overcome these struggles by innovating the value creation and value delivery systems *together* with other value chain actors instead of by farmers independently.

This deliverable builds upon **D3.3. "Initial version of reference sustainable collaborative business model archetypes"**. While D3.3. provided an overview of sustainable collaborative business model archetypes based on the analysis of sustainable agri-food start-ups, this deliverable:

- Updates the identified archetypes by moving beyond start-ups and analysing existing businesses and lessons learnt during the project (e.g., the outcomes of the Ploutos Sustainable Collaborative Business Model Innovation process). In total, nineteen different archetypes are identified.
- Provides insights into how the different archetypes augment each other and can be used in conjunction. We identified seven archetype combinations and demonstrated how the archetypes augment each other.
- Provides key considerations for the adoption of the archetypes by farmers, also outside of the Ploutos context. Specifically, we demonstrate that past investments, partnership vibes, clarity of the financial impact, the novelty of the business model and stakeholder management play an important role in the adoption of the archetypes by farmers.

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1 Introduction

1.1 Project summary

The Ploutos project focuses on rebalancing the value chain for the agri-food system, transforming it into one that works for the benefit of society and the environment. The project develops a Sustainable Innovation Framework (SIF) that applies a systemic approach to the agri-food sector, building on three pillars: Behavioural Innovation, Sustainable Collaborative Business Model Innovation (SCBMI) and Data-driven Technology Innovation. Exploiting a history of significant agri-food projects and the respective ecosystems around them, the project deploys 11 innovative systemic Sustainable Innovation Pilots (SIPs), whereby adopting a Multi-Actor Approach innovative solutions and methodologies are implemented, tested, assessed, generating practical learnings. The pilots cover a large range of agri-food ecosystems, across 13 countries, covering arable, horticulture (both open fields and greenhouses), perennials and dairy production among others. In each case, behaviour change, collaborative business modelling and data driven innovation are integrated to deliver the most environmentally, socially, and economically sustainable solutions. Moreover, a Ploutos Innovation Academy (PIA) operates as a vehicle for integrating the know-how, best practices and assessments developed across the project and derived from the SIPs. Ploutos includes 33 partners, 22 of them end-users, representing all relevant actors in the food system, including farmers, food industry companies, scientists, advisors, ICT specialists and policy makers.

1.2 Document relevance

Deliverable **D3.4, "Final version of reference sustainable collaborative business model archetypes"**, is developed in scope of Task T3.2, "Investigation of reference sustainable business model archetypes". The deliverable is an updated and enriched version of **D3.3. "Initial version of reference sustainable collaborative business model archetypes"**, which was submitted in M8. The purpose of this task is to provide practical options for the SIPs to change and improve the business models that are needed to exploit the developments based on the SIPs. Analogies and practical examples are powerful means to inspire and configure business models innovations for the needs of the actors in the SIPs. The task generated a framework and examples of SCBMIs for application by the SIPs, and similar applications.

In the last decade, many new and digital innovations have reached the agri-food sector, including the farms. Each of these innovations is delivered through business model innovations. The purpose of this document is to present the approach that makes sense of all these developments, from the perspective of the innovations perceived and developed in the SIPs. It tries to offer help in answering the question: "Which of those new business models can be valuable for the economic and sustainability ambitions strived for in my SIP?". The approach for this includes a collection of relevant examples and typologies, with an emphasis on collaborative business models and structuring and analysis of the material. The reference business model archetypes are currently used in, and are partly an output of, the Ploutos Sustainable Collaborative Business Model Innovation methodology, as documented in D3.1 "Ploutos SCBMI approach - initial version" and applied in Task T3.4 "Support of the Pilots using the Ploutos SCBMI approach".

In other words, the purpose of the reference sustainable collaborative business model archetypes is to summarize and unlock knowledge of relevant business models for use in the design and evaluation of business models to create value from the innovations in the SIPs.

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1.3 Document structure

The document is structured as follows:

Chapter 1 presents a summary of the project as well as the document scope and structure.

Chapter 2 introduces the need for sustainable collaborative business modelling and provides an overview of relevant theory for SCBMI.

Chapter 3 details the research methodology.

Chapter 4 provides the archetypes, the combination of archetypes and the key considerations for implementing the archetypes

Chapter 5 contains the conclusions of this report.

Chapter 6 lists the references used throughout this report.

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2 Theory

The business model is a conceptual tool to help understand how a firm does business (Osterwalder & Pigneur, 2010). These conceptual tools can be divided into two approaches: static business models and dynamic business models (Burkhart et al., 2011). The static approach describes a firm's current state while the dynamic approach describes the evolution of the business model, i.e. the modifications that businesses apply to their business models over time (De Reuver et al., 2013). This deliverable focuses on static business models, with the intention to provide a snapshot of how actors in the agri-food value chain, and in particular farmers, can achieve sustainable performance in a collaborative way.

There are many different formats to understand the static business model. For instance, one can describe the business by using a free text description, by defining activities and resources and even by modelling the business model in a more or less formal description language like E3Value or VDML (Gordijn, 2004). Although many conceptual tools exist to describe a business model, the practitioner-oriented '*business model canvas*' of Osterwalder and Pigneur (2010) and the '*business model navigator*' of Gassmann et al. (2014) are most widely applied in the corporate and start-up world, as well as in the academic world. Moreover, the business model canvas and the business model navigator converge on the three elements identified in the widely accepted theoretical definitions of the business model of Teece (2010) and Zott et al. (2011), namely:

- *Value proposition*: the product/service offered and customer segments.
- *Value creation and value delivery*: the key activities, key resources, channels, partners, and technologies.
- *Value capture*: the cost and revenue streams.

The value proposition is the "starting point for any business model" (Bouwman et al., 2008, p. 36). As the value proposition reflects the firm's core strategy (Kaplan & Norton, 2001) it is, in essence, the promise of the benefits offered to the customer (Bocken et al., 2014; Richardson, 2011). Traditionally, value propositions refer to providing customer value and can be described in general terms of cost leadership (e.g., affordable products), differentiation (e.g., providing – often intangible – value to the customers in the form of functionality, convenience, well-being and so forth) and focus (either on costs or differentiation in a narrow market segment) (Porter, 1980) or similar terms (Bocken et al., 2013; Miller, 1988; Mintzberg, 1988).

Massa et al. (2017) recognize that descriptive business model archetypes are helpful to understand how firms do business in a similar way. Well-known examples include business model archetypes such as 'razor & blade' (cheap core product, more expensive additional products), 'freemium' (product or service is offered free of charge, advanced functionalities are priced) or 'pay-per-use' (a fee per moment of use). Likewise, Al-Debei and Avison (2010) argue that business model archetypes allow other organizations to mimic or configure their business models towards the business model archetype. These purposes originate from strategy, management, and information systems. Consequently, traditionally an emphasis is placed on financial-economic revenues and costs related to the business model, while potentially neglecting the unintended and negative environmental and social impacts.

2.1 Sustainable business models

Since society increasingly pays attention to sustainable value, firms increasingly need to develop sustainable business models (Boons & Lüdeke-Freund, 2013; Patala et al., 2016; Yang et al., 2017). Based on Geissdoerfer et al. (2016) and Boons and Lüdeke-Freund (2013), we define sustainable business models in this deliverable as "*business models that propose, create and deliver and capture social and/or environmental value in an economically viable way*". Sustainable business models can include a wide range of sustainable value propositions such as (Patala et al., 2016):

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- *Environmental value propositions:*
  - Reducing damage to resources (e.g., availability of minerals and fossil fuels).
  - Reducing damage to ecosystems (e.g., biodiversity and land use).
  - Reducing atmospheric impacts (e.g., radiation, respiratory effects, ozone layer depletion, climate change effects).
- *Social value propositions*:
  - Improving human rights (e.g., child labour, forced labour, non-discrimination).
  - Improving labour practices and decent working conditions (e.g., wages, benefits, safety at work, job satisfaction).
  - Supporting society (e.g., corruption, job creation, support of local communities).
  - Adhering to product responsibility standards (product safety concerns, labelling, ethical marketing communications).

The value creation and value delivery refer to the key activities, resources, channels, partners, and technologies used to create and deliver the sustainable value proposition and are, therefore, at the heart of the sustainable business model. Two main forms of sustainable value creation and value delivery can be distinguished to achieve the sustainable value proposition:

- *Incremental improvements*: organizations can pursue incremental improvements to optimize the sustainable performance of their current business models (e.g., optimize resource usage and limit damage to eco-systems and human health).
- *Radical improvements*: organizations can innovate their business models by creating and delivering new products and/or services which are in line with the sustainable value proposition.

The final element of a sustainable business model is how organizations capture the economic, environmental, and social value. This may include capturing the economic value through reduced costs and increased revenues and capturing the sustainable value through, for instance, enhanced environmental performance, natural resource preservation, social performance and societal wellbeing both in the long and short-term (Geissdoerfer et al., 2018).

Similar to the business model archetypes for traditional business models (e.g., 'freemium' and 'razor & blade'), archetypes for sustainable business models are valuable to guide firms in combining the different business model elements into a coherent business model (Tell et al., 2016). Bocken et al. (2014) propose seven[1] sustainable business model archetypes which cover the sustainable value propositions, value creation and value delivery and value capture elements namely 'maximize material and energy efficiency', 'create value from waste', 'substitute with renewables and natural processes', 'deliver functionality rather than ownership', 'adopt a stewardship role', 'encourage sufficiency', and 'repurpose for society'. Variations thereof have been implied in various industries, such as the banking sector (Yip & Bocken, 2018). However, literature does not yet provide sustainable business model archetypes for the agri-food sector.

[1] Bocken et al. (2014) propose eight sustainable business model archetypes, where the eight archetype refers to scaling any of the other seven sustainable business model archetypes. We consider the scaling of the business model not as a separate business model but as part of the business model.

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2.2 Sustainable business models in the agri-food sector

To develop sustainable business model archetypes for the agrifood sector, it is important to acknowledge that farmers face several economic, environmental, and social pressures such as:

- *Economic*: demand volatility, profit, sales, capital structure, liquidity, competitive position (Franceschelli et al., 2018).
- *Environmental:* biodiversity management, gentle soil cultivation, sustainable fertilizer usage, avoidance of artificial substances, waste minimization, sustainable packaging, careful water usage, energy savings and provisioning of ecosystem services (Dressler & Paunović, 2019).
- *Social*: positive work atmosphere, employee retention, reliable partner relationships, social engagement, food security (Dressler & Paunović, 2019).

Sustainable business models can provide a response to all these challenges. Table 1 provides an overview of the seven sustainable business model archetypes according to Bocken et al. (2014), which we modified for the agrifood industry by building upon examples from the Food Sustainability Observatory and the Smart Agri-food Observatory of Politecnico di Milano.

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Business model archetype[a]	Value proposition	Value creation and delivery	Value capture	Examples in the agri-food sector[b]
Maximize material and energy efficiency	Products or services that use fewer resources, generate less waste and emissions, and create less pollution than products that deliver a similar functionality	Activities and partnerships aimed at using fewer resources and generating little waste, emissions, and pollution. Focus is on product and manufacturing process innovation and new partnerships and value network reconfigurations to improve efficiencies and reduce supply chain emissions	Costs are reduced through increased operational efficiency, leading to increased profits	- Smart farming - Precision farming - New farming approaches (e.g., aquaponics, hydroponics, vertical farming) - Automation (e.g., agrobots) - Artificial Intelligence (for sorting food, supply optimization by testing and monitoring food quality, ensuring hygiene with smart cameras)
Create value from waste	Turning existing waste streams into useful and valuable input to other production	Activities and partnerships to eliminate life cycle waste, close material loops and make best use of under-utilized capacity. Introduction of new partnerships (e.g., recycling firms), potentially across industries, to capture and transfer waste streams	Economic and environmental costs are reduced through reusing material and turning waste into value	- Insect farming - Surplus food reuse and redistribution - Fertilizers from agricultural waste (e.g., compost) - Animal feed from food waste and agricultural waste - Agricultural by-products into new products

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Substitute with renewables and natural processes	Reduce environmental impacts and increase business resilience by addressing resource constraints associated with non-renewable resources and man-made artificial production systems	Innovations in products and production process design by introducing renewable resources and energy and conceiving new solutions by mimicking natural systems. New value networks based on renewable resource supply and energy systems. New partnerships to deliver holistic 'nature inspired' solutions.	Revenue associated with new products and services	- Holistic farming (integrating livestock and crops) - Biologic farming - No-till farming - Crop rotation - Planting cover crops - Adopting agroforestry practices
Deliver functionality, rather than ownership	Provide services that satisfy user needs without users having to own physical products	Delivery through product-service offerings require	Lower costs related to ownership	- Farming equipment sharing - Renting and leasing farming equipment - Crowd-farming
Adopt a stewardship role	Manufacture products and services intended to genuinely and pro-actively engage with stakeholders to ensure their long-term health and well-being. Better engaging the consumer with the full story of production and the supply chain	Ensuring activities and partners are focused on delivering stakeholder health and well-being	Stewardship strategies can generate brand value and potential for premium pricing	- Healthy food - Traceability - Certification and labelling - Geographic indications such as PDO (Protected Designation of Origin) and PGI (Protected Geographical Indication)
Encourage sufficiency	Product and service solutions that seek to reduce demand-side consumption and hence reduce production	Ensuring activities, partners and customer relations are focused on consuming less, wasting less and using products longer	Profitability (premium pricing), customer loyalty and increased market share realised from provision of better products	- Vegan food - Nutrient dense food - Cultured meat

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Repurpose for society/ environment	Prioritizing delivery of social and environmental benefits rather than economic profit maximization, through close integration between the firm and local communities and other stakeholders	Creating societal benefits (e.g., secure livelihoods), and environmental benefits (e.g., regenerating flora and fauna) through activities, channels, and partners	Resilience through supporting stakeholders in times of downturn. Additional income streams for the created social and environmental benefits	- Carbon credits - Payments for eco-system services (e.g., ponds for migrant birds and land strips for bees) - Social farming

[a] Bocken et al. (2014)
[b] Derived from the Smart Agri-food Observatory (2019) and Food Sustainability Observatory (2020)

Table 1 – Sustainable business model archetypes in the agri-food sector

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2.3 Collaborative sustainable business models

Albeit the apparent abundance of sustainable business models for farmers, the sustainable business models take the perspective of a single firm and neglect that farmers are part of a wider value creation system. In fact, business models are mostly firm-centric; meaning they focus on a single organisation and how this organisation creates, delivers, and captures the proposed value. A strong rationale for expanding the scope to include other organizations is given by Adner (2012) in his book "*The wide lens*". Based on several examples from industry, he explains the concepts of co-innovation and co-adoption. Co-innovation refers to situations in which other organizations need to innovate too for both organizations to make success. An example of this is Philips' HDTV, which also required recordings to be made using specific cameras. Co-adoption refers to situations in which other organizations need to endorse an innovation to be available to the customer. A situation often found in health care, where certain products require prescription. It can also be found in domestic energy savings products that require complex installations. The central message in these concepts is that organizations other than the focal actor need to have and see benefits for a focal organization to succeed. This requires a value creation and delivery system approach rather than the focus on individual firms. The agri-food value chain produces, processes, distributes, and consumes products in a complex value creation system with interrelated actors – see Figure 1.

Commented [SCDM1]: I don't know the example and I could not find it in Google. Maybe just a couple of words more?

Figure 1 – Typical value creation and delivery system in the agri-food value chain

Within this value creation system, two factors create unfavourable situations which limit farmers to adopt sustainable business models (Cagliano et al., 2016; Fritz & Matopoulos, 2008; Tell et al., 2016):

- *Power imbalance*: an increasing power imbalance in favour of other supply chain actors such as retailers (e.g., large supermarket chains) reduces profit margins and, consequently, the economic ability of farmers to adopt sustainable business models.
- *Market access*: most food products are now routed through (regional) distribution centres and several processing stages, which increase the distance between the farmer and the market. Consequently, farmers struggle to benefit from the willingness of consumers to pay premiums for sustainable products produced through sustainable business models.

As illustrated in Table 1, the economic value capture of sustainable business models often takes place through premium pricing, increased brand value and additional income streams. To enable farmers to benefit from premium pricing, increased brand value and additional income streams, existing value creation and delivery systems need to be innovated.

Collaborative business models offer a promising avenue to innovate value creation and delivery systems. Building upon Rohrbeck et al. (2013) and Bankvall et al. (2017), we define collaborative business models as *"business models which create and deliver value on (part of) a value creation and delivery system level involving the long-term collaboration between two or more actors".* As such, the collaborative business model has an overarching notion and can be considered as a business model of (part of) the value chain. Moreover, the collaborative business model might have a "complementary" character, meaning that the collaborative business model complements the individual business models of the involved actors where farmers and other

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value chain actors update their business model to align it with the overarching collaborative business model. This idea is depicted in Figure 2.

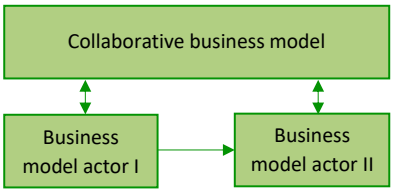

Figure 2 – Collaborative business models for value creation and delivery systems

The collaboration in collaborative business models can take place through either vertical collaboration with actors with a different position in the value chain, such as consumers and suppliers, and horizontal collaboration with partners from other industries (e.g., energy, ICT, research, NGOs and governments) and similar partners (other farmers) (Barratt, 2004). The collaboration supersedes the transactional relationships between the partners. Table 2 operationalises the elements of collaborative business models. Aligned with this, in this deliverable, a collaborative business model has at least one of the value creation and value delivery elements as listed in Table 2.

Value creation and value delivery elements	Examples
Key activities	Collaborative production activities, collaborative administrative processes, collaborative marketing processes, collaborative risk sharing
Key resources and technologies	Shared hardware, shared software, shared equipment, shared facilities
Channels	Collaborative sales channels, collaborative communication channels, collaborative distribution channels

Table 2 – Operationalization of the term "collaborative business model".

However, despite the apparent need, knowledge on collaborative sustainable business models in the agri-food sectors remains underdeveloped and more empirical evidence is needed as collaborative business models can achieve more than conventional business models (Ulvenblad et al., 2019). This deliverable therefore aims to:

- Develop collaborative sustainable business model archetypes for the agri-food sector to support farmers and other value chain actors to select and implement a collaborative sustainable business model.
- Provide insights into how combinations of business model archetypes can augment each another.

In addition, although many farmers have a strong intention to adopt sustainable business models – possible due to the fact that many farmers are family businesses strongly rooted in their communities and are strongly connected to the land of their ancestors (Barth et al., 2017) – farmers might struggle to implement and benefit from sustainable business models. Farmers tend to be small businesses with few employees. Consequently, farmers are often "generalists" or "all-rounders" who have to run all aspects of their business and, therefore, lack the specialist's view on innovation and innovative business models (Tell et al., 2016). We therefore added an additional objective, namely:

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- Provide insights into the key considerations for farmers to adopt a collaborative sustainable business model archetype.

3 Methodology

3.1 Justification of methodology

To develop farmer centric collaborative sustainable business model archetypes, we followed a three-step approach.

The first step, as documented in **D3.3.**, aimed at developing an initial version of the farmer centric collaborative sustainable business model archetypes. To do so, the archetypes as reported in **D3.3.** derive from an analysis of sustainable collaborative business models of start-ups. Although collaborative business models are not a new concept, recent developments in collaborative platforms and technologies have enabled several new opportunities for collaborative business models. Start-ups are typically among the first to commercialize new business models as start-ups are not limited by the legacy system such as key resources, activities, partners and channels built up over time (Criscuolo et al., 2012). Instead, start-ups have the advantage of starting out from a blank page, presumably resulting in a rich variety of collaborative business models. Furthermore, start-ups, as new market entrants, are forced to take a holistic perspective on monetizing collaborative business models as they cannot rely on other income streams. As such, theoretically, only profitable collaborative business models will survive. Finally, as start-ups start from scratch, their business models are likely to be implementable by actors who have limited resources at their disposal such as farmers. In sum, the first-mover character, the high variety of unspoiled business models and the adoptability for small actors like farmers renders start-ups a promising avenue for developing collaborative sustainable business models for the agri-food sector. As a result, sixteen archetypes were reported in M8 in **D3.3.** To validate the identified archetypes and to identify other, yet undocumented, collaborative sustainable business model archetypes, we involved a wide variety of experts from the agri-food, business model, innovation, and management fields, as well as practitioners (i.e., SIPs and farmers).

In the second step, we employed a workshop format with the SIPs to identify which combination of archetypes are promising for them. The diversity of the SIPs in terms of country, technologies used and involved actors provided a fertile ground to identify combinations of archetypes in a wide variety of contexts. Note, this step is also part of the business model innovation processes as documented in **D3.1. Ploutos SCBMI approach**).

Commented [SCDM2]: D3.1 Ploutos SCBMI approach - initial version
D3.2 Ploutos SCBMI approach - final version

Finally, in the third step, we interviewed SIPs and farmers to evaluate the farmer centricity in terms of desirability, feasibility, and viability. Given the exploratory nature, interviews are particularly suited as they allows us to gain an in-depth understanding of the underlying mechanisms which explain the challenges and success factors of the archetypes (Eisenhardt, 1989).

In sum, because of the three-step approach, we were able to:

- Develop a comprehensive set of collaborative sustainable business model archetypes
- Identify promising combinations of collaborative business model archetypes
- Identify challenges and enablers for implementing collaborative business model archetypes

The next sections provide more details on the data collection and data analysis used in each step.

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3.2 Step 1 – The identification of collaborative sustainable business model archetypes

As reported in **D3.3**., to identify collaborative business models of start-ups, we drew upon the Crunchbase database, a database which contains organizational data of over 650.000 start-ups from all over the world. On the 18th of December 2020, we downloaded the information of start-ups founded in the last five years which belonged to the food and beverage and the agriculture and farming industry groups. In addition, we downloaded the information of start-ups founded in the last five years which contained any of the keywords or any grammatical variation of the keywords (e.g., singular and plural and English and American spelling) in Table 3 in their organizational description. The keywords are derived from the NACE framework which describes the activities in the primary agri-food supply chain stages (Eurostat, 2016). As a result, we extracted a total of 20.666 start-ups.

Agri-food value chain stage	Search terms
Input companies	Plant, seed, animal, supplement, feed, fertilizer, compound, pesticide, agrochemical, insecticide, rodenticides, fungicides, herbicides, acaricides, molluscicides, biocides, antisprouting
Farmers	Tuber, grape, fruit, citrus, pome, spice, farming, harvest, crop, cereal, oil, vegetable, root, rice, sugar cane, legume
Breeders	Pig, poultry, chicken, turkey, duck, geese, guinea fowl, rabbit, ostrich, cattle, buffalo, cow, horse, mule, donkey, ass, camel, snail, bee, honey, sheep, goat, swine
Fishers	Shrimp, oyster, mussel, fingerling, seaweed, worm, frog, lobster, fish, crustacean, mollusc, whale, turtle, urchin, algae, aquaculture
Food processing	Grain, flour, wheat, rye, oat, maize, starch, glucose, gluten, maltose, tapioca, bread, cake, bakery, pastry, pie, tart, food, meat, pork, lamb, mutton, beef, slaughterhouse, caviar, roes, potato, juice, vineyard, jam, marmalade, jelly, nut, tofu, pancake, salad, waffle, biscuit, noodle, pasta, couscous, cocoa, syrup, chocolate, confectionary, chewing gum, tea, coffee, condiments, herb, sauces, salt, pepper, pizza, homogenised, cider, perry, vermouth, whiskey, gin, brandy, liqueur, vodka, malt, cola, pasta, oil, margarine, dairy, milk, cheese, butter, yoghurt, curd, casein, lactose, ice cream, soup, broth, sandwich, egg, yeast, beverage, alcohol, water, beer, wine, spirit, sake, lemonade, orangeade, tonic
Food service	Restaurant, hotel, refuges, cafeteria, fast food, bar, catering, canteen, tavern, cocktail, lounge
Retailers	Stall, market, vending machine

Table 3 – Keywords for data extraction from Crunchbase

To select a sample of farmer centric collaborative sustainable business models, we searched for keywords based on literature and from the project proposal. The identified start-ups were first coded as collaborative and non-collaborative. For the collaborative business models, we analysed the description of the start-ups to identify new key words. We repeated this process until we did not identify any new start-ups in the database. Table 4 gives an overview of the search terms used. Other search terms such as “synergy”, “mutual”, “combined” and “sharing” were applied. However, these keywords returned a large amount of non-collaborative business models and were therefore excluded from the search. As we aim to only include

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farmer centric business models, the business models should involve the farmers, breeders, and fishers value chain stage.

Coding criteria
Co-creation, cooperative, collective, consortium, network, platform, supply chain, value chain, collaborative, partnership, traceability, visibility, insurance, soil passport, payments for ecosystem, agri-food tourism, benchmark, distribution model, chain of custody, track & trace, end-to-end blockchain, crowdsource, open data, farm to fork, trading platform, marketplace.

Table 4 – Search terms to identify collaborative business models

The selection resulted in 1369 start-ups which, after a manual check on the collaborative business model elements, were further reduced to a sample of 912 start-ups. As we aim to develop sustainable business model archetypes, we coded each start-up according to the sustainable development goals (SDGs). To do so, we first selected SDGs and targets related to the agri-food industry. Table 5 provides an overview of the selected SDGs and the relevant targets as well as the coding criteria. We subsequently coded whether the start-ups responded to the different targets of the SDGs. The SDGs give a broad overview of a multitude of social, environmental, and economical goals, as such providing a holistic view on the sustainable practices. After a manual check based on additional data derived from a web search a sample of 308 start-ups remained. The coded database is available upon request. Roughly half of the start-ups is located in developed countries (N=161), such as the United States, Western Europe, and Japan, while the other half of the start-ups is located in developing countries (N=147) such as India, most South American countries and the African countries.

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SDG	SDG target	Coding criteria
2	2.1. By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including enfants, to safe, nutritious, and sufficient food all year round.	Food shortages, food redistribution to poor and vulnerable people.
	2.2. By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women, and older persons.	Malnutrition for children, provide healthy food to children and babies, solutions for breast feeding and pregnant mothers.
	2.3. By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists, and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment	Solutions for small-scale food producers, sales channels such as (online) farmers markets, supporting local food, finance for small farms (such as crowdfunding)
	2.4. By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding, and other disasters and that progressively improve land and soil quality	Resilient agriculture practices to deal with or prevent disasters
	2.5. By 2020, maintain the genetic diversity of seeds, cultivated plants, and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed	Increasing biodiversity and use of local varieties, seed banks and plant banks
6	6.3. By 2030, improve water quality by reducing pollution, eliminating dumping, and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	Reducing of chemicals which affect water pollution and pollute oceans, rivers, etc., wastewater treatment, water recycling
	6.4. By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	Smart use of water such as smart (precision) irrigation and farming practices which use less water such as crop rotations, using drought tolerant plants, aeroponics, hydroponics, vertical farms
8	8.5. By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	Provide work to vulnerable groups such as social enterprises and pursue ethical working conditions such as equal pay

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	8.8. Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment	Improving safety, security, health and working conditions
	8.9. By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products	Local and green tourism, local products, agri-tourism
12	12.2. By 2030, achieve the sustainable management and efficient use of natural resources	Reducing inputs (e.g., precision farming), increase yields, increase seeds (GMO), efficient farming practices such as horticulture, vegan (plant-based and cultured meat)
	12.3. By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses	Reducing food waste (e.g., increase shelf-life), re-use of food waste, circular economy practices
	12.4. By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil to minimize their adverse impacts on human health and the environment	Eco-friendly pest protection and chemicals and fertilizers
	12.8. By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature	Traceability, transparency, increase customer awareness, healthy diets, labelling
15	15.1. By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains, and drylands, in line with obligations under international agreements	Regenerative farming, protect eco-systems, address climate change

Table 5 – SDGs selected to identify sustainable business models in the agri-food sector

To develop the archetypes, we first coded the start-ups in the sample according to the sustainable business model archetypes of Bocken et al. (2014). Within the archetypes, we further analysed the start-ups to identify common themes and practices to derive more detailed sub-archetypes. As a result, sixteen archetypes were identified and reported in **D3.3.**

To validate the identified archetypes and to identify other, yet undocumented, collaborative sustainable business model archetypes, we involved a wide variety of experts from the agri-food, business model, innovation, and management fields as well as practitioners (i.e., SIPs and farmers). To do so, we discussed the collaborative business model archetypes with experts from the agri-food industry such as the Food Sustainability and Smart-Agrifood Observatory communities of Politecnico di Milano, experts on innovation and management such as the experts on the CiNET conference and experts on business model innovation involved in the Ploutos project such as the partners of Work Package 3. In addition, during the Ploutos project, we accustomed ourselves with the agri-food industry which enabled us to identify new business model archetypes as well. As a result, we identified new archetypes and modified existing ones.

Commented [EJP3]: Add footnote with more info about the communities:
- How many companies are involved
- Type of companies

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3.3 Step 2 – Combining collaborative sustainable business model archetypes

To explore how different combinations of archetypes can augment each other, we developed an interactive workshop with the SIPs. After an introduction of the archetypes, the SIPs were asked to assign points to each archetype based on the general relevance for their SIP. Based on this, the SIPs selected an initial set of the most relevant archetypes. Next, the SIPs were asked to evaluate the desirability, viability, and feasibility of the set of archetypes. Specifically, the SIPs were asked to elaborate on how the set of archetypes rebalance the value chain in favor of the farmer (desirability), the business logic behind the set of archetypes (viability) and the challenges related to implementing the set of archetypes (feasibility). Next, the SIPs were asked to re-iterate through the previous steps by evaluating how other business model archetypes could contribute to the desirability, viability, and feasibility. The iterations continued until a final set of archetypes was identified. To ensure that no archetype was overlooked, the SIPs had to justify why the remaining archetypes were not used. Afterwards, the results of the workshop were analyzed to identify collaborative sustainable business model archetypes combinations. The workshop was held online as part of the PIA. We used Miro as an interactive whiteboard[2]. Figure 3 provides an example of the workshop template.

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[2] The template can also be found using the following link: https://cutt.ly/G2xTUts

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Figure 3 – Workshop template for combining the collaborative sustainable business model archetypes

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3.4 Step 3 – Key considerations for implementing collaborative sustainable business model archetypes

To explore the considerations of farmers for implementing the archetypes, we relied upon a multiple case study. Farmers within the Ploutos project have received support in developing the data-driven technologies, in enabling and securing the behavioral innovations as well as for the development of the collaborative business models. This support was enabled by the project funding. However, in future scenarios, such support may not always be in place.

We therefore opted to interview farmers outside of the Ploutos project. We had the opportunity to interview Colombian farmers who fitted these requirements. The farmers grow different types of fruits and vegetables (carrots, potatoes, lettuce, cilantro, cabbage, avocadoes, strawberries, passion fruits and tamarillos). Despite some obvious differences between Colombian and European farmers – such as the different sustainable challenges in Columbia versus Europe, the different financial strength of the farmers and the different technological maturity – the considerations of farmers to implement the different archetypes shows many parallels as well due to the similarities with the Ploutos context. In fact, the farmers were in rural areas, had limited financial means to make a sustainable impact on their own, and grow commodities which are primarily sold to large and powerful supply chain actors. As such, despite the differences, valuable lessons can be extracted for the Ploutos project and for European farmers in general.

The farmers were contacted with the help of agronomists of a large multinational agrochemical company operating in Colombia. In total, ten farmers were interviewed following a semi-structured interview protocol. The interview protocol followed a standard set of topics with "what if" questions related to each archetype. Examples of questions are *"what if you have to change many of your current resources?", "what if you have to make a significant capital investment?", "what if you have to change your main business?", "what if you have to create new relationships?", "what if you have to maintain a relationship with actor X?"*. Having similar questions facilitated the comparison between farmers while increasing the reliability of the findings (Voss et al., 2002; Yin, 2009). Due to geographic distances, the interviews took place online. On average, the interviews lasted 45 minutes. Each interview was recorded and transcribed verbatim. The transcriptions were coded using a within-case analysis approach. Next, we compared the different cases following a cross-case approach to identify whether the challenges and key success factors were case specific or showed a pattern, as such suggesting a larger generalizability.

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4 Results

Figure 4 presents the identified collaborative sustainable business model archetypes. Building on Bocken et al. (2014), the archetypes can be classified into five main archetypes. The "*substitute with renewables and natural processes*" and "*encourage sufficiency*" archetypes were not covered by the start-ups. A possible explanation may be that these business model archetypes do not rely on collaborative efforts of multiple actors but, rather, are implemented by individual actors independently. In addition, we have added two additional main archetypes to the archetypes defined by Bocken et al. (2014) namely "*shorten the supply chain*" and "*support financial stability*", as these archetypes are – to the best of our knowledge – not covered in literature, while they have a clear social sustainable aspect as they help to improve the economic performance of (small-holder) farms.

For each of the main archetypes, we derived a set of sub-archetypes. The sub-archetypes often have a "complementary" character for farmers and, as such, can be combined with existing business models as well as with other sub-archetypes (see also section 4.2). Compared with **D3.3.** on the initial version of collaborative sustainable business model archetypes, some changes have been made. First, two archetypes are merged ("*improving through transparency*" and "*knowledge sharing*") as both archetypes had a similar value proposition namely, to improve farming efficiency through learning from others. Second, compared to **D3.3.**, four new archetypes were identified ("*cooperative branding*", "*cooperative sales*", "*cooperative purchasing*" and "*agriculture 4.0 as a service*"). A possible explanation why we did not identify the first three archetypes, the ones with a cooperative character, in the initial version of this deliverable is the fact that the initial version was based on start-ups. It is reasonable to assume that start-ups, as for-profit entities, do rarely adopt a cooperative business model together with other firms. Rather, they launch innovative products or services on the market. The remaining new archetype, "*agriculture 4.0 as a service*", finds its origin in a reinterpretation of the data, enabled by an increased understanding developed during the course of the Ploutos project and the exchanges with the various experts within and outside of Ploutos. The changes with **D3.3.** are highlighted in Figure 4.

The next sections first discuss each sub-archetype in more detail. Next, we provide insights into where the archetypes are mostly used.

Main archetypes	Maximize material and energy efficiency	Create value from waste	Deliver functionality rather than ownership	Adopt a stewardship role	Re-purpose for society	Shorten the value chain	Support financial stability
Sub-archetypes	- Aligning supply and demand - ***Improving through transparency*** - Data-driven farm optimization	- Farming on food waste - Valorising farm waste - Marketing blemished and surplus food	- Farming equipment as a service - ***Agriculture 4.0 as a service*** - Farming as a service	- Transparent farming practices	- Payments for eco-system services	- Cooperative food processing - ***Cooperative branding*** - ***Cooperative sales*** - ***Cooperative purchasing*** - B2B marketplace - B2C marketplace	- Parametric insurance - Collaborative financing

Figure 4 – Collaborative sustainable business model archetypes (deviations with D3.3. are highlighted in bold and italic)

4.1 Detailed description of the archetypes

This section presents the business model archetypes in more detail by means of a standardized table which describes the value proposition, the value creation and value delivery, and the value capture accompanied

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by examples. Note that the value proposition, value creation and value delivery and the value capture are described in general terms and might therefore slightly differ in specific cases.

4.1.1 Maximize material and energy efficiency

The main archetype "*maximize material and energy efficiency*" covers business models which aim to reduce farmer inputs and farm waste through collaboration. Hence, the sub-archetypes presented in this section aim to improve the performance of existing business models rather than adopting new business models. Tables 6 to 8 present the four business model archetypes as identified in this study.

Maximize material and energy efficiency – Aligning supply and demand	
Value proposition for farmers	Improving the match between the production/harvest of food and the demand for food.
Collaborative value creation and value delivery	Vertical collaboration between farmers and their existing buyers (e.g., HoReCa and retailers) enables information sharing on demand (e.g., when are products ready to be harvested) and supply (how much food is needed). The information sharing between the farmers and their existing buyers is facilitated by a platform provider (with or without an automated coupling to information systems).
Value capture by farmers	The better alignment between supply and demand results in less waste generation (lower disposal costs) and higher incomes by selling a larger proportion of the produce. The better alignment between supply and demand also allows farmers to sell fresher products, opening opportunities for premium pricing.
Examples	- Bon Harvest (United States) offers an inventory management software to improve how farms and HoReCa work together. The platform provides insights in inventories, streamlines negotiations, and provide user insights. - Prezo (Spain) is an online order management tool that facilitates communication between farmers and HoReCa. - FreshVnF (India) connects farmers with HoReCa to supply fresh fruits and vegetables based on a data-driven inventory system. - Farmhut (Zimbabwe) allows farmers to place their produce for sale before the actual harvest time to ensure that there are no losses that occur post-harvest due to a lack of demand. - Crisp (United States) provides a food supply forecast platform that supports information flows between HoReCa and farmers on food supply based on sales forecasts (weather, day of the week, promotions, etc.). - Urbie (United States) enables more intelligent ordering and invoicing through smart contracts based on the quality of the produce.

Table 6 – Aligning supply and demand

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Maximize material and energy efficiency – Improving through transparency	
Value proposition for farmers	Increasing farm efficiency by having insights into best practices of other farmers.
Collaborative value creation and value delivery	Horizontal collaboration between farmers, often enabled by dashboards, platforms and farm management systems like Gaiasense, enables farmers to identify and implement best practices and to benchmark their performance against other farmers.
Value capture by farmers	The increased insights on how to improve farm performance can result in lower costs due to lower resource usage while it can simultaneously increase farmer income due to higher crop yields. The more sustainable performance (e.g., reduced pesticide usage) can allow farmers to request premium prices.
Examples	- My Dairy Dashboard (United States) is a platform which includes milk processor data, feed data and weather data and enables farmers to connect their data sources and benchmark the performance of their herds. - ManajeBem (Brazil) is an online platform that connects farmers with the aim to spread sustainable agriculture. - BirdPreneur (Nigeria) is an aviculture platform that helps farmers to raise birds to increase meat and egg production.

Table 7 – Supply chain transparency

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Maximize material and energy efficiency – Data-driven farm optimization	
Value proposition for farmers	Increased insights on how to improve farm performance through reducing inputs and/or maximizing yields.
Collaborative value creation and value delivery	The horizontal collaboration between farmers and service providers enables farmers to optimize their farm performance. The service providers analyse farm data and provide insights to the farmer to improve farm performance. Data is typically collected by farmers by means of sensors and IoT devices while (automated) reports and benchmarks (against similar farms) are generated by the service providers.
Value capture by farmers	The increased insights on how to improve farm performance can result in lower costs due to lower resource usage while it can simultaneously increase farmer income due to higher crop yields. The more sustainable performance (e.g., reduced pesticide usage) can allow farmers to request premium prices.
Examples	- BharatRohan (India) collects data from farms and converts it into actionable information and reports to decrease crop loses, optimize agri-inputs and maximize yields using UAV or drone based hyperspectral imaging. - AgromeIQ (Brunei) collects data from farm systems to create customized solutions and real-time monitoring to increase overall farm productivity. - DigiFarmz (Brazil) uses algorithms that combine biotic (genetics, pathogen, etc.) data with abiotic (climate, sowing date, location, etc.) data to provide real-time dynamic recommendations for farmers to optimize the use of agrochemicals, increase crop yields and the profitability of their crops. - Apiary Book (United Kingdom) helps beekeepers to monitor and analyse data of bee colonies and the environmental factors that affect their health. - Meshine (Turkey) offers drones as a service and provides accompanying services such as image recognition. - Fefifo (Malaysia) modernizes farms by getting farmland ready to plant and mentors and guides farmers in adopting new farming technologies such as fertigation, hydroponics and aquaponics. - iPAGE (Bangladesh) offers a holistic solution to smallholder farmers by offering and managing a number of precision-farming technologies as a service.

Table 8 – Data-driven farm optimization

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4.1.2 Create value from waste

The main archetype "*create value from waste*" covers business models which aim to reduce (farm) waste through collaboration. The "*create value from waste*" business models can be added on top of existing business models but, in contrast with the "maximize material and energy efficiency" business models, they are not aimed at incrementally improving the existing business models but, rather, to add new activities to the business model. Tables 9 to 11 present four different sub-archetypes which are often used by agri-food start-ups.

Create value from waste – Farming on food waste	
Value proposition for farmers	Using food waste as input for farmers.
Collaborative value creation and value delivery	The horizontal collaboration between farmers and food waste producers (e.g., restaurants, food processing companies and other farmers) enables farmers to turn food waste into valuable products by means of innovative farming practices such as insect farming and growing mushrooms.
Value capture by farmers	Farmers generate novel income streams by using low-cost inputs such as food waste. In some cases, farmers may receive income by diverting food waste from landfills.
Examples	- Bbite (United Kingdom) uses insects to turn food waste into food ingredients and functional snacks. - Loopworm (India) farms black soldier fly larvae on food waste to produce premium animal feed and pet food. - OneCycle (India) buys leftover food and recycles it into animal feed. - HaagseZwam (The Netherlands) grows oyster mushrooms on coffee grounds.

Table 9 – Farming on food waste

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Create value from waste – Valorising farm waste	
Value proposition for farmers	Getting rid of farm waste and by-products in a sustainable way.
Collaborative value creation and value delivery	The horizontal collaboration between farmers and agri-food waste processing companies enables farmers to turn their waste and by-products into a valuable input for other industries. To do so, the farm waste needs to be homogenous which might require sorting activities.
Value capture by farmers	Farm waste and by-products become an additional income source (or have at least reduced disposal costs).
Examples	- MycoCup (Canada) is a sustainable take-out cup made of agricultural waste and mycelium. - Mobius (United States) converts lignin containing waste (found in grasses and trees) into biodegradable polymer. - Ecovon (Ghana) turns coconut husk and sugar cane bagasse into wood alternatives. - HighSociety (Italy) presses agricultural waste into high quality materials used to make designer lamps. - Rubbies in the Rubble (United Kingdom) produces condiments from overripe and blemished fruits and vegetables which they collect from farms. - Abandoned Hard Cider (United States) forages apples from abandoned orchards and wild-growing trees to produce ciders.

Table 10 – Valorising farm waste

Create value from waste – Marketing blemished and surplus food	
Value proposition for farmers	Offering otherwise unsold blemished food and surplus food from the farm.
Collaborative value creation and value delivery	The horizontal collaboration between farmers and platforms enables farmers to reach a wider audience to sell their blemished and surplus produce.
Value capture by farmers	Decreasing disposal costs, additional income streams (based on low-cost products).
Examples	- Imperfectus (Spain) enables farmers to sell seasonal fruits and vegetables that do not meet the cosmetic requirements of supermarkets and retailers. - COGZ (United Kingdom) is a business-to-business ecommerce platform that enables farmers to sell blemished food and surplus food to directly to food and beverage manufactures. - Food Finder (Brazil) is a marketplace where restaurants can buy near maturity products from farmers. - FoodMesh (Canada) is a marketplace that matches surplus food to a verified network of businesses and charities.

Table 11 – Marketing blemished and surplus food

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4.1.3 Deliver functionality rather than ownership

The main archetype "*deliver functionality rather than ownership*" is about shifting towards a service model by delivering or using the function of the product rather than the ownership. Such a shift results in a better alignment between customer needs and the offer of the producer and has the potential to change consumption patterns (Bocken et al., 2014). Although the "*deliver functionality rather than ownership*" does not always have a clear link to sustainable performance (Mont & Tukker, 2016), the agri-food start-ups under this archetype have a clear social benefit by improving the economic position of smallholder farmers while making efficient use of resources. Tables 12 to 14 provide detailed insights on the sub-archetypes of "*deliver functionality rather than ownership*".

Deliver functionality rather than ownership – Farming equipment as a service	
Value proposition for farmers	Using (expensive) farming equipment without capital investments.
Collaborative value creation and value delivery	The horizontal collaboration between farmers and equipment owners (e.g., other farmers and equipment rental companies) allows farmers to use farming equipment without making capital investments.
Value capture by farmers	Lower working capital, more flexibility (access to a wider range of machines allows farmers to change crop types more easily) and less risk (of machine breakdown).
Examples	- TunYat (Myanmar) is an online platform that connects farms - FarmSpark (Nigeria) in a platform which connect smallholder farms to certified, reliable and affordable agro-service providers such as equipment rental vendors. - MaqFácil (Brazil) is a mobile application that optimizes the rental of machines and agricultural implements. - Farm-r (United Kingdom) is a marketplace platform that allows farmers to rent out their under-utilized farm machinery to farmers who need it.

Table 12 – Farming equipment as a service

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Deliver functionality rather than ownership – Agriculture 4.0 as a service	
Value proposition for farmers	Using agriculture 4.0 technologies and the insights of such technologies to improve farming performance.
Collaborative value creation and value delivery	The horizontal or vertical collaboration between farmers agronomists and/or technology providers help farmers with deploying the technologies and/or with collecting and analyzing the data collected with agriculture 4.0 technologies.
Value capture by farmers	Lower working capital, more flexibility (access to a wider range of machines allows farmers to change crop types more easily) and less risk (of machine breakdown).
Examples	- Meshine (Turkey) offers drones as a service and provides accompanying services such as image recognition. - AgromeIQ (Brunei) collects data from farm systems to create customized solutions and real-time monitoring to increase overall farm productivity.

Table 13 – Agriculture 4.0 as a service

Deliver functionality rather than ownership – Farming as a service	
Value proposition for farmers	Offering to the customer the service of farming rather than the output of farming.
Collaborative value creation and value delivery	Vertical collaboration between farmers and consumers (e.g. final consumers, restaurants and retailers) enables farmers not to sell products to consumers but sell the service of farming on (excess) land where the end-products are owned by the buyer.
Value capture by farmers	Additional and secure farmer income due to upfront payments and possibilities for premium pricing due to increased transparency and an improved customer relationships.
Examples	- Lettuce Networks Inc (United States) installs, maintains and harvests dense networks of connected backyard farms and provides fresh and healthy produce to the neighbourhoods. - YouFarmer (Italy) cultivates and manages backyards by certified farmers which will guarantee certified quality vegetables and clear provenance. - VinX (Israel) enables wineries to sell wine futures in advance. Consumers receive bottles from their parcel as well as a certificate of adoption. - Cacao Shares (Japan) enables consumers to purchase shares in cacao trees which entitles the owner of the share to a quota on the productivity of the cacao tree for its entire life (which is about 25 years).

Table 14 – Farming as a service

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4.1.4 Adopt a stewardship role

The main archetype "*adopt a stewardship role*" is about engaging with stakeholders and consumers to ensure their long-term health and well-being (Bocken et al., 2014). In the context of farming and collaborative business models, farms can adopt a stewardship role by providing insights on the food to the buyers. Table 15 provides insights into the "*traceable farming practices*" sub-archetype.

Adopt a stewardship role – Traceable farming practices	
Value proposition for farmers	Offering precise and accurate information of the farming production to consumers.
Collaborative value creation and value delivery	The vertical collaboration between farmers, other value chain actors and the horizontal collaboration with a platform provider, typically enabled through blockchain technology, allows the traceability of food products. Data on the farming production stage is (automatically) generated and shared with all actors until it reaches the final consumer.
Value capture by farmers	Premium prices due to guaranteed quality (and access to labels and certifications).
Examples	- Vinequery (Israel) uses blockchain technology to enable consumers to scan the barcode on the wine bottle labels to get access of a full picture of the winery's production and quality. - EcoTrace (Brazil) guarantees the origin of the product ensures complete monitoring, control and governance from farm to fork. - WhatsHalal (Singapore) uses blockchain technology to provide halal traceability from farm to fork. - AgriPlace (The Netherlands) enables quick data sharing with auditors and buyers to enable transparent supply chains. - Know Seafood (United States) utilizes blockchain technology to follow the seafood from the point of harvest right to the customer's table.

Table 15 – Traceable farming practices

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4.1.5 Repurpose for society

The main archetype "*repurpose for society*" is about creating social and environmental benefits rather than economic benefits (Bocken et al., 2014). In the context of farming and collaborative business models, farms can repurpose their business model for society through payments for eco-services. Table 16 provides insights into the "*payments for eco-services*" sub-archetype.

Repurpose for society – Payments for ecosystem services	
Value proposition for farmers	Performing environmental eco-system services such as carbon sequestration, ponds for migrant birds and land strips for bees.
Collaborative value creation and value delivery	The horizontal collaboration between farmers and actors from various value chains as well as governments and citizens, often through a platform, connects farmers with entities who are willing to pay for eco-system services such as carbon sequestration.
Value capture by farmers	Additional income streams related to the payments for the eco-system services.
Examples	- Nori (United States) is a carbon removal marketplace that allows anyone in the world who is willing to pay to remove excess carbon dioxide from the atmosphere by connecting carbon removal suppliers with buyers. - Treedom (Italy) allows people and companies to plant trees and follow the growth of the tree online while directly financing local farmers around the world. - CiBO (United States) helps farmers to enrol their land on a platform and to qualify for (and receive) carbon credits for regenerative agricultural practices.

Table 16 –Payments for ecosystem services

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4.1.6 Shorten the supply chain

The "*shorten the supply chain*" main archetype is a new archetype which was, to the best of our knowledge, previously uncovered in business model archetype literature. The "*shorten the supply chain*" archetype covers business models which are aimed at improving the economic position of farmers and to increase transparency for the buyers by removing actors from the supply chain. Tables 17 to 22 provide insights into each sub-archetype.

Shorten the supply chain – Cooperative food processing	
Value proposition for farmers	Offering processed food instead of raw products.
Collaborative value creation and value delivery	Horizontal collaboration between farmers to open and run a facility to process their raw products.
Value capture by farmers	Higher prices and more control over the prices due to controlling a large part of the value chain. By being less dependent, farmers can pursue and monetize sustainable efforts.
Examples	- Delta Peanut (United States) is a company owned by sixty farmers to integrate their peanut production with the goal to produce and process the high-quality peanuts while emphasizing stewardship and sustainability. - Bay Area Ranchers Cooperative (United States) is a cooperative for ranchers to process meat in a sustainable and non-competitive environment.

Table 17 – Cooperative food processing

Shorten the supply chain – Cooperative branding	
Value proposition for farmers	A strong brand for agricultural products.
Collaborative value creation and value delivery	Horizontal collaboration between farmers and vertical collaboration between farmers and other value chain actors to create and operate under a common brand. The brand is often based on product or geographical characteristics.
Value capture by farmers	Higher prices and more control over the prices due to a stronger brand. The higher margins can enable farmers to pursue and monetize sustainable efforts.
Example	- Grana Padano (Italy) is a consortium of farmers and cheesemakers who, collaboratively, created a premium cheese brand. Thanks to the joint forces, they managed to create a significant marketing budget which was not possible to reach by individual actors.

Table 18 – Cooperative branding

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Shorten the supply chain – Cooperative sales	
Value proposition for farmers	A shared sales channel for agricultural products.
Collaborative value creation and value delivery	Horizontal collaboration between farmers and vertical collaboration between farmers and other value chain actors to create a shared sales channel.
Value capture by farmers	Higher prices and more control over the prices due to fewer middlemen. The higher margins can enable farmers to pursue and monetize sustainable efforts. In addition, the more direct interaction with consumers can help farmers to innovate their product offer.
Example	- Porro Cervere (Italy) is a consortium of leek farmers who jointly sell their leeks on food markets and food events such as the SlowFood events.

Table 19 – Cooperative sales

Shorten the supply chain – Cooperative purchasing	
Value proposition for farmers	Shared purchasing for agricultural products.
Collaborative value creation and value delivery	Horizontal collaboration between farmers enables farmer to purchase farming inputs and farming equipment together.
Value capture by farmers	The better negotiation position due to the collaborative purchasing leads to lower purchasing costs while the shared investments in equipment can lead to the procurement of more efficient equipment with related (long-term) cost savings. Additional benefits include increased market insights, increased supplier performance in terms of delivery speed and flexibility, and less bureaucratic hassle.
Example	- AF Smart Farm Procurement (United Kingdom) and Fram Farmers (United Kingdom) buys farming inputs like seeds, fertilizers, animal feed, and fuels for multiple farmers.

Table 20 – Cooperative purchasing

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Shorten the supply chain – B2B marketplace	
Value proposition for farmers	Connecting farmers with markets and offering buyers with transparency of their food.
Collaborative value creation and value delivery	Horizontal collaboration between farmers and buyers (often in combination with an online platform) enables farmers to sell their produce to a wider audience such as retailers and the HoReCa sector. The shortened supply chain increases transparency.
Value capture by farmers	Increased market access and increased transparency empowers farms to get better prices for their produce and their sustainable practices.
Examples	- Foodshed (USA) is a platform that connects small-scale producers to chefs, supermarkets and institutional buyers within a 250-mile radius. - Agrow (Argentina) in an online platform that allows farmers to sell bulk fruits, vegetables, cereals, meat, wines and other agro-products to food processors. - PanelFresh (Bolivia) connects farmers with restaurants though an online platform.

Table 21 –B2B marketplace

Shorten the supply chain –B2C marketplace	
Value proposition for farmers	Connecting farmers with consumers and offering consumers transparency on their food.
Collaborative value creation and value delivery	Horizontal collaboration between farmers and consumers (and often a platform provider) enables farmers to sell their produce directly to consumers and to provide consumers with insights on the food.
Value capture by farmers	Increased market access and increased transparency empowers farms to get better prices for their produce and their sustainable practices.
Examples	- L'alveare che dice sì (Italy) is an online platform where farmers can post their produce and where consumers can pick up the food at pick-up locations. - Beanboat (Bahrein) is an e-commerce platform that connects family-owned coffee farmers in Colombia with consumers around the world. - Masafresh (United States) is an online farmers market which operates on a localized e-commerce platform where farmers and small-batch producers can list their produce.

Table 22 –B2C marketplace

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4.1.7 Support financial stability

The "*support financial stability*" archetype helps farmers to increase or free up their working capital. The additional working capital may be used to invest in sustainable practices much as in the "*develop scale-up solutions*" from (Bocken et al., 2014). However, the difference between the "*develop scale-up solutions*" and the "*support financial stability*" archetype is the broader scope of the latter which, besides scaling up solutions, is aimed at the social aspect of continuing (small-holder) farming activities. Tables 23 and 24 provide insights into the sub-archetypes of "*support financial stability*" found in the start-up sample.

Support financial stability – Parametric insurance	
Value proposition for farmers	Secure income and faster pay-outs in case of damage due to unmanageable and unforeseen disastrous events such as storm, hail, and frost
Collaborative value creation and value delivery	The collaboration between farmers, insurers and technology providers enables farmers to get better quotes based on more accurate risk assessments that leverage on field sensors and/or satellite images.
Value capture by farmers	The faster pay-out and secure income free of otherwise reserved working capital for adverse events. In addition, parametric insurance simplifies processing and reduces the need for site visits by setting up predetermined pay-out criteria as such speeding up the pay-out so farmers can replant faster
Examples	- BirdsEyeView (United Kingdom) harnesses high resolution satellite imagery to provide farmers with weather risk insurance. BirdsEyeView provides accurate weather alarms so farmers can protect their crops. - OKO (Mali) uses satellite information to define risks and create insurance products for farmers in emerging markets. - Hailios (United Sates) captures data from hail, wind, temperature, and moisture to develop insights on micro-regional climate patterns and weather events which insurers and farmers can use to insure crops.

Table 23 – Parametric insurance

Support financial stability – Collaborative financing	
Value proposition for farmers	Access to funds to finance farm modernization.
Collaborative value creation and value delivery	The horizontal collaboration between crowdfunding platforms and farmers and the horizontal collaboration between farmers to pool financial resources allows farmers to attract finance from investors throughout the world.
Value capture by farmers	The improved access to funds can be used to invest in more efficient and/or more sustainable production equipment which can result in lower operational costs or increased revenue streams.
Examples	- HeavyFinance (Lithuania) is a crowdfunding platform to provide loans for farming equipment. - Ifarm360 (Kenya) is a crowdfunding platform that links smallholder farmers in Africa with investors around the world. - Money farm (Gambia) is an online crowdfunding platform that links farmers to investors around the world.

Table 24 – Collaborative financing

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4.2 Collaborative sustainable business model archetype combinations

The workshop with the SIPs resulted in various combinations of collaborative sustainable business model archetypes. Table 25 shows the desired combinations for each SIP. The next paragraphs elaborate on the combinations of archetypes developed by the SIPs.

Archetype	Sub-archetype	SIP1	SIP2	SIP3	SIP4	SIP5	SIP6	SIP7	SIP8	SIP9	SIP10	SIP11
Maximize material and energy efficiency	Aligning supply and demand	■	■	■	■					■		
	Improving through transparency	■		■		■		■				
	Data-driven farm optimization		■		■	■	■	■				■
Create value from waste	Farming on food waste									■		
	Valorising farm waste											
	Marketing blemished and surplus food									■		
Deliver functionality rather than ownership	Farming equipment as a service						■					
	Agriculture 4.0 as a service	■				■	■	■				■
	Farming as a service											
Adopt a stewardship role	Transparent farming practices	■		■				■				
Repurpose for society	Payments for ecosystem services						■					
Shorten the supply chain	Cooperative food processing											
	Cooperative branding	■				■						■
	Cooperative sales				■							
	Cooperative purchasing				■							
	B2B marketplace											
	B2C marketplace							■		■		
Support financial stability	Parametric insurance		■									
	Collaborative financing				■							

Table 25 – Combinations of collaborative sustainable business model archetypes

Commented [EJP6]: What to do with these two SIPs?

A cross-SIP analysis reveals a couple of recurring patterns. First, all SIPs adopt a collaborative business model related to 'maximize material and energy efficiency'. This is in line with the data-driven innovation to reduce the environmental impact of farming, which is one of the foundations in Ploutos. Second, all SIPs combine the 'maximize material and energy efficiency' archetypes with one of the other archetypes.

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- **Maximize material and energy efficiency + agriculture 4.0 as a service** (SIPs 1, 5, 6, 7, 11): Collaborations between farmers and organizations who offer agriculture 4.0 as a service enables farmers to make better use of the data generated with their data-driven technologies. For instance, farmers may provide raw data and receive advice on how to improve their farming practices. Specifically, this combination often involves the 'improving through transparency' sub-archetype as the collaboration enables benchmarking the farming practices of multiple farmers.
- **Maximize material and energy efficiency + transparent farming practices** (SIPs 1, 3, 5, 7): Collaborations between farmers and supply chain actors to create transparency enables farmers to demonstrate the sustainable practices achieved through the 'maximize material and energy efficiency' archetypes. Hence, this combination allows farmers to not only reduce input costs and increase yields, but to also obtain premium prices.
- **Maximize material and energy efficiency + shorten the supply chain** (SIPs 1, 4, 5, 7, 9, 11): Horizontal collaboration between farmers to shorten the supply chain (e.g., selling together and creating a common brand) augments the benefits from the adoption of maximize material and energy efficiency archetypes. The sustainable performance achieved through the adoption of the data-driven technologies can be exploited in a marketing and sales strategy such as jointly selling (under a common brand).
- **Maximize material and energy efficiency + payments for eco-system services** (SIPs 6, 8, 10): Exploiting alternative income streams for eco-system services achieved by the data-driven technologies can provide an additional income stream to farmers, as such augmenting the adoption of 'maximize material and energy efficiency' archetypes. For instance, the use of smart farming technologies can lead to carbon sequestration in the soil, therefore opening possibilities on the carbon credit market. Furthermore, the use of smart farming technologies can increase the biodiversity of the region, which can augment (agri-)tourism, an indirect form of payment for eco-system services.
- **Maximize material and energy efficiency + farming equipment as a service OR collaborative financing** (SIPs 4, 6): This combination of archetypes is useful when farmers do not have the financial means to invest in the data-driven technologies and the equipment needed to utilize these technologies. For instance, smart-farming devices may offer little value when tractors are not equipped with the right technologies to execute the advice such as the variable rate application of fertilizers. Adopting the 'farming equipment as a service' archetype or the 'collaborative financing' archetype can enable farmers to obtain the required equipment.
- **Maximize material and energy efficiency + parametric insurance** (SIP2): The adoption of data-driven technologies to maximize material and energy efficiency provides the co-benefit of enabling parametric insurance. The generated data, such as weather data, can serve as input for parametric insurance, as such providing more financial stability to the farmer.
- **Aligning supply and demand + create value from waste** (SIP9): One of the main barriers for the circular economy is the uncertainty of when waste is produced. The combination of 'aligning supply and demand' with 'create value from waste' addresses this barrier. By aligning supply and demand, for instance through a platform where both supply and demand is shared between the different actors, otherwise wasted food can be recovered more efficiently.

4.3 Considerations for implementing collaborative sustainable business model archetypes

The interviews with the farmers show the following considerations when implementing a collaborative business model (ranked from most important to least important):

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- **Past investments**. As farmers have made investments in the past (and have financial commitments related to them), they are hesitant to adopt business model archetypes which lead to less optimal exploitation of those investments.
- **Partnership vibes.** Farmers prefer to collaborate with firms and organizations who do not have conflicting goals. Preferably, farmers prefer to work with firms and organizations which they already know. If this is not the case, farmers prefer to collaborate with cooperatives, research institutes, charities and NGOs since those entities are not driven by optimizing their profit (at the potential expense of the farmer). In addition, farmers prefer to collaborate with firms and organizations which are approximately similar in size as they feel that these firms and organizations are more willing to consider their needs.
- **Clarity of the financial impact**. Farmers prefer collaborative business model archetypes which have a clear revenue stream and cost structure. Archetypes which have less clear financial impact, for example related to potential savings or additional sales in the future while making investments today, are perceived as less attractive.
- **Novelty of the business model**. Farmers prefer novel business models as they are fairly used to innovate (e.g., changing crops and farming practices). When a business model archetype is not considered as novel by the farmer, they are less likely to expect the archetype to provide them with a benefit.
- **Stakeholder management**. Farms, and especially small farms, are often embedded in a social context in which several stakeholders are present. Examples of such stakeholders are family members, employees, and the local community. When adopting a new business model archetype, farmers consider the interests of these stakeholders and are hesitant to adopt a business model archetype which might potentially harm those stakeholders. Due to this, farmers tend to prefer incremental innovations rather than disruptive innovations due to the lower risk profile.

Obviously, the different considerations have a different impact on the identified business model archetypes. The interviewed farmers limited interest in the “repurpose for society” and “adopt a stewardship” archetypes. They cited that this archetype involves a change in resources to optimize social and environmental benefits instead of economic benefits, requires the development of partnerships with organizations with which they may have less affinity, and the abstract and insecure financial benefits. Likewise, the involvement of new and unknown actors was cited as a reason for the limited interest in the archetypes related to “creating value from waste”. The same reasoning explains why farmers prefer the business model archetypes related to “maximize material and energy efficiency”, “deliver functionality rather than ownership” and “shorten the supply chain” as those archetypes do, according to the farmers, not risk past investments, have a clear financial impact and can often be realized by working with similar and already known partners.

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5 Conclusions

This deliverable provides the final version on the reference sustainable collaborative business model archetypes as part of Task 3.3 of the Ploutos project. The goals of these reference models are: (i) to serve as a source of inspiration for the SIPs, (ii) to have a clear and condense overview of applicable business models and the combinations of these business model, and (iii) to provide insights in which actors should be involved and what activities they should undertake.

After a brief introduction with the underlying motivation for sustainable business models, we present a theoretical framework of sustainable business models with a particular focus on the agri-food sector, its challenges and the role of collaboration. This also includes an overview of already known business model archetypes from literature.

Next, we present our methodology. This deliverable builds upon **D3.3. "Initial version of reference sustainable collaborative business model archetypes"**. In **D3.3.**, we developed the reference SCBM archetypes by using a database (Crunchbase) of start-ups due to their small scale and innovative nature. Starting from a selection of keywords, manual filtering and further narrowing of keywords resulted in a final database of just over 300 relevant start-ups. All of these are coded on several dimensions related to business models, collaboration, digitization, and sustainability. Through clustering and filtering and mapping onto pre-existing business model archetypes, a stable set of archetypes and sub-archetypes was derived. In the current deliverable, we updated the initial version of the archetypes by analysing existing businesses and lessons learnt during the project (e.g., the outcomes of the Ploutos Sustainable Collaborative Business Model Innovation process). Furthermore, through the collaboration with the SIPs, we identified relevant combinations of archetypes. Finally, we interviewed farmers to identify their key considerations when adopting the archetypes. Together, these mixed methodologies enabled us to provide a comprehensive overview of the reference sustainable business model archetypes.

In the Results section, we present the **seven archetypes** found based on the data analysis, which are a combination of five previously known archetypes, supplemented by two novel archetypes, which are all also subdivided into **a total of 19 more specific sub-archetypes**. For each archetype and sub-archetypes, we provide a concise description of the main value proposition, value creation and value capture elements, and some notable examples. Furthermore, we identified seven archetype combinations and demonstrated how the archetypes augment each other. Finally, we demonstrate that past investments, partnership vibes, clarity of the financial impact, the novelty of the business model and stakeholder management play an important role in the adoption of the archetypes by farmers.

The archetypes, the combinations of archetypes and the considerations of farmers directly feed into the Collaborative Sustainable Business Model Innovation methodology (reported in **D3.1** and **D3.2**) that is developed in *T3.1 – Development of the Ploutos SCBMI approach*. In particular, the archetypes are used as a source of inspiration in the Design phase, as well as more indirectly in the context of the required actors and activities. During the execution of task *T3.4 - Support of the Pilots using the Ploutos SCBMI approach*, the SIPs are supported to design and evaluation novel collaborative and sustainable business models following the methodology. With the objective of Ploutos in mind, to create substantial sustainable impact and to safeguard and improve the farmers' position, a key challenge for adopting the archetypes unfolds. This observation is that most of these archetypes *could potentially* benefit from something which we call '*a collective provision'*. A collective provision is something that is useful for multiple actors such as sharing data (e.g., '*data-driven farm optimization*'), organization of multiple farmers (e.g., '*cooperative food processing*') or the organization of multiple value-chain actors (e.g., '*transparent farming practices'*). However, considering the sovereignty of farmers and considering scaling for substantial impact, commercial implementations, despite their undeniable value creation for the farmer and other value chain participants, may carry downsides. Foremost, commercial implementations represent yet-another dependency of the

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farmer on a business. Such business may change their service conditions unilaterally or be taken over by powerful conglomerates. To ensure farmer control, the application of the archetypes requires that farmers can 'call the shots', a concept known as owning the control point (Eaton et al., 2010; Woodard, 2008). Examples of control points are access to data, terms of service, prices etc. The way these control points are owned by farmers affects whether net value for farmers is created or extracted over time. To ensure that farmers have control in collaborative business models, WP3 supports the generation of multiple business model implementation scenarios in the scope of the SCBMI approach of *T3.1 – Development of the Ploutos SCBMI approach.*

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