D3.3: Initial version of reference sustainable collaborative business models

WP3 – Sustainable Collaborative Business Model Innovation

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Definitions, Acronyms and Abbreviations

Acronym/Term	Explanation
SIP	Sustainable Innovation Pilot
SCBM	Sustainable Collaborative Business Model
SCBMI	Sustainable Collaborative Business Model Innovation
HoReCa	Hotel, Restaurant, Catering
SDG	Sustainable Development Goal
NGO	Non-Governmental Organization

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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 main reasons:

- *Power imbalance*: an increasing power imbalance in favour of retailers (e.g. large supermarket chains) reduces economic benefits and the economic ability for farmers to adopt sustainable business models.
- *Market access*: most food products are now routed through (regional) distribution centres and several processing stages which increases the distance between the farmer and the market which reduces farmers in monetizing sustainable 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 the farmer independently. Based on analysing the collaborative business models in the agri-food sector found in practice, the objective of this deliverable is to present collaborative business model archetypes for the SIPs. In total, sixteen archetypes are presented. Figure 1 provides an overview of the archetypes based on the classification framework presented in *D1.2. Map of existing solutions and baseline performance.* Based on the implementation of the archetypes in *T3.1 – Development of the Ploutos SCBMI approach,* the archetypes and the challenges to implement the archetypes presented in this deliverable will be update in M28 of the Ploutos project.

Innovation readiness	Technical	Organizational
Medium-high	- Improving through transparency - Data-driven farm optimization - Traceable farming practices	- Aligning supply and demand - Farming on food waste - Farming as a service - Collaborative food processing
Medium-low	- Parametric insurance	- Knowledge sharing - Valorising farm waste - Marketing blemished and surplus food - Farming equipment as a service - Online B2B and B2C marketplace - Collaborative financing - Payments for eco-system services

Main innovation focus

Figure 1 – Classifying the collaborative sustainable business models

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1 Preface

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 will develop a Sustainable Innovation Framework that applies a systemic approach to the agri-food sector, building on three pillars: Behavioural Innovation, Sustainable Collaborative Business Model Innovation and Data-driven Technology Innovation. Exploiting a history of significant agri-food projects and the respective ecosystems around them, the project will deploy 11 innovative systemic Sustainable Innovation Pilots (SIPs), where by adopting a Multi-Actor Approach innovative solutions and methodologies will be implemented, tested, assessed, generating practical learnings. The SIPs 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 will be integrated to deliver the most environmentally, socially, and economically sustainable solution. Moreover, a Ploutos Innovation Academy will be established 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 being 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 scope

Deliverable D3.3, “Initial version of reference sustainable collaborative business model archetypes”, is developed in scope of Task T3.2, “Investigation of reference sustainable business model archetypes”. 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. That 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 of 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: collection of relevant examples and typologies, with an emphasis on collaborative business models; structuring and analysis of the material. The reference business model archetypes are to be used in 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 explains the related task.
Chapter 3 provides an overview of relevant theory for SCBMI.
Chapter 4 details the research methodology.
Chapter 5 provides the archetypes.
Chapter 6 discusses initial insights into the implementation of the archetypes and directions for the update of this deliverable in M28.
Chapter 7 contains the conclusions of this report.
Chapter 8 lists the references used throughout this report.

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2 Introduction

Our farming and food system is currently under great pressure and in need for change. The farming and food system is expected to secure the world's nutrition needs with safe foods. It is expected to adapt to our dietary needs and is currently also associated with substantial ecological impacts and trends towards decreased biodiversity. No small tasks. In many food chains primarily the farmers are experiencing the pressures of globalized markets and skewed power balances. Yet digitization developments are linking value chain partners, humans, organizations and technologies in new ways as data is needed to precisely monitor and manage the growth of individual plants or animals by exact amounts of nutrients or control of production equipment, to forecast and control production volumes and to identify the current and past conditions and whereabouts of the food on the table. The transition towards a more sustainable and digital farming and food system requires value chains to be organized in new collaborative ways, e.g. short local supply chains and community based farmer's markets (Lawson et al., 2008) or participation in multiple supply chains, referred to as value-nets (Kähkönen, 2012). In other words the *value creation logic* of the food and farming system is changing: farms create more than the financial equivalent of the foods produced, as the production affects health insights by data and development of new or older types of foods, ecological quality, biodiversity, social value for the farmer and workers, community value on local markets, regional value in a rural/urban balance. Realigning the business models of multiple actors in the food and farming system in a more or less synchronized way requires collaboration.

Collaboration has traditionally a strong presence in the farming sector, witnessed by the many cooperatives that organize farmers to share equipment, share risks, coordinate production planning, accumulate power to sell at reasonable prices, et cetera. Yet, the process of designing and implementing new value creation logics across multiple value chain actors, through collaborative business models, is novel. In collaborative innovation settings, much like the SIPs in Ploutos, it makes sense to expand the scope of business modelling to include multiple organizations that are deliberately working on interaction, interoperability and other relations. Expanding the scope to multiple actors also turns the design activity from a single organization to a participatory approach in which participants from multiple organizations need to evolve their mutually dependent perspectives.

With the aim to support the SIPs to develop collaborative business models, that generate sustainability effects while involving multiple organizations and digital innovations, the business model design task becomes quite prominent. It should be clear that involving multiple organizations in a business model design process increases the 'degrees of freedom' (and consequently its complexity). An increased complexity in the design task can be overcome by ways that support organizations to quickly navigate the 'design space'. This is exactly the purpose of the archetypes developed and presented in this document. The purpose of the collaborative sustainable business model archetypes is to present the SIPs with relevant examples that i) highlight interesting approaches, while also omitting non-relevant areas of the design-space and ii) serve as an inspiration for modelling the value creation in the SIPs.

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3 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 and 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 business model as described above focuses on the economic performance of the business and may therefore result in unintended and negative environmental and social impacts. Adding social and environmental performance to the value proposition, the value creation and delivery and the value capture – i.e. creating sustainable business models – is regarded as a promising approach to reach sustainable objectives (Yang et al., 2017).

3.1 Sustainable business models

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*". The following sections elaborate on the sustainable aspects of the value proposition, the value creation and value delivery and the value capture.

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). Since customers increasingly pay attention to sustainable value, firms increasingly need to offer sustainable value propositions – i.e. value propositions which integrate environmental and social benefits (Boons & Lüdeke-Freund, 2013; Patala et al., 2016). Typical environmental and social elements for sustainable value propositions include (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, in turn, 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 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). The measurement framework presented in *Deliverable 1.1. State of the art and initial SIF* report provides a comprehensive overview of how organizations can capture sustainable value.

However, note that the definition of the sustainable business model is barely normative. We adopt a 'relative approach' where we consider a business model sustainable when it improves the status quo.

3.2 Sustainable business models in the agri-food sector

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 of these challenges. However, 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

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"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).

Massa et al. (2017) recognizes that descriptive business model archetypes are helpful for 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, an emphasis is placed on financial-economic revenues and costs related to the business model. Nevertheless, the same logic can be applied to sustainable business model archetypes. Sustainable business model archetypes are valuable to guide farmers 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. Table 1 provides an overview of the seven sustainable business model archetypes according to Bocken et al. (2014), complemented with examples derived from the agri-food sector (Food Sustainability Observatory, 2020; Smart Agri-food Observatory, 2019).

[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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Business model archetype	Value proposition	Value creation and delivery	Value capture	Examples in the agri-food sector derived from Smart Agri-food Observatory (2019) and Food Sustainability Observatory (2020)
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 DOP (denominazione d'origine protetta = protected designation of origin) and IGP (indicazione geographica protetta = 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

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

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3.3 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 a number of 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 in order 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 in order 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.

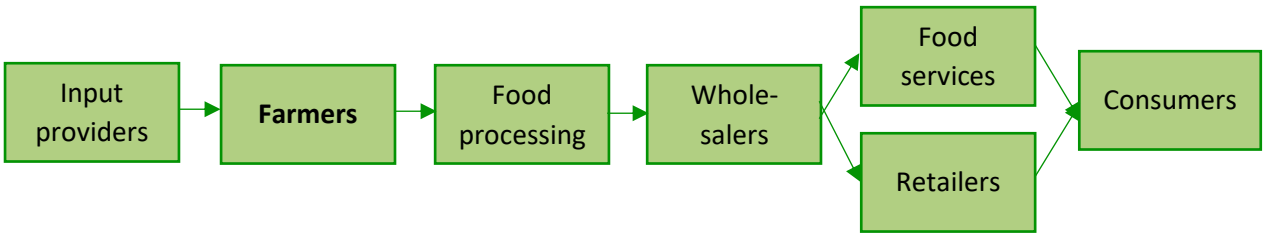

Figure 2 – Typical value creation and delivery system in the agri-food value chain

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 retailers (e.g. large supermarket chains) reduces economic benefits and the economic flexibility to adopt sustainable business models.
- *Market access*: most food products are now routed through (regional) distribution centres and several processing stages which increases the distance between the farmer and the market which reduces farmers in monetizing sustainable 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.

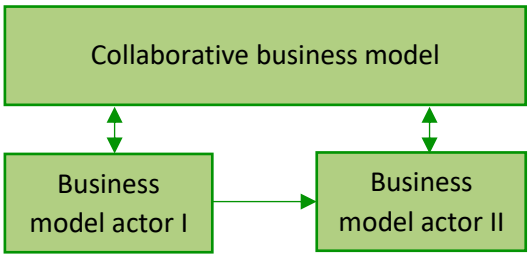

Figure 3 – Collaborative business models for value creation and delivery systems

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 aid farmers and other value chain actors to select and implement a collaborative sustainable business model.

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4 Methodology

4.1 Justification of methodology

To develop farmer centric collaborative sustainable business model archetypes, we analysed the 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.

4.2 Database construction

To analyse the 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

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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 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 was 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 or not 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 are located in developed countries (N=161) such as the United States, Western Europe and Japan while the other half of the start-ups are 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 bio-diversity 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., waste water 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 in order 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

4.3 Data analysis

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. The next chapter presents the results of the coding process.

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5 Results

5.1 Overview of the archetypes

Figure 3 presents the collaborative sustainable business model archetypes which are identified through analysing the start-up database. Building on Bocken et al. (2014), the 303 start-ups can be subdivided 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. The next sections first discuss each sub-archetype in more detail. Next, we provide insights into where the archetypes are mostly used.

Main arche-types	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-arche-types	- Aligning supply and demand - Improving through transparency - Data-driven farm optimization - Knowledge sharing	- Farming on food waste - Valorising farm waste - Marketing blemished and surplus food	- Farming equipment as a service - Farming as a service	- Transparent farming practices	- Payments for eco-system services	- Collaborative food processing - Online B2B marketplace - Online B2C marketplace	- Parametric insurance - Collaborative financing

Figure 4 – Collaborative sustainable business model archetypes

5.2 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, the value capture and 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.

5.2.1 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. Although some investments might be needed, the compliance with existing business models make the "*maximize material and energy efficiency*" business model archetypes relatively easy to implement. Tables 6 to 9 present the four business model archetypes as identified in this study.

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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 up 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	Reducing waste along the supply chain and guaranteeing product quality.
Collaborative value creation and value delivery	Vertical collaboration between the farmers and other agri-food value chain actors enables the optimization of (parts of) the value chain and guaranteeing high quality products by identifying and acting upon weak spots through monitoring the various stages of the supply chain. IoT sensors are used to measure parameters such as temperature and humidity and HACCP procedures are digitized and shared through blockchain and platform solutions along the (entire) value chain. The data provides insights into where losses (waste and quality implications) occur.
Value capture by farmers	Farmers can get higher prices due to guaranteeing the quality of the produce. In addition, farmers can get lower insurance fees as they can prove whether or not potential quality occur on the farm or elsewhere in the value chain. Additional savings can occur due to more efficient value chains with less waste.
Examples	- Tsenso (Germany) is an automated, cloud-based solution to track and gather information on product storage conditions from farm to fork. This enables value chain actors to make decisions on quality assurance and to determine weak spots within the supply chain. - Holifresh (Belgium) provides a cloud platform and plug and play sensors which allows to continuously monitor parameters such as temperature, humidity and CO2. They also provide complimentary modules to digitize HACCP procedures such as inspections and cleaning registrations. - Milkchain (Brazil) offers a remote monitoring system to monitor temperature, volume and humidity in milk cooling tanks on farms. As such, they are able to identify non-standard events that impair the quality of the milk. These insights and quality assurance helps farmers to get fair prices. - Onalytics (Portugal) delivers smart end-to-end tracking and monitoring solutions for beverage kegs as such providing actional insights to increase operational efficiency along the supply chain. - AgNext (India) uses the latest technologies in computer vision, spectroscopy and IoT devices merged with AI for instant analysis of physical, chemical and ambient quality of food from farm to fork.

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. - 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. - 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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Maximize material and energy efficiency – Knowledge sharing	
Value proposition for farmers	Knowledge to improve farming practices.
Collaborative value creation and value delivery	The horizontal collaboration between farmers enables them to share and gain a deeper understanding of farming practices through using knowledge platforms.
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	- 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. - Aqua App (India) is a mobile application for the dissemination of agronomic information related to improve yields of aquacultural practices.

Table 9 – Knowledge sharing

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5.2.2 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 10 to 12 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 10 – 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 11 – 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 12 – Marketing blemished and surplus food

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5.2.3 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 small holder farmers while making efficient use of resources. Tables 13 and 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 there under-utilized farm machinery to farmers who need it.

Table 13 – Farming equipment as a service

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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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5.2.4 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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5.2.5 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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5.2.6 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, 18 and 19 provide insights into each sub-archetype.

Shorten the supply chain – Collaborative 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 – Collaborative food processing

Shorten the supply chain – Online 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, platform providers and buyers enables farmers to sell their produce to a wider audience such as retailers and HoReCa. 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 18 – Online B2B marketplace

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Shorten the supply chain – Online 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 platform providers enables farmers to sell their produce directly to consumers and to provide consumers on 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 19 – Online B2C marketplace

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5.2.7 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 20 and 21 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 20 – 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 21 – Collaborative financing

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6 Initial insights into the implementation of the archetypes and the further development of the deliverable

Although we have uncovered sixteen sustainable collaborative business model archetypes, farmers are unlikely to adopt all archetypes. This chapter provides initial insights on how to apply the archetypes and discusses possible future directions for the update of this deliverable planned in M28.

6.1 Selecting the right archetype

To help famers and other value chain actors in selecting the right archetype based on the farmer's technological and organizational innovation readiness, Figure 4 classifies the archetypes based on the SIF classification framework as presented in deliverable *D1.2. Map of existing solutions and baseline performance*. The ease of implementation for farmers relates to the innovation readiness levels where easily implemented business models need only a medium-low innovation readiness level. More difficult to implement business models, for example due to investments and major changes to the business model, need a medium-high innovation readiness level. These insights can help farmers to select the right business model for their farm. In addition, appendix A provides insights in the geographical context in which the archetypes are found.

Innovation readiness	Technical	Organizational
Medium-high	- Improving through transparency - Data-driven farm optimization - Traceable farming practices	- Aligning supply and demand - Farming on food waste - Farming as a service - Collaborative food processing
Medium-low	- Parametric insurance	- Knowledge sharing - Valorising farm waste - Marketing blemished and surplus food - Farming equipment as a service - Online B2B and B2C marketplace - Collaborative financing - Payments for eco-system services

Main innovation focus

Figure 5 – Classifying the collaborative sustainable business models

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6.2 Ensuring farmer control

With the objective of Ploutos in mind, to create substantial sustainable impact and also the safeguard and improve the farmers' position, an observation with respect to the archetypes unfolds. This observation is that most of these archetypes *could potentially* benefit from something 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. '*collaborative food processing*') or the organization of multiple value-chain actors (e.g. '*traceable farming practices'*). However, in light of the sovereignty of farmers and in light of scaling for substantial impact, commercial implementations, despite their undeniable value creation for the farmer and other value chain participants, may incur downsides. Foremost, commercial implementations represent yet-another dependency of the farmer on a business. Such business may change its service conditions unilaterally or, when successful, be taken over by powerful conglomerates. To ensure farmer control, the application of the archetypes require 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 help identify how farmers have control in collaborative business models, WP3 will support the generation of multiple business model implementation scenarios in the scope of the SCBMI approach of *T3.1 – Development of the Ploutos SCBMI approach.*

6.3 Further development of the deliverable

Despite the initial insights, much remains unclear. The update of this deliverable in M28 therefore aims to elaborate on the factors which affect the implementation of the archetypes and how to ensure farmer control. Exact directions will be based upon the challenges and questions arising from the implementation of the archetypes in *T3.1 – Development of the Ploutos SCBMI approach.*

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7 Conclusion

This deliverable covers the initial work on 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 (iii) to gather 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 for gathering 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 Results section, we present the **eight 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 16 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. Finally, we conclude with an overview in which the geographical division, the most prevalent archetypes and a classification based on innovation readiness levels are briefly touched upon.

These archetypes directly feed into the Collaborative Sustainable Business Model Innovation methodology (reported in D3.1) that is developed in *T3.1 – Development of the Ploutos SCBMI approach*. In particular, they can be 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 will be supported to design and evaluation novel collaborative and sustainable business models following the methodology. In this process the applicability and usability of the archetypes will be tested and improved. This will then feed into the further development in the context of *T3.2 - Investigation of reference sustainable business model archetypes*, and a Deliverable containing the final version is expected to be delivered in M28.

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8 Reference list

Adner, R. (2012). *The wide lens: A new strategy for innovation*. Penguin.

Al-Debei, M. M., & Avison, D. (2010). Developing a unified framework of the business model concept. *European Journal of Information Systems*, *19*(3), 359–376. https://doi.org/10.1057/ejis.2010.21

Bankvall, L., Dubois, A., & Lind, F. (2017). Conceptualizing business models in industrial networks. *Industrial Marketing Management*, *60*, 196–203. https://doi.org/10.1016/j.indmarman.2016.04.006

Barratt, M. (2004). Understanding the meaning of collaboration in the supply chain. *Supply Chain Management*, *9*(1), 30–42. https://doi.org/10.1108/13598540410517566

Barth, H., Ulvenblad, P. O., & Ulvenblad, P. (2017). Towards a conceptual framework of sustainable business model innovation in the agri-food sector: A systematic literature review. *Sustainability (Switzerland)*, *9*(9). https://doi.org/10.3390/su9091620

Bocken, N. M. P., Short, S. W., Rana, P., & Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production*, *65*, 42–56. https://doi.org/10.1016/j.jclepro.2013.11.039

Bocken, N., Short, S., Rana, P., & Evans, S. (2013). A value mapping tool for sustainable business modelling. *Corporate Governance (Bingley)*, *13*(5), 482–497. https://doi.org/10.1108/CG-06-2013-0078

Boons, F., & Lüdeke-Freund, F. (2013). Business models for sustainable innovation: State-of-the-art and steps towards a research agenda. *Journal of Cleaner Production*, *45*, 9–19. https://doi.org/10.1016/j.jclepro.2012.07.007

Bouwman, H., Faber, E., Haaker, T., Kijl, M., & de Reuver, M. (2008). Introduction. In H. Bouwman, H. de Vos, & T. Haaker (Eds.), *Mobile Service Innovation and Business Models* (Issue July 2016, pp. 31–70). Springer. https://doi.org/10.1007/978-3-540-79238-3

Burkhart, T., Krumeich, J., Werth, D., & Loos, P. (2011). Analyzing the business model concept-A comprehensive classification of literature. *International Conference on Information Systems 2011, ICIS 2011*, *5*(January), 4183–4201.

Cagliano, R., Worley, C. G., & Caniato, F. (2016). The challenge of sustainable innovation in agri-food supply chains. In *Organizing Supply Chain Processes for Sustainable Innovation in the Agri-Food Industry* (pp. 1–30).

Criscuolo, P., Nicolaou, N., & Salter, A. (2012). The elixir (or burden) of youth? Exploring differences in innovation between start-ups and established firms. *Research Policy*, *41*(2), 319–333. https://doi.org/10.1016/j.respol.2011.12.001

De Reuver, M., Bouwman, H., & Haaker, T. (2013). Business model roadmapping: A practical approach to come from an existing to a desired business model. *International Journal of Innovation Management*, *17*(1), 1–18. https://doi.org/10.1142/S1363919613400069

Di Vaio, A., Boccia, F., Landriani, L., & Palladino, R. (2020). Artificial intelligence in the agri-food system: Rethinking sustainable business models in the COVID-19 scenario. *Sustainability (Switzerland)*, *12*(12). https://doi.org/10.3390/SU12124851

Dressler, M., & Paunović, I. (2019). Towards a conceptual framework for sustainable business models in the food and beverage industry: The case of German wineries. *British Food Journal*, *122*(5), 1421–1435. https://doi.org/10.1108/BFJ-03-2019-0214

Eurostat. (2016). *Rev. 2 – Statistical classification of economic activities in the european community*.

Food Sustainability Observatory (2020) Politecnico di Milano. La Sostenibilita vien innovando! Informazione e circolarità, chiavi di volta per una filiera più sostenibile e inclusiva.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000594

Franceschelli, M. V., Santoro, G., & Candelo, E. (2018). Business model innovation for sustainability: a food start-up case study. *British Food Journal*, *120*(10), 2483–2494. https://doi.org/10.1108/BFJ-01-2018-0049

Fritz, M., & Matopoulos, A. (2008). Sustainability in the agri-food industry: a literature review and overview of current trends. *Proceeding of the 8th International Conference on Chain and Network Management in Agribusiness & the Food Industry*, *May*. http://www.researchgate.net/profile/Aristides_Matopoulos/publication/273627391_Sustainability_in_the_agri-food_industry_a_literature_review_and_overview_of_current_trends/links/5506c9930cf2d60c0e6d994a.pdf

Gassmann, O., Frankenberger, K., & Csik, M. (2014). *Business Model Navigator: 55 Models That Will Revolutionise Your Business*. Pearson. https://manchester.idm.oclc.org/login?url=https://search.proquest.com/docview/2134291381?accountid=12253%0Ahttp://man-fe.hosted.exlibrisgroup.com/openurl/44MAN/44MAN_services_page?genre=book&atitle=&author=Gassmann%2C+Oliver%3BFrankenberger%2C+Karolin%3BC

Geissdoerfer, M., Bocken, N. M. P., & Hultink, E. J. (2016). Design thinking to enhance the sustainable business modelling process – A workshop based on a value mapping process. *Journal of Cleaner Production*, *135*, 1218–1232. https://doi.org/10.1016/j.jclepro.2016.07.020

Geissdoerfer, M., Morioka, S. N., de Carvalho, M. M., & Evans, S. (2018). Business models and supply chains for the circular economy. *Journal of Cleaner Production*, *190*, 712–721. https://doi.org/10.1016/j.jclepro.2018.04.159

Gordijn, J. (2004). E-business value modelling using the e3-value ontology. In *Value creation from e-business models* (pp. 98–127). Butterworth-Heinemann.

Kähkönen, A. K. (2012). Value net - a new business model for the food industry? *British Food Journal*, *114*(5), 681–701. https://doi.org/10.1108/00070701211229972

Kaplan, R. S., & Norton, D. P. (2001). Transforming the balanced scorecard from performance measurement to strategic management: Part I. *Accounting Horizons*, *15*(1), 87–104. https://doi.org/10.2308/acch.2001.15.1.87

Lawson, R., Guthrie, J., Cameron, A., & Fischer, W. C. (2008). Creating value through cooperation: An investigation of farmers' markets in New Zealand. *British Food Journal*, *110*(1), 11–25. https://doi.org/10.1108/00070700810844768

Massa, L., Tucci, C., & Afuah, A. (2017). A critical assessment of business model research. *Academy of Management Annals*, *11*(1), 73–104. https://doi.org/10.1097/00006534-200002000-00083

Miller, D. (1988). Relating Porter ' s Business Strategies to Environment and Structure: Analysis and Performance Implications. *The Academy of Management Journal*, *31*(2), 280–308.

Mintzberg, H. (1988). Generic strategies: toward a comprehensive framework. *Advances in Strategic Management*, *5*(1), 1–67.

Mont, O., & Tukker, A. (2016). Product-Service Systems: reviewing achievements and refining the research agenda. *Journal of Cleaner Production*, *14*(17), 1451–1454.

Osterwalder, A., & Pigneur, Y. (2010). *Business Model Generation - A handbook for visionaries, Game Changers and challengers*. John Wiley & Sons Inc. https://doi.org/10.1523/JNEUROSCI.0307-10.2010

Patala, S., Jalkala, A., Keränen, J., Väisänen, S., Tuominen, V., & Soukka, R. (2016). Sustainable value propositions: Framework and implications for technology suppliers. *Industrial Marketing Management*, *59*, 144–156. https://doi.org/10.1016/j.indmarman.2016.03.001

Porter, M. E. (1980). *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. Free Press.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000594

Richardson, J. E. (2011). The Business Model: An Integrative Framework for Strategy Execution. *SSRN Electronic Journal*, *September*, 1–27. https://doi.org/10.2139/ssrn.932998

Rohrbeck, R., Konnertz, L., & Knab, S. (2013). Collaborative business modelling for systemic and sustainability innovations. *International Journal of Technology Management*, *63*(1–2), 4–23. https://doi.org/10.1504/IJTM.2013.055577

Smart Agri-Food Observatory (2019). Politecnico di Milano. Il ruolo dei big data analytics nell'agroalimentare.

Teece, D. J. (2010). Business models, business strategy and innovation. *Long Range Planning*, *43*(2–3), 172–194. https://doi.org/10.1016/j.lrp.2009.07.003

Tell, J., Hoveskog, M., Ulvenblad, P., Ulvenblad, P. O., Barth, H., & Ståhl, J. (2016). Business model innovation in the agri-food sector: A literature review. *British Food Journal*, *118*(6), 1462–1476. https://doi.org/10.1108/BFJ-08-2015-0293

Tripoli, M., & Schmidhuber, J. (2018). Emerging Opportunities for the Application of Blockchain in the Agri-food Industry Agriculture. *Food and Agriculture Organization of the United Nations*, *August*, 21. http://www.fao.org/3/CA1335EN/ca1335en.pdf

Ulvenblad, P. ola, Ulvenblad, P., & Tell, J. (2019). An overview of sustainable business models for innovation in Swedish agri-food production. *Journal of Integrative Environmental Sciences*, *16*(1), 1–22. https://doi.org/10.1080/1943815X.2018.1554590

Yang, M., Evans, S., Vladimirova, D., & Rana, P. (2017). Value uncaptured perspective for sustainable business model innovation. *Journal of Cleaner Production*, *140*, 1794–1804. https://doi.org/10.1016/j.jclepro.2016.07.102

Zott, C., Amit, R., & Massa, L. (2011). The business model: Recent developments and future research. *Journal of Management*, *37*(4), 1019–1042. https://doi.org/10.1177/0149206311406265

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9 APPENDIX A – Geographical context of the archetypes

Table A1 provides an overview of the geographical context in which the collaborative business models are found. As a first observation, it seems that most archetypes are found in both developing and developed countries. Exceptions are the "*knowledge sharing*" archetype which we only found in developing countries – arguably due to the fact that such platforms already exist in developed countries – and the "*valorising farm waste*" archetype which we found only once in developing countries. Besides, also "*equipment as a service*" and "*access to funds*" are mostly found in developing countries which is possibly due to the more mature financial markets in developed countries. More technological advanced archetypes such as "*collaborative farming*" and "*transparent farming practices*" are more widespread in the developed countries. As a second observation, most collaborative business models rely on some sort of platform strategy where a third party connects farmers with other farmers or other agri-food value chain actors. As a final observation, we notice that the "*online B2B and B2C platforms*" and the "*transparent farming practices*" archetypes are by far the most common. This may indicate a market trend on which farmers can capitalize. For future research, it would be interesting to analyse against other variables such as the type of farming and the type of collaboration.

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	Aligning supply and demand	Improving through transparency	Knowledge sharing	Data-driven farm optimization	Valorising farm waste	Farming on food waste	Marketing blemished and surplus food	Collaborative food processing	Farming equipment as a service	Farming as a service	Transparent farming practices	Payments for ecosystem services	Online B2C	Online B2B	Parametric insurance	Collaborative financing
Developed countries	8	8	0	17	9	7	7	3	2	7	32	5	21	32	3	6
Developing countries	5	4	6	8	1	5	3	1	7	2	12	0	21	58	5	16
EU member states	1	5		6	1	4	3		1	2	12	2	3	11	1	2
Other western Europe					1									2		
Eastern Europe													1	2		
Australia	1						1			1			1	1		1
North America	5	2		7	6	1	3	3		2	16	3	14	12	2	6
South America	1	3	2	2		1	2		2		3		6	11	1	3
Central America											1				1	
East Asia			1	4		3			2	1	6		5	11		1
South Asia	2	1	1	2		3			2		2		5	23		2
Western Asia	1	1		2	1					1	3		2	4		1
North Africa											1			3		
East Africa				1				1					1	5		4
Southern Africa	1						1			2				1		
West Africa	1		2	1	1				2				3	3	3	5
Central Africa													1	1		
Total	**13**	**12**	**6**	**25**	**10**	**12**	**10**	**4**	**9**	**9**	**44**	**5**	**42**	**90**	**8**	**25**

Table A1 – Geographic context of the sub-archetypes

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