

# Community Supported Agriculture: The Concept of Solidarity in Mitigating Between Harvests and Needs

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## ABSTRACT

There is a developing recognition of the social and economic costs entailed in global supply chains. In this paper, we report on efforts to provide alternative, more sustainable and resilient models of production. Community Supported Agricultures (CSAs) address this problem but require new means of exchange which, we suggest, offer a design opportunity for sustainable HCI research. This paper presents a two months participatory observation in a food movement, a German CSA which developed a distribution system involving their own currency. Based on our ethnographic observations, we focus our discussion on (1) the solidaristic principles upon which the movement is based and (2) techniques of mediating between consumers' wishes and the constraints of local agricultural production. By relating to the continued development of CSAs, we identify three interrelated innovation gaps and discuss new software architectures aimed at resolving the problems which arise as the movement grows.

## CCS CONCEPTS

• **Human-centered computing** → Empirical studies in collaborative and social computing; • **Computer systems organization** → Peer-to-peer architectures.

## KEYWORDS

Community Supported Agriculture, Sustainable HCI, Solidarity, Trust, Currency, Distributed Ledger Technology, Cooperative Work, Technological Sovereignty, Food Sovereignty

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## 1 INTRODUCTION

Our current forms of production and consumption lead to ecologically and socially destructive externalities. In response there is an increase of critical, ethical and sustainable consumption, that is not simply a consumer trend. It is an attempt to fix a broken system, but it cannot succeed by focusing changes in consumption practices alone. A root cause for unsustainable practices, then, lies in our economic system and it calls for new modes of organizing economic activity in local, resilient and quality of life oriented production. Covid-19 has recently drawn attention to a particular fragility in relation to food production and exchange. The exploration of these new modes involves new forms of communication, accounting and expressions of value. Various alternative food movements address this problem. Among them, Community Supported Agricultures have attained a certain level of professionalism and are about to become providers of a relevant fraction of food production.

Community Supported Agriculture (CSAs) is an organizational form that represents an alternative to traditional companies. There is no uniform set of rules for when something may call itself a CSA, but the most characteristic feature is the mutual commitment between producers and consumers. A group of consumers unites and pays for the entire costs of a farm for the coming year. In return, the farm commits to providing the consumer community with healthy food to the best of their ability. The farm is thus secured and the community are the *harvest shareholders* (They are indeed called “shares” but instead of speculating on an increasing market price of a stock corporation, “shareholders” receive a food). Although the same model has existed in Japan at least since the 1960s, the concept was developed in the 1980s in the United States. It was from the beginning motivated by and intermingled with the ideas of biodynamic agriculture, the agricultural part of an anthroposophical idea complex going back to the German philosopher Rudolf Steiner. Therefore, a common feature among CSAs are practices of *biodynamic agriculture*. In addition, CSAs typically deploy short supply-chains to attain a high degree of *food sovereignty* – the idea of equitable, sustainable and resilient food production systems. In the default approach for community building, members buy a share (or half of a share) and the produce is distributed equally among the shares. In Germany in particular, where solidarity is even eponymous for the German name for CSA, which translates literally as “Solidarity Agriculture”, around half of the CSAs extend solidarity to an inter-community level: In a community bidding procedure, in contrast to an auction, the members are predetermined and make

voluntary bids. If the total bid does not cover the costs of the farm, all members are asked to raise their bids. This is repeated until either the money is raised or the farm reduces its budget. The idea is that those members who can afford to pay more should pay more so that others can pay less. This *pay what you think* property has echoes of communitarianism (see [14]) and is similar to European models of health insurance. Nevertheless, this is an explicit attempt to escape the logic of the market, and thereby challenges basic assumptions of capitalism and consumerism. In the framework of anti-consumerism CSA membership can be understood as a first step of prosumerism. Consecutive steps are also common among CSA, namely the involvement of members in *voluntary work* on the farm or providing the equity for the enterprise. Usually CSAs are legally a *cooperative*. The degree of prosumer engagement in this sense varies between members as well as between CSAs.

However, CSAs have themselves been confronted with difficulties. Notably, in attempting to provide alternatives to market mechanisms they sometimes reintroduce problems that were usually solved by traditional market exchange mechanisms. In particular matching their produce with their members wishes under the constraints of local and sustainable agricultural production is a challenging task. Most CSAs distribute their produce equally among the shares. Thereby, they can neither satisfy individual preferences, nor do they have a feedback mechanism for adapting to average preferences. Furthermore, forms of flexible product cooperation between CSAs become complicated. We suggest that this search for a new mechanisms to exchange (within and between CSAs) offers a design opportunity for sustainable HCI research. For the challenges of internal exchange a CSA in Germany has found a solution that involves a currency innovation. Therefore the first author conducted an observational study at this research site, which also yielded implications for the external challenge that the CSA faces.

Throughout this paper we attempt to answer the research question:

what solidarity principles underpin community agriculture in Buggingen and what exchange mechanisms or currencies might support this?

After relating to the state of the art and situating the research site, we will discuss (in section 4) the understanding of solidarity that the people at the Luzernhof have, as the value complex around it is foundational for the distribution and cooperation mechanisms. In section 5 we relate these insights to the development of CSAs, identify innovation gaps and offer considerations how information technology can help to fill them.

## 2 STATE OF THE ART

What sustainable agriculture activists believe is described by Naomi Klein as “The climate needs to avoid collapse is a contraction in humanity’s use of resources; what our economic model demands to avoid collapse is unfettered expansion. Only one of these sets of rules can be changed, and it’s not the laws of nature.” Whereas there is general agreement in science about the first part of the statement (e.g. the Club of Rome reports), strangely mainstream economics is partly in denial about the second [16].

### 2.1 Sustainable HCI

For more than a decade, research on sustainability issues has been conducted within HCI (SHCI). DiSalvo, Sengers, and Brynjarsdóttir [11] first *mapped the landscape* of S-HCI into genres. Our research is preliminary for what Knowles et al. [27] argue for as *designing for sustainability*. However, there is developing concern about the lack of agreement on what sustainability means and how SHCI as a community can actively contribute to a change towards more sustainability [26, 44]. The fragmentation of SHCI is attributed to the fact that a consideration of a rationally acting consumer and with it the confirmation of neoliberal world view within SHCI has dominated [6, 23]. The results of this were shown in contributions that aimed to influence and nudge people to sustainable consumption by persuasive design. Meanwhile, there are voices that critically question the long-term effect of these contributions and emphasize a different point of view (e.g. [40, 41]): This is constituted in research that examines practices, i.e. everyday routines in which people, meanings, materials and competences are gathered [43] to support sustainability. In their Grand Challenge to HCI [33] argue that *the paradigms and practices of HCI risk perpetuating the shortcomings of food systems*.

In 2005 Warde paved the way for the connection of theory of social practices and research on consumption [50]. For Warde, consumption itself is not a practice, but rather a moment in almost every practice, because most practices, and probably all integrative practices, require and condition consumption. While the vast majority of consumer research conducted to date has examined consumption from an individualistic perspective and used the term rather vaguely in connection with both purchase and consumption, Warde emphasizes the study of consumption as an integral part of most areas of daily life. The act of consumption itself is rarely significant. Therefore, one cannot speak of a human desire to consume [17]. In this view, intentions are derived from practices rather than being generated by individual desire. Behavior is based on conventions and standards rather than individual choice. In the field of energy, this type of research, for example in the case of Gram-Hansson, has led to the investigation of different forms of prosumption through observation of energy consumers [18]. For prosumers, the levels of consumption and production blend into complementary interrelationships [37, 38].

The global view of food production focuses on how to ensure that sufficient food is available on the supply side in the face of a growing world population (Davies 2014), and also how this economic development is linked to environmental and social levels to meet sustainability and climate change objectives (Poppy et al. 2014). However, Ganglbauer stresses the importance of the local context for food [15]. Weber et al. [51] argue that all of this is needed for a *deep change*, under which they understand a *systematic societal change, entailing fundamental change in social norms and values, institutions and behaviors, practices and technologies that together produce the functions, structure and identity of the food system*. But how do we *enable food sovereignty, push for new policies and reconfigure the power and trust relationships in food systems* [33]? The background of this work combines at least two of Weber’s five approaches, namely sustainable agriculture (e.g. [28]) and grassroots food production (e.g. [21, 30]). Hirsch et al. [6, 23] conclude

*Given their vulnerability to environmental change, their complicity in creating environmental threats, and the fact that most of the world's population depends on their labor for its sustenance, one may well argue that small-scale food producers should be at the center of any serious sustainability movement, including the one forming within the HCI community.*

CSAs are a small-scale food producer movement addressing the otherwise unsustainable aspects of conventional agriculture and research suggests that CSAs do indeed render ecosystems stable [24]. Furthermore, there exists (limited) economic research [4, 34], ethnography [20] and consumer sociology [47] on CSAs. Within SHCI, however, there is relatively little research on CSA yet [5, 9, 49].

When Norton et al. 2019 investigated permaculture communities in the United States, one of the findings was that participants *framed modern financial systems as the culprit, believing that an overhaul of the financial sectors away from extractivism and consumerism is fundamentally necessary to address local and global ecological crises*. To comprehend sustainability we should then investigate the intersection between agriculture and money. This, again, has been of only minor concern to SHCI, as yet.

## 2.2 The Connection to Money

Although many people use the words interchangeably, the economic system, the financial system and the monetary system are more precisely understood as being stacked on top of each other. With respect to the monetary system, we understand the currencies that exist, how they are issued and redeemed, how they are controlled and how they interact with each other – today largely a matter of (central) banks. The financial system consists of the institutions that use those currencies to finance long-term projects – to a large extent private banks. The economic system is the system of all the businesses that operate with actual goods and services and use financial and monetary systems for everyday settlements. Hewitt [22] identifies “Slow Money” as the most important movement connecting money and agriculture. This is, however, a new mindset at the level of financing. For the Farm we investigated, the Kulturland Genossenschaft<sup>1</sup> represents this idea, but we should note that their ambitions go right to the monetary layer with their Terrafina [36] project. After all, to address the root causes at the bottom of the stack alternative currencies are of particular interest.

From a sociological standpoint, Dodd [12] argues that money always features social utopianism, whereas his understanding includes what can be called pro-topianism (designing in the right direction instead of designing the ideal world immediately). In economics, in contrast, money is usually characterized by its functions – store of value, means of exchange, unit of account. However, for these considerations the borders of money are blurry and currency innovation is basically about new modes of transacting and accounting [3]. For instance a Blockchain is only a protocol to account for transactions, although in origin, cryptocurrencies like Bitcoin were advocated for their Utopian, anti-governmental disintermediation possibilities. Sas et al. [39] review the role of cryptocurrency and trust in HCI. In their topology of Blockchain applications Elsdén et al. [13] regard Cryptocurrencies as *new kinds of programmable*

*money, with intended values*. One noteworthy approach for a new kind of intended value is time-banking, a movement for taking hours as a unit of account. However, Victoria Bellotti finished her investigation on time-banking as a community currency, concluding that *future peer-to-peer systems must incorporate different rewards and incentives in order to accommodate users with different motivation* [7, 42]. This suggests a gap, where S-HCI, agriculture and money intersect, and thus this CSA with their currency invention promises to be an instructive object for observation and a community to engage with.

## 3 RESEARCH CONTEXT

### 3.1 The Research Site

The Luzernenhof in Buggingen in the south of Germany is a CSA that was founded in 2012. Five years later it reached its capacity of 200 members and today there exists a waiting list to join the community of around 50 people, indicating that their model is a success. In 2018 they launched in collaboration with the “Kulturland Genossenschaft” a successful crowdfunding campaign purchasing land to secure the existence of the Luzernenhof. On a farmland area of 33 hectares vegetables and crops are grown and animals are raised for the manufacturing of a variety of dairy goods and butchered for meat production. This work is done by a changing group of people, whose number fluctuates around 10 full employed cultivators and sometimes volunteering members. With an annual turnover of roughly 480.000 Euro it (partially) feeds an estimated 500-600 people in the households of the members. The degree to which members buy external food ranges from more than 50% down to very rarely (e.g. spices and fruits are almost non-existent in the assortment).

The work on the farm is loosely structured into a gardening-, an agriculture-, a stable- and a dairy-team – Some employees are in multiple teams. The daily work is organized by very short full meetings every morning, where everyone lays out what s/he plans to do during that day. In this meeting the access to tractors and machinery is coordinated. The coworkers perceive themselves as a team that is together responsible to keep the farm going, in which solidarity to help each other and trust play a significant role (more of it later). In addition there is one worker for bookkeeping, and every day someone cooks for the whole team.

Overall the Luzernenhof consists of different legal structures. There is the registered association (we will call it the association), which is the heart of the CSA and which the members and the permanent employees join. It is responsible for the whole project and pays the coworkers for the planning, production and distribution of the food. In addition the land ownership is arranged by the “Kulturland Genossenschaft” into an entity, that aims to transfer farmland into ownership structures, where it can only be used according to organic principles and not be sold again on the market. This cooperative is the financier of the Luzernenhof and other projects. The machinery is the property of a third legal entity, which buys and maintains them and rents them to the Verein. This way, the Verein can calculate regular costs for the machinery and has a buffer for the cases where expensive machinery break. As an example, during the time of the fieldwork a new mower had to be purchased which was not anticipated in the annual calculation, but could be

<sup>1</sup><https://www.kulturland.de/>

bought on the account of this legal entity which supplies only the Luzernenhof.

As common for CSAs, on an annual gathering the members organize themselves and make bids for the monetary contributions they are willing to pay over the next twelve months. This bidding happens in autumn and takes place partly remotely. If the bids do not add up to the calculated expenses for the next year, it is repeated until enough money is promised. If this failed, the farm would be required to make a more affordable proposal for the year, which until now never happened. Members can order the products from an assortment of more than 200 items and receive them weekly in a package, which they need to pick up at one of nine distribution points within a radius of 30km. About a third of them pick up their package at the Luzernenhof itself. There they can also pick items during the week.

### 3.2 Methodology

The first author conducted an action-oriented research [45] and participatory action research [8], predicated on a largely ethnographic approach. In the words of Alice McIntyre[31], he *participates with people in improving and understanding the world by changing it*. In particular, one of the reasons for embarking on this study in the first place was to better understand what technological solutions might aid in sustainable local food production. Our epistemological background in relation to design case studies [52] is committed to qualitative research and orients to participatory action research.

Over two months between February and April 2020 the first author spent six weeks living on the farm as a participant observer. With him there lived the cofounder “J”, a full time agriculturalist and part time lecturer, with his wife who roughly twice a week cooked lunch for all coworkers, their three children, as well as three other coworkers doing their intern- or apprenticeship in agriculture. The author conducted all kinds of work, such as gardening, planting, harvesting, stable work, packaging, repairs etc.. His observation was mostly focused on the people and processes on and around the farm. The methods of data collection comprised informal interviews during the collaborative work. The main themes of interests at the outset were the workers perspectives on CSA and the Luzerne currency. The working day started at 8 am with a general team meeting, where the coworkers coordinated the tasks that they planned for that day and the machines (mainly tractors, cars and a electrically powered bike trailer) they would need to use. It included a shared lunch and ended on average between 5 and 6 pm. Sometimes either social events or long conversations with J, the cofounder and inventor of the Luzerne followed. Their topics revolved around currency innovation, values and biodynamical agriculture. The first author did not audio record any of the conversations but documented the findings by writing field notes at night. Therefore, the quotations of coworkers presented in this paper may not be word-for-word (and were translated to English).

During the two months there were only a few occasions to talk to other members when they picked up food at the farm. Because the fieldwork fell into the period when the Covid-19 lockdown took place, close contact with members was problematic. Therefore, in addition three loosely semi-structured telephone interviews of roughly 30 minutes each were then conducted. The author used the

farm’s weekly email newsletter to its members as an outreach asking for willingness to talk about their view of the Luzerne currency and future developments of it. These three members answered and the interviews focused on their understanding of solidarity, their view on the ordering system, the currency and future cooperation with other CSAs. These interviews were audio recorded, later (partly) transcribed and translated into English.

Theoretical work on the concept of solidarity certainly exists, such as Spades “Solidarity not Charity”[46] and Deans work on “Reflective Solidarity”[10]. While certainly related to this ethic notion of solidarity, we investigate solidarity and the related notions as emic concepts – how the people of this CSA understand solidarity.

## 4 MONEY, SOLIDARITY AND COMMITMENT

During its eight-year existence, the Luzernenhof has been confronted with numerous challenges and has had to become creative in order to manage them. Their currency, the Luzerne, is only one of these creative solutions. Like all CSAs, the Luzernenhof was confronted with the problem of fair distribution. A sign on the farm tells the story. *And suddenly there are vegetables [...] and they want to be distributed*. For members, the usual approach of equal distribution was unsatisfactory because the shares received were not responsive to their individual needs. So the farm developed an individual ordering system. Now members are permitted to order or fetch as many products as they desire, within the capacities of the production (details below). The largest part of the supply is ordered online. In general computer technologies are used. For example, spreadsheets are used for planting and harvesting plans, site plans and in accounting. Within the teams infrequently messengers or phone calls are used for communication. Online searches are made for contact details, organic databases and other information. However, this is usual for agriculture in a western country like Germany. One tool that distinguishes this CSA, however, is the Google Spreadsheets document, which is used to process the orders and their billing. Depending on the stock which depends on seasons and the decisions of the coworkers, a variety of products are offered to the members. Out of this assortment, orders are collected up until Wednesday morning, when the gardeners harvest on demand. Then, the harvesting team takes printouts of the spreadsheet where the orders are summed up to the field. On Thursday mornings the products are prepackaged according to the orders. Here the same document is read out by a customized program running on an old windows pc which supports the packaging team by presenting the orders in a more conveniently readable form. Depending on the members’ choices, these packages are either delivered to one of eight collecting points in the region, or stay at the farmyard itself, where they can be picked up. At the farmyard, in addition, products can be picked up without an order during the whole week. These takings are recorded and attributed to the members accounts manually. Accordingly each member receives a recommendation as to how much to bid for the next year (details below 4.2).

### 4.1 Distribution

Since most CSAs distribute their produce in equal shares, usually weekly boxes, their members are often dissatisfied with the composition of their share [35]. This, along with moving away, has been

cited as the main reason why people leave CSAs. With regard to this problem of demand-oriented food supply, J explains their solution by referring to anthroposophy. He explains how Rudolf Steiner assigns the three ideals of the French Revolution, freedom, equality, fraternity, to the world of ideas, law and economics respectively. According to this, the distribution of food should thus be fraternal rather than equal.

Therefore, any member can order from the product range at will, but the order is visible to all members. This is achieved by the online spreadsheet. Every week one of the coworker decides which products are in stock and selects the relevant columns to be visible to the members. The document has one column for each product that was in the available assortment, ordered by categories like vegetables, dairy goods etc. He can also set quantity limits or change the prices (more on that below). At this point the members are authorized to write in the shared document. Each member has a row with their name and can order products by writing quantities in the appropriate fields. Members can, by accident, write in the rows of other members orders and, in that case the document history enables a resolution. For this Google service the farm pays a negligible fee. This ordering system works well according to members.

The fact that members can order products of any value is quite remarkable. Members do see a price tag, either in the column or in the local farm, but they do not have to pay these prices. So the prices serve primarily as an orientation point for the members. *I only compare the prices of each bit of produce* described a member. How much each member has consumed during the year is summed, but this amount serves only as a recommendation from the farm as to how much the member should pay in the coming year. As another member put it, *In our first year, we consumed more than our contributions. We offered to remargin, but that was not necessary. Then we simply paid some more in the next year.*

Although in theory members could order and never pay, this has not yet happened in practice. However, it is to be expected that if a member would “free-ride” on this, the farm would have objections. One might think that the social control of the other members is the essential factor that prevents free riding. However, at the annual meeting, the numbers of the members are only disclosed in an anonymous form. Instead, all three members interviewed have reported that it is important for them to pay their fair share. *We are not people who take food for 350 euros and only pay 100* said one member. For the “prices” (with which orders are charged in form of recommended contributions), it makes no sense in the farm’s view to use external market prices. Instead the farm’s own conditions are used as an indicator to how laborious the production of a product is there. However, to disentangle this is an impossible task, because one cannot simply produce more milk instead of a potato, for example. The plants each fulfill a function in their crop rotation and form a cycle with humans and animals. For example, the cows feed on the grasses of fallow land, the pigs get their manure and the whey produced during milk processing, while their liquid manure is used as fertilizer in the fields to benefit the plants. For this reason, the product quantities can only be varied to a certain extent, without losing the holism of the cycle. Thus a coworker tells how the neighbouring garden Coop held cattle for the manure, which however they did not want to slaughter or

use for milk production because of the vegan requirement of some of their members. *When the cattle got old, they sold them and the buyer of course slaughtered them. Now they have a pasture manure cooperation with us.* The Luzernenhof then selected the “prices” in approximate accordance with market prices, but adjusted them upwards or downwards according to the conditions on the farm. On average they are slightly more expensive than in the organic supermarket.

Interestingly enough the approximate quantity ratio of the products fits quite well to the needs of the members. Only for a few products (e.g. cherry tomatoes, which require a lot of care) is there a demand that exceeds the farm’s ability or willingness to produce them. If this is the case, first a *product limit* is given, which is the maximum amount of the product available. When it is reached, further orders are not carried out. As second step a *household restriction* can be introduced, which is how much an individual member can order of a product. This rule was felt initially to be unfair, since the members, who want to nourish a whole family from their portion were placed in an inferior position. They would have an incentive to register multiple members to circumvent these limits. Therefore, this limit was multiplied by a self-selected *household factor*, which takes into account the number of people supplied with this share and the percentage of which these people get their food from the Luzernenhof. As a worker put it *What is a 5 person household doing with 100g cherry tomatoes?* However, these measures and even information about how much of a product is in stock is in many cases not applied. Tubers and cabbage, for example, are warehoused. Many other vegetables do not decay, because they are harvested on demand. Due to these products being always available members also have the option to place default orders which are repeated automatically every week, unless they modify them. Product limits, household restrictions and household factors are all implemented by the same mentioned online spreadsheet. For bookkeeping the orders of every week are also downloaded and stored offline.

#### 4.2 “Luzerne” as a Monetary Unit

Due to these demands and the agricultural conditions of the farm, some products at the Luzernenhof have significantly higher “prices” than in an organic supermarket. This means that it regularly happens that members decide not to order these products from the Luzernenhof but to buy them externally. *Then our products are left lying around, but that doesn’t make sense because we produced these products for the members and they already paid for them,* says J. That’s why in 2018 he developed in collaboration with the community the Luzerne, a currency unit, *to bring them out of the mental state of shopping.* The currency and the farm are both named after the plant (*Medicago sativa*), which is used for its nitrogen-binding properties to improve soil quality and as fodder for cattle. Since then, the “prices” are given in Luzerne instead of in Euro. This is implemented by simply using a different unit of account both, in the ordering spreadsheet and the price tags at the farmyard. One Luzerne is intended to represent one hundred thousandth of the products ordered each month, so the farm estimates its annual production at 1.2 million Luzerne. In reality, however, this target is only roughly met, since the yield of the harvest and the demand of the members cannot be predicted exactly.

This number can be set in relation to the annual contributions of all members in order to calculate an exchange rate which is also announced by the Luzernenhof (“exchange rate” even if no exchange between Euro and Luzerne is possible). The only conversion takes place when at the end of the year this rate is used to convert the accumulated accounts of the members (in Luzerne) into payment recommendations for the next year (in Euro). Members can therefore use this rate to convert prices back to euros and still compare them with external prices, but the barrier has been raised by the introduction of the Luzerne. The members’ opinions about the Luzerne vary. While one of the interviewed members likes the idea and says she does mentally convert between the currencies, another thinks it is important to do exactly that and that the Luzerne is an unnecessary complication: *I understand what this is supposed to do, but I don’t see the point*. Most coworkers had a rather indifferent attitude *I don’t care about that. That’s just so that the prices are not in Euro*.

The only products for which this system has not worked out is meat. When an animal is butchered, which happens roughly once a month, the relevant meat products are ordered in advance. It sometimes happened that some member is shocked by the true cost of meat from animals raised under these conditions. This was because their expectations were shaped by cheap discounted meat, and they found themselves ordering meat which was much more expensive than anticipated. A hybrid rule was found. Such that 70% of the price is paid directly in Euro, and 30% is accounted in Luzerne, so as to make cost more visible.

Of course the membership contributions are paid in Euro and the farm has to pay their expenses in Euro. There are also no Luzerne issued in monetary form. Instead it is merely used as an accounting instrument for the internal distribution of products and a feedback mechanism for the members to estimate their expenses. The currency is also an expression of an attitude that the community, as diverse as it is, largely shares. It separates distribution at the inside from the prices at the outside. J says *If I had the chance, I would have left behind [the central banking system] years ago*, showing that he has identified the monetary system as somehow a root cause for problems in agriculture. This urge motivated the Luzerne as a currency experiment, although members are well aware of the fact that the Luzerne is dependent on the Euro.

### 4.3 The Topology of Trust

Members have revealed in the interviews (and the board has asserted that this is the dominant view among all members) that the willingness to pay more than one’s recommendation is to support the Luzernenhof and its workers, on the one hand securing its continued existence, and on the other hand as a good deed to the commons. Although the transactional structure may suggest a strong trust among the members, most of them do not even know each other. As one member said, *If I wanted to have more contact to other members I could reach out to them, but I don’t need anyone taking me by the hand for that*. He also voiced the opinion that, *For this decision the responsibility, and our trust, is with the farm*. This was in response to questions about how the Luzernenhof could cooperate with other enterprises. Thus, the topology of trust is primarily between members and the farm, not so much directly

between members. Members’ trust in the farm is built through the commitment of supplying high quality food being reliably met. This trust is reflected in the monetary and non-monetary contributions the members make. The farm’s trust in its members, on the other hand, is reflected, among other things, in the voluntary nature of the discretionary contributions. Therefore the farm acts as an intermediary for people who do not know each other. This topology of trust and its mediation are relevant to our observations concerning Blockchain in chapter 5.6.

J., a cofounder of the Luzernenhof, explained that the connection with other CSAs should not merely be a trade, since this would place them in competition with each other. Instead the cooperation should incorporate some of the solidaristic characteristics described above. This would be the case if, for instance, the trade balances were not seen as needing to net each other out. This is analogous to the principle that within a CSA the members do not pay according to their consumption, but instead according to what they are able, willing, and what is negotiated to be fair, to pay. When the CSA network “Netzwerk solidarische Landwirtschaft”<sup>2</sup> self-organized their first apprenticeship, the same principle was applied for the fees, paid by the participants. Compared to the conventional model, where everyone pays for the good or service the same price, with the solidarity principle people who are able to pay more subsidize those, who are not able to pay as much. Therefore applying a rule, that comes close to this solidarity principle between CSAs would also mean that members of one CSA subsidize those of another one which they might have no personal relationship to. Furthermore, it would raise the question, of whether implicit social self-regulatory norms might be corroded, if one’s consumption is paid for less by one’s own community, and more by other, distant communities.

The impact of the Covid-crisis supported the idea that local structures and short supply chains are indeed more resilient. However, it also illustrated that trust (in this case between the coworkers) is fragile and requires steady attention.

### 4.4 CSA Properties

With this system the Luzernenhof fulfills the CSA properties listed in the introduction. It has the *harvest shareholder* and the *pay what you think* property. It is a *cooperative* that applies practices of *biodynamic agriculture* which their members regard as of a higher standard than organic food production. A member asserted *Best would be Demeter [a biodynamical sigil] or at least organic*. He became a member because of the assortment, what the Luzernenhof does not supply are *only be eggs, slaughter poultry and fruit*. However, this indicates how *voluntary work* of the members plays only a subordinate role. During the two months the 1st author was present on the farm, only one of the members joined the coworkers in their fieldwork. However, on ‘big’ occasions, such as the harvest of onions, the farm invites the members to help and it becomes a big social event. *We did this once. That was really good though [...] to show the junior members where the onions come from and that it is hard work*, narrates a member. These vegetables are then warehoused and distributed over the year. Another one says *I was doing the packaging for a while*. In addition, some members engage in organizational matters such as participation in regular board

<sup>2</sup><https://www.solidarische-landwirtschaft.org/startseite/>

meetings. Overall, the Luzernenhof tends to attract members who value it as a food supplier more than a community activity. An external person who has placed herself on the waiting list describes it as *The Luzernenhof has a reputation for being a place for people whose time is scarcer than their money. The others tend to go to the neighboring Garden-coop.* Concerning the fact that the engagement of the members is so small J. said, *First we had to develop functioning work structures.* That was regarded as more easily manageable with a small group of paid professional full time workers than many fluctuating and only partly committed community members. He further said, *Now it would be of course nice if the [community engagement] increases again.* With the processing of dairy products, the Luzernenhof has a specially broad assortment of produce. This was pointed out as a main reason to become a member by one of the interviewees.

The practices of the Luzernenhof and its resilience to the effects of the Covid crisis have shown that there is a high degree of *food sovereignty*. This is not an accidental byproduct but a deliberate value. Referring to neighbouring conventional agriculturists that were protesting about the need for awareness of their problematic situation, J. once mentioned that *they are correct that now they are screwed.* But the reason is, because in the past they made themselves dependant upon big corporations. By analogy to that development, there is an awareness for technological sovereignty being an important aspect of this food sovereignty. As J. jokingly puts it *it is quite nice, when from time to time an email server or something crashes. Then you can say just say sorry and are not distracted by that anymore.*

On top of that the Luzernenhof stands out from other CSAs because members do not simply receive fixed equal boxes which they have no control over. Instead every member is allowed to order the products and in the quantities that he or she desires (see 4.1). On the one hand this includes a *free product choice*, a criterion in demand satisfaction which is significant enough to potentially bring CSAs to the mainstream. On the other hand, it is a significant credit of trust by the farm to its members. In a sense, members have *indefinite share sizes*, which they determine themselves over the year by the size of their orders. It evidences trust in the members. Each member could theoretically break the system during the year by exaggerating their demand and is trusted by all other members not to do so. This trust sometimes confuses people who are market oriented. A member said about former members that left because the Luzernenhof stopped delivering to their village *they didn't get it until the end.* By 'it' he referred to the fact, that members are allowed to order food and not pay accordingly.

Note that these two properties (free product choice and indefinite share sizes) are theoretically independent from each other. Shares were only allowed a fixed monetary amount of produce to be ordered (for free product choice with out indefinite share sizes) or members could be allowed to pick up an arbitrary number of prepackaged equal boxes during the year (for indefinite share sizes without free product choice).

The indefinite share sizes might only be a side effect of the chosen tool, the online spreadsheet, because definite share sizes would be a little more difficult to implement. However, they did not appear to cause any problems although they introduced a significant trust component. This shows the central role the document plays for

the ordering and accounting system. Switching to another provider would present a hurdle, since the document is heavily customized with macros. This is typical for the Luzernenhof, and in relation to machines, J says: "Every farm is different, so machines always have to be adapted." And he suggests that this is how it should be. At the same time, he also appreciates the relative independence from technology and jokes: *It's nice when an email account, server or something like that breaks down every now and then and all the data is gone. Then you can say: we are sorry. And you don't have to deal with this stuff anymore.* This expresses the ambivalent attitude towards technical aids quite well.

#### 4.5 A Holistic Understanding of CSA

The ideology and practice of the Community Supported Agriculture should only be understood holistically. In addition to the mentioned distinct properties (harvest shareholder, biodynamic agriculture, voluntary work, pay what you think, food sovereignty, cooperative, free product choice, indefinite share sizes), the conversations about solidarity revealed recurring themes. These were (1) generating diversity, (2) solidarity with nature, (3.) being a magnet for alternative practices and (4) food as political.

*Generating Diversity.* The wide range of products is thus not only due to the goal of full supply for the members, but also as a response to diversity, which is considered a value in itself. A coworker has explicitly named this diversity as the reason why birds are settling in the area again - a step towards restoring the ecosystem. Another coworker explains *there are so many sub-types of plants, that conventional agriculture does not use anymore. CSAs can help to rediscover them.* While passing a field J laughs *here we are probably taking it too far, others would cut this out as weeds, and we are planting it pointing on a cultivated type of dandelion, that is used as a salad.*

*Solidarity with nature.* Another coworker explained that he prefers to loosen the soil slowly and strenuously with a digging fork rather than with a mechanical tiller, as this is much better for underground small animal life. On another occasion he jokingly commented on increasing local birth rates: *The Luzernenhof is bringing fertility back, apparently not only on the fields.* This captures a shared understanding of the work as a duty to the commons. *We are doing it for everything here. For the insects, the birds, all of it.*

*Magnet for Alternative Practices.* J also teaches in an academic course on biodynamic agriculture and said that he is regularly asked about Permaculture, for example. From his point of view, this is not the actual state the farm is in, but a research direction whose findings can be applied in agricultural practice. Furthermore, biodynamic agriculture is itself experimental.

*Food as Political.* On a wall next to the yard an event is advertised 'food is political'. This seems obvious to the community. A coworker named the political aspects of food to be the rejection of the market logic, of conventional practices, of universal prices and basically of capitalism in general. Though this may sound radical, the CSA patterns of transaction do, in a very real sense, constitute an alternative to the market economy.

## 5 DISCUSSION

Based on the observations from the previous chapter we now discuss the values at stake and in particular the understanding of solidarity at the Luzernenhof. Afterwards, in chapter 5.2, we are able to comprehend their solution for demand orientation. In 5.3 we relate this to the development of CSAs and their vision for the future. These considerations prepare us to discuss the potential for IT in second half of the discussion: After explaining in chapter 5.4 how our design expectations were not met, in 5.5 we identify three interrelated innovation gaps and finally, in 5.6, offer considerations as to how technology can help to fill them.

### 5.1 Values at stake at the Luzernenhof

By the structure of their ordering system, the Luzernenhof relies on trust relationships significantly beyond what is common practice among CSAs. Whereas it is common that members pay different prices for their shares, these shares are predefined as equal. As a result there is a limit on how much a single member could exploit the community. At the Luzernenhof, however, the share of produce that a single member can extract is a matter of demand. The resulting *indefinite share size* places the members in a situation of mutual trust. It goes significantly beyond the mutual trust that is required for the common *pay what you think* property. In particular, with indefinite share sizes it is possible that a member receives less produce than he or she expected at the beginning of the year, because other members order too much. However, the rules addressing limited supply restrict the extraction that would be possible in the worst case. In addition, the hybrid rule offers a protection for precious meat. An additional trust component is (unintentionally) introduced by the fact that in the spreadsheet other members could alter your orders. This component is not necessary and could be removed by changing the software.

Even though the concept of individual members deciding how much they are willing to pay may suggest a form of subsidizing support between the members, their answers regarding what they were willing to pay for revealed, instead that their support is primarily directed toward the farm. Thus the topology of solidarity is not so much between the members, but between member and farm. It is therefore quite surprising that the factual structure presupposes a solidarity that seems to exist only indirectly, via the farm. Instead, each member seems to regulate itself through implicit social norms. It is worth noting, that the behavior of members wanting to pay at least their fair share contradicts the models of selfish utility maximizing agents, that underlies mainstream economics. The so called ‘free rider problem’, such that members live on expense of others, does not exist in this community.

If the Luzernenhof system should serve as a model for other enterprises, one needs to be aware that it relies on both trustworthiness and actual trust between the community members. The whole CSA model relies on trust of the members into the farm (harvest shareholders, cooperative). The community can then extend this trust back to its members (via *pay what you think* and *indefinite share sizes*). For the latter one, the members’ self regulation is a prerequisite. In communities where this is not given, the *indefinite share sizes* might not work (or require further restrictions). Further

expressions of solidarity, such as voluntary work, strengthen the community cohesion.

### 5.2 The Luzernenhof solution to demand orientation

CSAs try to escape the logic of markets. However, they need to find ways to coordinate harvest yield and consumers’ needs. Thus, in some manner they reintroduce the problem of matching supply and demand. The most common approach to distributing supply equally among all members can be seen as an attempt to force the demand to be equal to the supply. It can, however, hardly change consumer preferences, so that CSAs can fall short of meeting the real demands of their members. This is the problem of demand orientation that all CSAs face.

The Luzernenhof solution to this problem is implemented by a technical tool, the Google spreadsheets document. It enables the members to communicate their real demand to the producer. As a consequence the farm is able to adjust the planned supply for the following years (or earlier for dairy products). Because the members preferences do not change much from one year to another, the Luzernenhof is now able to calculate roughly accurate. Nevertheless, variance in the harvest, changing members, further experiments with the produce stock or an unwillingness or inability to provide certain products or quantities can still cause a mismatch between supply and demand. It is worth noting that their solution would be possible with prices denominated in Euros instead of Luzernen. Therefore, we consider possible solutions in terms of two different innovations. Both will be covered in this section: Firstly, the **ordering system** and secondly, the **Luzerne**.

*The Ordering System.* The way in which the spreadsheet document is utilized primarily enables the communication of orders and therefore a feature of the members’ demand conditions. To match the supply and demand, they apply market mechanisms which work like prices and non-market mechanisms in form of further rules. The market tools are the increase or decrease of the price tags. Apparently these signals function to regulate demand even though the price that the orders are accounted as in is decoupled from the price that the members actually pay with their contributions. After all, orders only result in contribution recommendations for the next year. Price tags can be smoothly chosen on a continuum. The non-market tools are discrete steps for increasing impact. In the direction of scarcity there are first product limits (for instance, there are only 80 glasses of Sauerkraut on the stack) and second through member limits (adjusted by the household factor). In the case of excess the non-market possibilities start with notifications about the excess, after the price is reduced to zero. External giveaways, animal feeding and not harvesting are the options. Due to the farm’s by now substantial experience with its members, it today can quite accurately predict members’ demand, so that these non-market tools play a less significant role. To arrive at this, it was essential that the members were able to communicate their true demands with their orderings.

The framework of anti-consumerism allows us to understand members of a CSA as prosumers. However, there are increasing levels of involvement in the production, of which membership is the first one. Further levels are helping with administrative work,

doing physical work on the farm and being involved as a co-funder or co-owner. Within the subsystem of a CSA, the demand oriented ordering system also enables some members to take the role of flexumers, adjusting their preferences to the outcome of the harvest and possibly, if the prices reflect that, being rewarded for this behavior.

*The Luzerne.* The Luzerne is an innovation on the level of the monetary system (see 2). Because the Luzerne-accounting is refreshed every year, the currency design makes it unusable for financing. Instead its purpose is accounting in this micro cosmos of the economic system, in particular for the distribution of food. But what difference does using an alternative currency make to economic activity? The observation that the Luzerne is not a necessary component of the ordering system raises the question of its purpose. Why is it that the value of the products is not simply denoted in Euros? There are different perspectives on this.

The Luzerne only projects the a priori incomparable products onto a linear scale of value. Therefore, from a narrow economic theory perspective it can be seen as a unit of account that does not qualify as money, because it does not fulfill the other two functions of money. It is neither a store of value, because one cannot accumulate it, nor is it a means of exchange, because it does not change hands. This perspective, however, gives no insight into its purpose.

One way of understanding the Luzerne is as an expression of a worldview. In the act of creating a new currency the Luzernenhof shows utopian or pro-topian thinking (2). It directly addresses the monetary system that we use today as a root cause of fundamental problems. Using a different unit of account as a measure of value, expresses a rejection of the outside markets measure of value. These products do not have a price in Euro, under which system any stranger has the same right to buy the produce. Instead they belong to the community and have a measure of value which helps them organize their distribution. This aligns with the coworkers' description of the political dimension of food which includes the rejection of universal prices (4.5). It also echoes the intentions of the currency's inventor when addressing the monetary system (4.2). However, it would not be accurate to describe the Luzerne as an expression of value by the whole community. Even people in the community that roughly share this worldview do not necessarily see the currency as related to it. The attitude of indifference to the Luzerne is actually widespread. Some even find it bothersome (4.2). Nevertheless, this friction is seen by some as positive, since it brings the members out of the 'mental state of shopping'. Therefore, the Luzerne can also be understood as a psychological tool. As such it nudges the members to order the produce they collectively paid for (instead of buying externally). Thereby (and by not having a limit for how much Luzerne members are allowed to order) the currency contributes to what is in economic terms called market clearing. If a relevant fraction of the produce decays, that can be considered as a failure of the distribution mechanism.

Another perspective is given when the accounting for the orders in Luzerne is regarded as a purchase. In this sense, they would indeed be paying with Luzerne as their account is charged, although their account exists only implicitly in the form of their accumulated orders in the spreadsheet. By analogy, the system works in a fashion

akin to credit cards, such that the members have unlimited credit limits, and the negative account balances of the members are settled in the end of the year when they are taken as a recommendation for the next year. An insight this perspective offers is the (almost) unlimited trust in the members. It is only indirectly limited by the rules of the ordering system. If this trust was not justified and a single member misbehaved and exploited it by exorbitant orders, the system would fail. We will discuss alternative design choices for this system in chapter 5.4.

### 5.3 At the Frontier of CSAs

In preparation for the discussion of the potential for technology, we first try to describe where the CSA development is going. In the search of new modes of organizing economic activity. . Therefore, uncovering the implicit social rules that are at work is necessary in order to make them explicit and scale them up. The explication of these rules could be then implemented by scaleable software, to design a wider form of social delivery after the model of a CSA. However, as our discussion on solidarity showed, the structure is based on trust which depends in turn on personal relationships (member to farm). Such trust relations are difficult, if not impossible, to manage at scale. Furthermore, the scaled up version would be basically a planned economy and the history of the 20th century can be read as a failure of that model. Finally, locality is an important aspect of CSAs that would be lost. This was already common knowledge among CSA researchers outside of S-HCI [2].

*CSA as resilient structures in times of crisis.* That being said, we do see a high potential for expanding the role of CSAs and related modes of organizing economic activity. In contrast to cooperatively organized alternative food networks on the one hand and conventional production on the other, CSAs are able to satisfy the critical consumer that does not have time for large overhead (to do either fieldwork or research on the food origin). Achieving this involves a horizontal diffusion and cooperation of CSAs (or alternative food networks in general). Because these enterprises have a certain size, at which they function effectively, but also have the potential to increase their efficiency by working together [2], they could be seen as the atomic units of a new paradigm in food production. The fact that during the fieldwork, external food producers that were considering switching their business model to CSA visited on two occasions, showing that there is a potential for diffusion. Overcoming barriers to this horizontal diffusion and enabling a cooperation that is based on solidarity, is the gap where technology and therefore S-HCI-research and design can contribute. Therefore, instead of scaling up, the vision is a variety of exploratory local initiatives that inform global alternatives.

Because the fieldwork happened to be at the time of the early Covid crisis, we are able to record in a side note how our observations indicate that local food production is indeed more resilient in times of crisis. First of all the low reliance on external entities enabled the Luzernenhof to continue the food production. In addition, in a crisis the members showed some willingness to support their CSA voluntarily, for example with work, should the coworkers get infected. Finally, due to the fact that the members are the shareholders of the harvest, in the worst case they may receive a poor return on their investment, but the CSA as a food production

infrastructure can survive. This finding supports the ideal of food sovereignty as it indeed increases the resilience of the food system, lacking the fragility of global supply chains.

#### 5.4 A Potential for IT?

From the many usages of information technology and the infinite circumstances where IT usage would be possible, the following chapters focus on the ones that we regard as most interesting, because they appear specific for, and most useful to, this development in the organization of economic activity on CSA principles.

At the beginning of the fieldwork the authors expectation was that a good next step would be to implement the Luzerne as a means of payment. The model was that members would get an amount of Luzernen that they obtained in the bidding rounds of the membership assembly, issued onto member accounts. Then, they would be able to actually spend the money from these accounts on food orders. If they ran out of currency, they could either start trading with those members who realize that they have more than they need or there might be an option to buy further Luzerne. After one year, any existing currency would become invalid and a new round would be issued. The difference with the existing system can again be understood in analogy to credit cards: The members would have previously negotiated credit limits, whereas currently their credit limits are infinite. This would have introduced the advantage that the farm can precalculate the amount of currency that the entirety of members can spend. That figure, in other words, corresponds to the full harvest (although some margin to achieve market clearing might be required (see 5.2)). Thereby food shortages, caused by members exploiting the arbitrary large negative balances, can be prevented. Making the currency a scarce commodity might enable a tighter price signaling. After all, in the current model the members could simply ignore the prices completely, since they are only nonbinding contribution recommendations. According to economic theory of markets, this change would be reasonable.

However, a main reason for the Luzerne to exist was stated to be bringing the members out of the mental state of shop-ping. This asserts that the signaling feature of prices is working (at least) strongly enough, despite the fact that they only result in nonbinding recommendations. Implementing the Luzerne as a means of payment, as sketched above, would only worsen this condition, since the Luzerne would be scarce in reality and spent like any other currency. In fact, both expected problems (1. the members' theoretically infinite Luzerne supply not matching the finite harvest and 2. the weak price signaling) turned out not to be relevant. That is because members take the recommendations seriously, or in other words, in the case of the Luzernenhof the trust by and in the members is justified. Nevertheless, the horizontal diffusion might include the formation of more communities in which this trust is not given at the beginning. Software that implements the demand-oriented ordering system would be very beneficial for them, but 'infinite trust' might not be given. Therefore the modification sketched out above, might be preferable in such circumstances.

#### 5.5 Surveying the Innovation Gap

Uniform software that provides an out of the box solution for new CSAs would be a big contribution to diffusion. In Germany 'solid-base' <sup>(3)</sup> is an initiative by the German CSA network that is set up for this task. 'Kulturland' <sup>(4)</sup> is a cooperative that has a project looking into DLT solutions for currencies like the Luzerne.

However, we found that there exists an innovation gap at the place where different CSAs and possibly other alternative food movements meet. The CSA network has even written plans to cooperate with other initiatives into their statutes, stating that cooperation should happen according to principles of solidarity as well. To achieve this requires some addition to the existing physical infrastructure at the depots as well as to the software infrastructure for accounting and communicating. Both would require further specification. The S-HCI community has not, as yet, considered the possibilities inherent in the diffusion of this kind of economic model. We offer considerations based on our observed understanding of solidarity.

The main task of a cooperative system is to enable members of one community to use their ordering or purchasing system to acquire goods produced at another community. Therefore it needs to be interoperable with the communities' ordering software and logistics. The order needs to be communicated by the member, to its CSA (A) and further to CSA (B) and the degree to which it can be met has somehow to be determined. In the case of scarce products, this involves rules, (1) how this external order is treated in comparison to the ones from members of B and (2) which of these external orders are prioritized. Specifically, should CSAs have a limited capacity to import, and if so who decides upon its scope and usage? How much is charged for the order? Do CSAs only import what is not in their own assortment? And do they only export what they categorize themselves as excess produce? How is the transportation handled if A and B do not share a pickup point? Do the trade balances need to even out, and if so by what mechanism is that achieved? These design choices imply important differences in trust relationships and there is an issue concerning what mechanisms can be considered to be "according to solidarity".

The central conflict for the design touches upon fundamental questions of economy and is as follows. For the mutual benefit which solidarity demands, an exporting community has to be rewarded with something that is at least as valuable to them (although not necessarily immediately). Usually, this problem is addressed by using free trade. That would, however, place the communities in competition with each other. On the other hand, if the trade balances were not to be offset, the communities would be placed in a relation to each other similar to the relation of members within a CSA. Those who can afford to would subsidize the shortcomings of others. Such a system would expand the implicit trust relations from a local to a more global level, if it could be realized. Every community would be trusted to still be productive although it could live from the subsidies of others. Such a system implicitly relies on trust relations which cannot be guaranteed outside of the local context. We therefore argue that the system has to be designed in a tradeoff between risking exploitative competition and risking

<sup>3</sup><https://www.solidarische-landwirtschaft.org/das-netzwerk/projekte/solid-base/>

<sup>4</sup><https://www.kulturland.de/>

exploitative indolence. This tradeoff has to be adaptable to changes in underlying trust relations.

The part of the system that communicates the orders between the cooperating CSAs, is not the problem. The difficult design choices are the rules which accompany them. The problem is very similar to the problem of distribution within a CSA that the Luzernenhof faced. The solution will probably involve a combination of market mechanisms and non-market rules. In some way the different CSAs will come together as members of an overarching structure based on solidarity. But this structure will have features which are distinct from the internal structure of a CSA, because on the CSA layer (a) every member exports and imports (not just consumes) (b) the topology of existing trust will be different (c) locality and transportation needs to be considered.

We separated out three gaps for technology usage, where CSA development has demand conditions that are different to that of conventional agriculturalists. All of them are interconnected.

- (1) The internal ordering system communicating the demand.
- (2) The internal accounting system implementing the rules and limits set by the CSA.
- (3) The overarching trade structure that enables CSAs to cooperate according to solidarity.

The ordering system (1) and the Luzerne currency (2) are currently implemented by nothing else apart from the google spreadsheets document. This is an extremely lightweight solution. Admittedly this is only possible, because the Luzerne does not fulfill all three functions of a currency. It is neither used as a means of exchange, nor as a store of value, instead it is merely a unit of account. Furthermore, because its application is limited in scope to the CSA, it is not problematic feature that every member is able to write in the document and could mistakenly (or ill intentionally) write orders for other people. This has happened from time to time, but could always be easily resolved. However, on a bigger scale, it would offer a serious weakness. The fact that spreadsheets are a common tool that different providers offer, relativizes the dependence on Google. Nevertheless the shared document function is essential and switching to a different provider would be cumbersome. If this solution were to be scaled up to include all available produce from other CSAs as well (given that an overarching system (3) was in place), it might transgress the boundaries of practicability.

As of today an overarching cooperation structure for CSAs (3) does not exist, yet. For any software system under consideration, the effort for the users needs to be small, the members e.g. would not want to manually buy a foreign CSA-currency on an exchange every time they want to order a product that originated from an adjacent CSA.

## 5.6 Distributed Ledger Technology

Our discussion revolved around forms of accounting, locality versus globality, currency and most importantly trust and the intermediation of it. CSAs wish to widen participation in food networks whilst maintaining commitments to the egalitarian ideas contained in their philosophy but are highly conscious of the challenges this entails. All these threads are also closely related to early versions of Blockchain and Cryptocurrencies or more general Distributed Ledger Technology.

Research suggests a huge potential for Distributed Ledger Technology in the agricultural sector [25, 48, 53]. We will not explain these technologies here because there is insufficient space. Nevertheless, we regard the backend of technology as a design aspect that is in this context important to discuss. Based on the community values expressed, we argue that neither central server structures nor Blockchain would be a fit, but other DLT might very well be.

Although Blockchain is sometimes described in terms of a shift from trust in institutions/people to trust in technology (Lustig coined the term *algorithmic authority* for it[29]), the approach does not work in this case. There are no rules that could be covered by smart contracts. Instead members are legally allowed to exploit others and they are trusted not to do so. Blockchain is also often conceived as a technology to implement currencies. However, it would not have made sense to use it for any implementation of the Luzerne (2). In the current version the Luzerne is a unit of account and because nothing is issued, there is nothing to implement. Literature suggests that the potential for Blockchain in agriculture lies in making information along the supply chain visible on a neutral ground that is not controlled by central intermediaries. If the ordering system (1) was built on a Blockchain, the advantage would be that people can no longer manipulate the orders of other members. But that would have been possible with a central server structure as well. To be able to compete with centralized software, a distributed system must therefore keep the additional cost low enough on a small scale already. A Blockchain does not do this. Besides the high energy cost of Blockchains which use the Bitcoin consensus algorithm called "Proof of Work", there is a fundamental dilemma for these Blockchains at least in the context of agricultural production. All the information that should be processed, for instance the members orders, needs to be stored in the Blockchain. To be stored in the Blockchain means to be stored by every full node of it. If this was viable and therefore adopted by the majority of enterprises in the sector, every full node of the Blockchain would have to store all the data from everyone. The high redundancy does not make sense for data that, for the most part, only the local community cares about. Thus, the advantages of a Blockchain, are not relevant in this small scale, high trust environment.

The advantages of a distributed ledger show up, however, when the scale increases and the trust decreases. Therefore, it might become relevant in the future, if many CSAs or other enterprises adopt similar models and use the same technology. If the system then already heavily relies on a centralized software architecture, this cannot easily be changed. We claim that the main advantages of DLT in this context would only show up in the future. People working in agriculture have almost no chance to comprehend the consequences of the choice of the back end. Yet, becoming dependent on technology, is something they can very well comprehend and that conflicts with their values of sovereignty.

In their approach towards technology, we observed an emphasis on sovereignty. Technology is welcome only as a useful tool requiring as little attention and dependence as possible. Altieri [1] calls this technological sovereignty and sees it as one aspect of food sovereignty. Based on the experiences that the rest of the agricultural sector has had (see chapter 4.4), the sustainable oriented agriculturalists tend to refuse to rely on big corporations. So, there is some awareness that food production is not resilient if it

depends on the will of external companies. This is in some conflict with running the spreadsheet document, which is essential for food allocation, through the Google servers. After all, if this access were to suddenly disappear, it would cause significant complications for the farm. Norton et al. [32] summarize these values under 'long-term values' for sustainability. Our point is that these values are on conflict with the implicit values of both centralized server structures and Blockchain technology. However, there is a fraction of Distributed Ledger Technology that goes beyond blockchain and is more sustainability oriented. (One possible candidate that aligns with the technological sovereignty is Holochain, a framework for peer-to-peer applications inspired by biomimicry [19]. We will discuss this in a forthcoming paper.)

In relation to implications for HCI, our study demonstrates the need for a careful understanding of the trust and solidarity issues that underpin community agriculture and cautions against technicist attempts to deal with the issues through classic Blockchain solutions. Attention to the practices of community agriculture and evaluation of potential solutions to existing problems, we believe, fills a current gap in the HCI/food literature.

## 6 CONCLUSIONS

We have shown how the Luzernenhof has further developed the system of CSAs and have discussed the significance of this development in the context of solidarity. Addressing our research question, we found mechanisms that go beyond common practices of CSAs. In particular, we were able to separate the free product choice property, the indefinite share size property and the currency as conceptually different. They were simply implemented by the same technical tool. Two innovation gaps consist of making these properties accessible as a software solution for other CSAs, whereas the currency is an optional addendum. We have discussed how, therefore, the trust structures in the community need to be taken into account.

We found a third innovation gap in the enabling of a cooperative distribution and accounting for alternative food networks. Filling this gap builds on the considerations of the internal distribution mechanisms. It involves requirements that are in tension to each other and it could but does not necessarily have to involve a currency innovation. Relatedly, the broader research field at the intersection of sustainable agriculture and currency innovation is still underexplored. Both offer design opportunities that require S-HCI or CSCW work. Whatever software will be designed, it has to make a technical choice at the backend. We argued that centralized databases as well as Blockchain technology both would conflict the communities long term community values of sustainability. We therefore suggest that other Distributed Ledger Technologies should be considered.

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