

## **Light-Color Money: Three-dimensional Digital Money That Can Express Uniqueness and Diversity of Value Beyond LETS**

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### **Abstract**

We understand that changing the way money today will be a breakthrough in overcoming the problems caused by free investment in globalization, which is the long-term tendency of expanding Market for exchange and shrinking Community for reciprocity and State for redistribution. Among community currencies, LETS is the most general form as integrative communications media of money and language and has a significant potential to solve the problems of globalization and create alternative socioeconomic markets independent of capitalist markets. However, conventional money including LETS is scalar money to evaluate things only quantitatively with one-dimension so that it might have defects of monochrome reduction of everything. We thus conduct a thought experiment on light-color money with such three dimensions as RGB so as to qualitatively evaluate not only products and services, including volunteer activity and shadow work, but also social and natural environments and resources more diversely. The several properties of light-color money derived from the rule of complementary colors are unique, so there is a large potential to use it to make our socio-economy non-capitalistic, sustainable, and diverse. Because it is not difficult to implement light-color money in ICT environments, it is worth to carry out a social experiment to test its feasibility and applicability.

**Keywords: Globalization, Free investment, Community Currency, LETS, ESG, Light-Color Money**

### **1. Introduction: Community Currencies and LETS to solve the problems caused by Globalization**

Money is said to be an indispensable and convenient economic tool, but it has many flaws: economic instability in bubble collapses and severe depressions accompanied by corporate bankruptcy and unemployment, and substantial income and asset disparities between individuals and regions. Free investment through globalization expanded markets all over the world but destroyed communities for mutual aids and human livelihood as well as nation-states for redistribution for social welfare. Although these are all complex phenomena through working of the markets for products, labor-power, and financial commodities, they can be regarded as the manifestations as the results of fundamental defects caused by one-dimensional reduction of everything by conventional money.

In order to theoretically define what globalization is, we introduce three different coordinating principles of socioeconomics, according to Polanyi (1944) and with my modifications (Nishibe 2015): 1) Market (the private domain of exchange and freedom), 2) Community (the common domain of reciprocity and fraternity) and 3) State (the public domain of redistribution and equality). Then, Globalization can be interpreted as the historical trend over several decades for Market to expand, and for Community and State to shrink, qualitatively, and quantitatively, as shown in Figure 1.

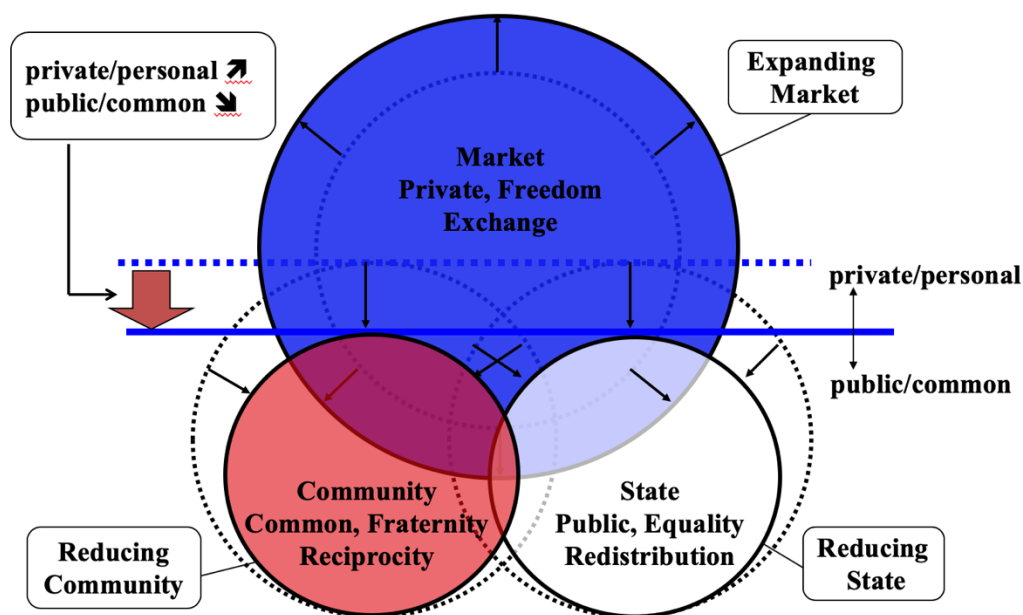


Figure 1. Globalization: the tendency of Market to expand and of Community and State to reduce

We understand that changing the way money today will be a breakthrough in overcoming the crises that globalization has created. The starting point of such a change would be that people can start to reconsider money as a communication medium, and think deeply about "community currencies (CCs)" as integrative communication media, and gradually spread them from below.

Since the 1980s, CCs that circulate only within local community areas had been taken notice of as possible solutions for such defects of money and globalization. LETS (Local Economic Trading Systems) is the most popular and radical scheme of CCs, because 1) it has no physical form such as paper money and permits no refund into legal tender, and 2) it can potentially create alternative socioeconomic markets independent of capitalist markets by giving each participant the right of issue and enabling multilateral settlements.

## 2. Money and language as communication media

CCs can be seen as the revival of the initial character of money as "communication media," and they have the potential to change the ways other money work than CCs, as well as our internal values and motivations. Before we touch on CCs more specifically, let us first consider language and money as communication media and then raise the issue of CCs as an integrative communication medium.

Firstly, we consider the identity and difference between money and language as media based on the ideas of Luhmann (Luhmann 1984=1993, 1998=1991). In the case of language media, the form is "utterance" in which multilayered structures such as the object, the subject, and the situation are expressed. In the case of monetary media, the form is "payment," which represents the object, the subject, the total expense, etc.

Money and language are also homomorphic in "generalization" that overcomes differences in three dimensions of time, events, and society. The generalization of events of money is enabled by the function of a measure of value, which attaches unidimensional "price" to diverse and heterogeneous "commodities" to provide universality and commensurability. "Commodities" and "price" in money correspond to "sentences" and "meaning" in language.

Language also has a function of generalization of events, although not as much as the function of a measure of value by money. The decisive difference between money and language is that money is "uniform media" that reduces the qualitative diversity and complexity of goods to unified information through price expression, whereas language is "diverse media" that can express overwhelming diversity and complexity, although it has the function of eventual generalization described above.

In other words, the form of payment only contains a much simpler structure than the form of utterance. Money as a measure of value can express the complexity of the real world by reducing and condensing it to unified values. Furthermore, the form of payment, by acting as "symbolic generalization," facilitates the division of labor, the division of knowledge, and the discovery and innovation of knowledge in the market, and enables the sale of a wide variety of commodities in large quantities.

At the same time, however, when money expresses everything at single unified prices, it will result in "diabolical generalization" in which the uniqueness and qualitative diversity in the culture, values, and norms of regions, organizations, and groups would be erased. In particular, once money emerges as capital whose sole purpose is to augment value, and as "internalization of the market" further proceeds in the midst of globalization since the late 1970s, not only investment and speculation prevail, but also the investors' mode of thinking such as opportunity costs and human capital are widespread among ordinary people, this problem becomes quite serious.

What this means is that people's consciousness will gradually become closer to capitalists. Increasingly, women and mothers perceive housework and childcare as the loss of an opportunity for wage income to earn outside their families, and people are increasingly viewing higher education, learning, qualifications, and even health as investments in human capital to increase future returns. Such changes in value and awareness are accelerating to the point where communities such as families, schools and universities are completely disassembled into markets. We will see later how CCs as integrative communication media can answer these problems.

### 3. CCs as Integrative Communication Media of Money and language

CCs are economic and social-cultural media that play a crucial role in Community (common), which is the socio-economic coordination domain along with Market (private) and State (public). Here we will view CCs from language and money that are the communication media. First, we must pay attention to the following unique characteristics of CCs.

#### 3.1 CCs as Economic and Social-cultural Media

CCs as 'integrative communication media'		
Side	Money (Economic media)	Language (Social-cultural media)
Purpose	Vitalization of local economy (autonomy, circulation, recycling)	Rehabilitation of community (dialogue, interchange, commitment)
Function	Independent Design, Issue and administration Bounded sphere of circulation Zero/ minus interest	Ferment of trust and reciprocity Cooperative 'prosumers' Linguistic expression/ transmission
Form	Complementary currencies and Emergency currencies (Stamp scrip, WIR, RGT, CC coupon)	Mutual-help and reciprocity (Time dollar, Time bank, Fureai kippu, Eco- money )
Domain	Commercial /non-commercial circulation (Market)	Non-commercial circulation (Non-market =community)

Figure 2 Dual properties of Community Currency as integrative communication media

CCs, like the ancient Roman god "Janus," have two aspects: "monetary" and "linguistic." They are unions of these two factors, but the term "currency" or "money" naturally indicates strong economic connotations. To make it clear that CCs include not only economic but also social and cultural domains, we will call them "integrative communication media" in the sense that they simultaneously hold both money as economic media and language as social-cultural media. Figure 2 summarizes the dual characteristics of CC as an integrative communication medium.

First, look at the "economic aspect" in the left column. Here, the monetary aspect means that heterogeneous and diverse goods and services are reduced to a single measure of CC, say, "Green Yen," and are one-dimensionally expressed and evaluated by the quantity of the "Green Yen."

While producers or sellers set prices of goods and services and wait for buyers to come, consumers or buyers look at the prices and buy goods and services if they judge the prices are not high. The entire network formed of these individual bilateral transactions of buying and selling constitutes the "Market." As long as CCs are used to set prices for goods and services, such unified expressions and evaluations are required. As monetary media, therefore, CCs also constitute a market domain that is a different type from the current capitalistic market economy.

It is often misunderstood that CCs create, not markets, but communities, but it is not true. The CC contains the monetary aspect in the sense that it aims at "reciprocal exchange." If another "linguistic aspect" is also considered, CCs form markets that are not only 'competitive' but also 'cooperative,' that is, 'coopetitive' local markets. To understand this, we need to escape from Neoclassical view of markets in which participants are supposed to be selfish and rational, and have no interactions under perfect competition, and rethink that markets can include altruistic and bounded-rational agents and cooperative and mutually-help interaction (Nishibe 2006).

Next, note the "social-cultural media" aspect of the CC in the right column of Figure 1. It is also called the "linguistic aspect." All human relations use language and numbers complementarily, but the monetary media is "one-dimensional media" that evaluates goods and services as single numbers and is different from "multi-dimensional media" that can express and evaluate everything more complexly like language. A CC can represent and communicate the social values, norms, and cultural diversity inherent in the issuing and operating entity and the local community in which it is circulated, as compared to ordinary currency.

### **3.2 The Purposes of the Economic Media and Social-cultural Media**

A CC has two purposes that respectively correspond to the "economic media" and the "social-cultural media."

The purpose of the "economic media" for CCs is "revitalization of the local economy." One of the causes of the recession and unemployment in the local economy is that money flows out of the region, and there is a lack of money circulating in the area. Even if deflation occurs in Japan as a whole, the seriousness of the problem, which appears as the bankruptcy rate and the unemployment rate, varies from region to region depending on the balance of payments and industrial structure. In general, the situation is more severe in rural areas than in metropolitan areas. Furthermore, every town and village in the nation is suffering from depopulation, an aging society with a declining birthrate, and the decline of shopping districts. Young people go to cities where there are many job opportunities. In addition, more and more local residents have become not to shop at local shopping districts, but instead, drive to large stores in neighboring towns or go to local convenience stores. As a result, purchasing power is flowing out of the region, and the problem is only getting worse. If shopping districts are dismantled, invisible community functions such as crime prevention, mutual aid, childcare, and cultural events will be lost. As a result, the living conditions of not only the elderly who cannot go shopping by cars but also the entire community will deteriorate, accelerating the decline of the local economy.

Under these circumstances, if people can create and manage a CC by themselves that does not flow out of the region and make it circulate within the local area, the regional economy will be revitalized and become relatively self-reliant, thereby promoting the formation of a circular economy based on "local production and local consumption." This is the primary purpose of the implementation of CCs for the purpose of regional economic revitalization.

On the other hand, another purpose is "revitalization of the community" or "strengthening of bond and activation of communication." This corresponds to the "social-cultural media" of the CC. Today, organs, germ cells, carbon emission rights, and even genetic information can be bought with money, expanding the domain of the markets (including black markets). Market fundamentalism is gaining momentum as the market economy increasingly covers the world, and deregulation and liberalization are promoted. In this globalized world where markets are expanding both in quality and quantity, human relations tend to be reduced only to economic trade and legal contract relations. But that would destroy communities that were built on mutual aid and altruism.

Communication between people also tends to be diluted, relying on mobile phones and the Internet, with non-face-to-face and anonymous relations expanding. If people become completely selfish and isolated, they may not be able to help each other or volunteer. Therefore, CCs have come to be used in such trends of market and individualism as a means of reconstructing mutually supportive and reciprocal relations, or as a means of making communication between people "face-to-face" and activating it.

### **3.3 Evolution and Diversification as CCs**

Thus, there are two aspects of CC: monetary and economic medium and linguistic and social and cultural medium. These are intricately combined and integrated into CCs, but it is possible to detect these two aspects. We cannot understand its unique property from one side only. Since one of the two aspects is usually relatively stronger, reflecting its uniqueness and originality of local regions, each CC takes a peculiar form of individuality. The evolution of CCs into species has led to the emergence of a variety of "subspecies." The purposes of introduction and the characteristics of each region are diverse, and the CCs also vary accordingly.

That's not all. The motivations and behaviors of participants and the performance and patterns of their communities influence each other and change over time. Through the media characteristics of CCs, the micro agents and the macro environment change endogenously through interactions. In this evolutionary process, it makes no sense to ask what form of CC is optimal or most efficient. This is because, in the course of evolution, the criteria for evaluation and judgment themselves change, and so do the rules of the game.

The CC aims to restrain the negative function of money as capital as in Luhmann's "diabolic generalization," and restore social stability and sustainability by intentionally limiting the versatility in terms of circulation area, period, objects of transactions, participants, etc. of a modern national currency. If a CC that is overwhelmingly weaker than a current national currency can be maintained evolutionarily, it will slowly have a gradual impact on the values, ethics, and habits of thought that are the inner institutions as shared rules of behavior for such agents as individuals and organizations.

### **4. Local Exchange Trading System (LETS)**

The details of the CC systems are not necessarily the same. For example, CCs include "centralized issue system" in which an administrator or management committee issues paper currency according to the predetermined rules or arbitrarily, and "distributed issue system" (also called "mutual credit system" or "multilateral clearing system") in which participants can voluntarily create money as buyers up to a specific limit or unlimitedly and an administrator registers sales as plus and purchases as minus in the accounts of both sellers and buyers. They can also be categorized into those that link currency values to labor hours, those that link to the national currency, and those that link both as in Ithaca Hours. CC differs according to the time and place in which it was established, and according to its purpose and philosophy. Such diversity indicates the significance and potential of CCs. However, we will take LETS as a typical example to help people understand the actual operation and structure of CCs.

### 3.1 Overview and an Example of Transactions of LETS

In February 1983, six members, led by Michael Linton, started LETS in the Comox Valley, a town of 60,000 people on Vancouver Island, Canada. LETS is a network in which participants voluntarily trade goods and services using CC. Linton and his colleagues called the monetary unit "green dollar."

To start LETS, they must first decide on "registry" and "trustee." The registry opens and manages the participant's account, records the transaction, and sends the account statement to the participant every month. The trustee sets transaction fees, monitors the system, regulates anti-social activities, and exchanges information with other LETS, and engages in system development. Participants (1) open their accounts and start from zero balance, (2) put the goods or services that they offer (sell) or want (buy) on the item list, (3) contact the other party when they find the goods or services they want and negotiate the terms of transaction such as price and quantity, and (4) ask the trustee to record the transactions in which the price agreed is added on sellers' account and the same price is subtracted from buyers' account. The balance of each participant can be negative up to a predetermined limit.

Participants may, at the time of transactions, learn from the registry about the account balance and transaction performance of other participants. No interest is charged or paid on the account balance. Finally, administrative expenses are paid with internal currency from the participant's account. The system is thus so simple.

The original system, which Linton started, does not allow green dollars to be converted into Canadian dollars, but the two are assumed to have the same currency value. This is to serve as a reference for valuing goods and services, and to allow the price of goods to be expressed as a mixture of cash and green dollars, for example, "\$10 (payable by green dollar up to 20%)." The actual exchange is, for example, as follows.

The buyer calls the office and leaves the following message on the answering machine. "This is David on number 35. Please get Cathy on number 220 to make a 100 green dollar surplus for computer lessons." The registry records this information on a computer. Kathy runs a 100 green dollar surplus, and David runs a 100 green dollar deficit or "commitment." David doesn't need to have it in his account before he spends 100 green dollars. And if Cathy is confident enough to make money from teaching computer lessons, she can buy the listed used Volkswagen van for 1000 green dollars from Mary. As a result, Cathy's account has a 900 green dollar deficit. Finally, Mary asks David to fix the roof of her house for 300 green dollars, the result of these three transactions would be a surplus of 700 green dollars in Mary's account and a surplus of 200 green dollars in David's account (Figure 3). Each participant's account surplus or deficit is continuously changing with each transaction, but the sum of all accounts balance in surplus or deficit is



always zero. Therefore, credit creation does not occur as a whole in LETS. The sharing of deficits or commitments among participants facilitate trades in goods and services.

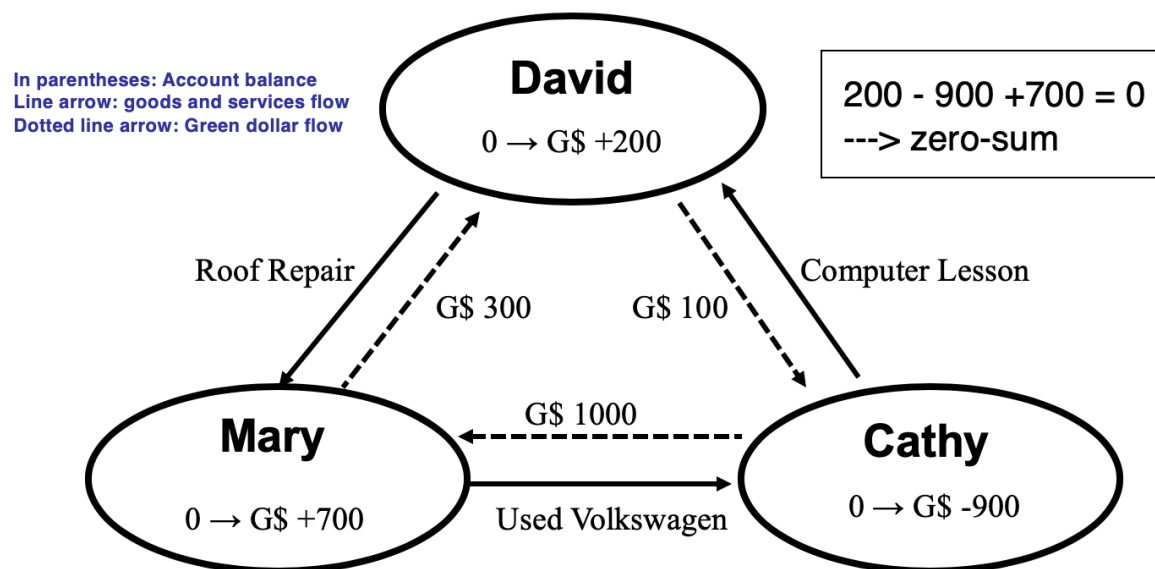


Figure 3 An example of transaction on LETS

#### 4.2 Four Principles of LETS

Interests on deposits and loans in bank accounts accumulate, so the balance increases over time. But LETS has no interest in surpluses or deficits. So those who have surpluses will buy goods and services from other participants as much as possible without hoarding them. As a result, CCs in LETS circulate rapidly within the community, stimulating demand within the local economy. In LETS, each participant can create money when buying goods or services and holds the surplus or deficit as a result. It does not represent the position in bilateral legal relations of right/obligation between two parties as in debtor/creditor relation. In the words of Linton, "It is the commitment of the people in the community to the people in the community," not the right/obligation under a legal contract.

The national currency flows as income in the community from the outside eventually flows out as expenditure. LETS aims to complement such money flow into or out of the community and to construct money circulation in which it flows around within the community as much as possible.

LETS is based on freedom in the community and the resulting responsibilities, and follows the four principles of "consent," "no interest," "sharing," and "information disclosure." "consent" means that all transactions, including participation and withdrawal, are based on consent; "no interest" means that there is no interest in either the positive or negative balance of the account; and "sharing" means that one of the

participants provides LETS support services on a non-commercial cost basis, with all participants sharing the costs, depending on their use. "Information disclosure" ensures that participants have access to information about other participants' transactions and account balances when making transactions. Linton calls LETS specifically LETSystem, which adds to these four principles the fifth principle of using an internal monetary unit of the same value as the national currency. This distinction became necessary when the LETS that uses standard labor hours was introduced in Britain and elsewhere. Linton's prototype is the LETSystem.

LETS appears to be a system with mutually contradictory duality. It is because it has the aspect of making individualism and liberalism in the market economy more thorough, and it also aspires to trust between neighbors and friends in the region and community. The two dimensions of freedom and cooperation are linked to the ethical dimensions of the individual: commitment based on personal choice and the resulting responsibilities. Cooperative nature is by no means a "closed" nature that forces exclusivity and assimilation into communities, and freedom and responsibility do not mean only those as consumers/investors who consider only economic merit.

#### **4.3 LETS as the general form of community currencies**

LETS has the highest degree of freedom and versatility, and it is conceivable that other CCs can be incorporated as a special case of LETS.

LETS does not reduce the value of money to an absolute measure of labor time. The 1: 1 ratio between the CC and the national currency is presupposed in LETSystem, but it is possible to remove it so that LETS can be independent of the pricing system of the external market and the parties to the exchange can determine the price comprehensively taking into account the more pluralistic values. Such endogenous and independent pricing decisions that do not depend on a single external measure imply that LETS is a system with a large degree of freedom that can encompass cultural, social, and ethical values other than economic values.

Also, LETS does not exogenously determine the amount of issue for circulation, as in the case of Robert Owen's Labor Notes where a single institution such as the management committee issues notes, but it is determined endogenously by voluntary issuance of participants. The interest rate in LETS is usually zero, but it can be minus as in Gesell's stamped money, and such LETS actually does exist. This is why what can be said about LETS thus applies to CCs proper.

#### **4.4 The Significance and Possibility of LETS: IOC as Micro Existence without any Macro Existence**

Then what is the significance and possibility of LETS?

First of all, LETS has a limited range of circulation for its currency as other CCs, its "community" is not a preexisting territorial or kinship community, nor a closed community that demands a single membership, but a topological neighborhood space in which participants commit positively in resonance with hobbies, interests, or ideas. Such a "community" can be realized by the use of information communication technology such as the Internet and smartphones. A CC deficit is called a "commitment" because it implies the responsibility for the "community" of one's choice, not for the "debt" nor "liability" to another particular individual. Instead, participants multilaterally lend and borrow via the community, and they do not stand in bilateral debtor/creditor relations. So, the crucial point is that we should understand the money created and multilaterally canceled in LETS as IOC (I Owe Community), not IOU (I Owe You). It is because the relations of participants in LETS are formed by the 'pay-forward' principle of multiple parties rather than the 'pay-back' principle between two parties.

The 'zero-sum principle' that the summation of balances in all participants' accounts in LETS amounts to zero means that money can seemingly appear only locally on the micro level but does not exist globally as the aggregation on the macro level. In other words, the money in LETS is not a thing as a material entity that can exist independently, but an event as the whole record information or collective memory on balances through all transactions in the past. The unique property of LETS lies in the fact that LETS constitutes a multilateral clearing system as a "community" where "money" is bilaterally created and multilaterally canceled among all participants as members of the community. Here a community is regarded as the group of individuals as well as the field of reciprocal exchange conducted by members. LETS simply depicts the modern image of an ideal community that keeps existing only as a collection of individuals and keeps being continuously sustained by mutual aids and cooperation among members in a community.

#### **4.5 Multi-LETS: Multiple Attribution of Individuals and glocal Community of Interest**

Also, since we can simultaneously participate in an arbitrary combination of multiple LETS as many as possible, we can express our identities regarding interests and values by selecting a unique blend of 'multi-LETS.' The different diversity of multi-LETS that each one chooses exhibits the uniqueness of individuals. Through such pluralistic attribution of individuals to multiple CCs, the meaning of "community" is extended from a "closed community" to an "open community" and the implications of "liberty" and "responsibility" are also extended from the freedom and self-responsibility of consumers and investors in the single global market to the freedom of choice and responsibility of multiple belongings to multi-LETS.

If each individual simultaneously belongs to multiple LETS, the situation is called Multi-LETS. Figure 3 shows the case of 5 participants belonging to 4 different LETS. There are four kinds of LETS Bike(B), LETS Childcare(C) LETS Tokyo (T), LETS Woods(W), and an individual *a* belong to C and T, *b* to C, T, and W, *c* to T, *d* to B, C, and W, and *e* to B. Then *b* has 3 accounts in LETS Childcare, LETS Tokyo and LETS Woods. Then, if unit of value of those LETS are not set exchangeable, the account balances of *a*, *b*, *c*, *d*, and *e* are expressed as such four-dimensional vectors, each element of which is 0, positive or negative, as  $(B, C, T, W) = (0, -34, 43, 0)$ ,  $(0, 24, 50, -10)$ ,  $(0, 0, -100, 0)$ ,  $(32, -40, 0, 25)$  ,and  $(3, 0, 0, 0)$ , respectively. The vector representation of all account balances of multi-LETS for participants expresses the diversity of their own interest depending on cultural identity and social characteristics as different individuals. It looks a little similar to light/ color money mentioned below, but the concept is completely different.

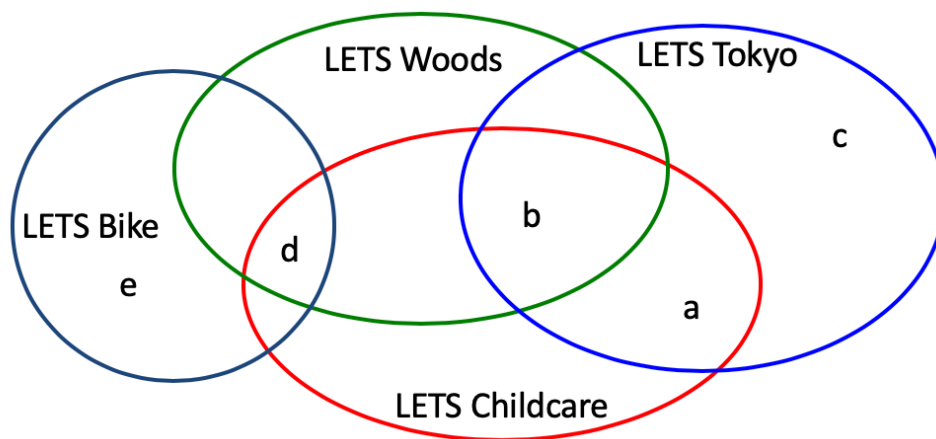


Figure 3 Multi-LETS (in case of and 5 participants belonging to 4 LETS)

In general, "local" means a close area or a neighborhood as an opposite concept of "global" representing a global area or a wide area. The term "local" in CC refers specifically to geographical regions ranging from neighborhood to elementary school districts, local shopping districts, and municipalities. In the past, many attempts at CC, regardless of its purpose or method, have been made "local" in this geographical sense.

However, these include "communities" who share specific issues, values, and interests, such as the conservation of the environment and nursing care. In this case, they can be considered as "communities of interest (COI)" that refer not only to the physical space or geographical region but also to the topological space of the neighborhood of meaning. In other words, the space in which people gather on specific themes, interests, hobbies, values, and ideas is also "local." Such locality may be more easily understood as circles, communities, or associations sharing some meanings. It does not necessarily depend on geographical proximity. If we can share values and interests, it can be broader. The development of

information and communications technology represented as the Internet, WIFI, and smartphones as products of globalization is making it much easier to create such virtual communities.

There already exist countless websites and blogs, and communities on such SNS as Facebook are virtual "communities." When we want to know the latest information about environmental issues and discuss them, we don't care where they are in the world. Such "communities" are "global" in the sense that they can participate from anywhere on the earth, and "local" in the sense that they form autonomous COIs. In other words, "virtual" communities are, by its very nature, *glocal*, global and local at the same time. And such glocal CCs on the Internet enable such a variety of virtual "communities."

The reason why CCs can be said to be counter-media against globalization is not because they deny globalization, or rebuild and confine ourselves in closed local communities, but because they have the possibility of creating new virtual "communities" by making the best use of the fruits of globalization. CCs should aim to develop new types of open communities in which people who spontaneously meet in harmony with values and ideas can build mutually beneficial relations and create richer communication based on trust and cooperation.

#### **4.6 Change in the Concept of Time**

Second, the significance of LETS that is interest-free money is that it prevents the accumulation of money and the self-augmentation of capital, and stimulates the "use" of money rather than the "possession," thereby increasing the velocity of circulation and promoting both buying and selling. Minus interest like Gesell's money (Gesell 1916) to depreciate might be possible in LETS. In this way, the circulation of goods and services within the region is enhanced.

Third, LETS, which takes the form of voluntary issuance by participants, allows participants to issue money as needed for their purchases without being affected by the malicious discretion of central bank issuance and monetary policy or the lending policies of financial institutions. Of course, participants are responsible for their own "commitments" and have to manage themselves, which also stimulates buying and selling.

Fourth, LETS, like markets and the Internet, represents an autonomous distributed network. The whole system is self-organized as a collection of individual buying and selling processes without regard to centralized management or overall coordination. Transactions are bilateral transactions, and pricing is left to the parties involved. Thus, actual valuations can take into account a variety of values other than economic efficiency and profitability with reference to historical and nearby customary prices, such as reciprocity, reproduction, and environmental conservation.

LETS can also pay for services that are generally not priced in the market. It thus promotes non-profit activities and cooperatives by targeting volunteers and 'shadow works' that were not previously traded in money. That is to say, we will be able to vanish the conflict occurring between volunteer and business, and between altruism and selfishness. In this sense, LETS can be conceived as not just economic media but also ethical and cultural media.

#### **4.7 LETS as a Trust Money**

Fifth, LETS is a "trust money" formed by participants' commitment to a "community" and trust among them. Attribution and solidarity of participants are spontaneously fostered based on trust. This allows participants to cultivate creativity and demonstrate originality actively and to confirm their dignity. For example, those who have lost their confidence after losing their jobs will empower themselves by thinking about what they can put on the offer list and developing their capability.

Finally, in LETS, the very meaning of money ownership and choice diversifies. The portfolio mix of multi-LETS in which we participate in and use is no longer determined in terms of maximizing economic value. There is a wide range of potential for cultural, ideological, and normative values to be reflected. Thus, LETS take on the character of social-cultural media beyond economic media. The communication realized as money exchange is gradually more multi-dimensional and complex and approaching linguistic communication. By complementing linguistic communication in a multitude of different CCs, these two forms of communication will not be completely separated, but rather will be combined and integrated as a hybrid.

Such conventional money as cash made people autonomous individuals and formed the basis for liberalism and individualism, but the excessive expansion of liberty as trade and investment in the market led to a decline in linguistic communication and communities. Conventional money also enabled anonymity in transactions, thus forming an area of personal confidentiality. But the spread of credit and debit cards has already shrunk the realm of anonymity, and the fact that credit companies and banks have instant access to personal information could even threaten personal privacy. If it is the case, it might be possible to open up a considerable area of anonymity to many different partial public spaces. LETS discloses information on transactions and balances of all participants, but it is up to the individual to decide what transactions should be conducted at which LETS. In other words, the extent to which an individual opens up to multi-LETS can be freely determined.

#### **4.8 The Limits of LETS**

But as long as LETS depended on manual recording on account books of participants and administration, it is faced with the problem of high costs in terms of troubles using analog technologies.

The rapid spread of such digital technologies and cryptocurrency as smartphones, QR code, blockchain, and mining can contribute to solving such problems found in manual LETS. As cryptocurrencies and token economies gained popularity among people, they started to seek other kinds of value such as people's bonds within communities, eco-friendly products, and simple lifestyles, all of which have wanted in CCs. Accordingly, LETS as integrative communication media has the possibility to expand in such a trend at present.

Nonetheless, the present author believes that the fundamental problem of all kinds of money, including CCs and LETS, until now lies in the fact they are all mono-dimensional, and all values are expressed as one-dimensional plus/ minus quantity. Then people are forced to evaluate the value of goods and services only quantitatively according to monetary costs and visible scarcity and are tempted to pay attention only to the amounts of costs, incomes, and profits. Assets are also estimated in portfolio investment in terms of different one-dimensional currencies.

However, if we can invent multi-dimensional money beyond LETS in order to extend the possibility as the integrative communication media, we can express uniqueness and diversity of value of things and evaluate goods and occupations not only by price/ salary but also by its high quality and safety, social significance, conservation of the natural environment, individual enjoyment. We will be free of uniform measurement that fundamentally causes economic, social, and cultural disasters so that we can adequately express and experience the potentiality of the various richness of our world.

We understand that LETS is a high potential social experiment to overcome defects of money and globalization. But there is still the traditional concept of money in LETS as the one-dimensional quantity that hinders us from seeking the true happiness and developing high QOL based on individuality and diversity of value. There are still vast unknown fields for the future of money that seemed to be no longer remained. But we cannot detect such fields under the prevailing institutions, rules, and concepts that look impossible to change at present. They can only be identified only in a thought experiment in which we assume that they are modifiable. This is the reason why we need to conduct a thought experiment on the future of money.

## **5. Light-Color Money as The Three-dimensional extension of LETS**

We understand that the fundamental defect of conventional money, as well as LETS, is its one- We understand that the fundamental defect of conventional money including LETS is its one-dimensional

representation and create a new concept of money with multi-dimensions that can provide the solution to the various problems caused by such "diabolical generalization" on the "uniform media" as economic instability in bubble collapses and severe depressions, substantial income and asset disparities between individuals and regions, and dissolutions of various community caused by excessive popularization of the spirit of free investment capitalism.

Capitalism is a world in which self-augmenting capital is omnipresent. In order for capital to quantitatively expand, an amount of money should increase. Therefore, a one-dimensional unit for a measure of value to calculate the amount of money, for example, the weight of gold or silver, pounds, dollars, or yen, is required. If such a unit cannot be specified, capital self-augmentation does not make sense. In other words, capitalism is an economic system that derives from the one-dimensional nature of money. Accordingly, to make capitalism cease to exist, we have only to introduce multi-dimensional money.

The question of the system selection between capitalism and socialism in the 20th century was regarded as two binary options of "private ownership and the free market" or "public ownership and central planning," and did not consider the problem of the institutional design of money at all. Even if the market economy is basically premised on private ownership and free markets, it is possible by changing the institutional design of money to create a non-capitalist market economy. It is not a capitalist market economy in which self-augmenting capital is the primary agent, but a non-capitalist market economy in which values are expressed not only quantitatively but qualitatively, and cooperation, exchange, and division of labor are carried out based on such diversity. Depending on the design of the money system, a socio-economy different from capitalism and socialism may emerge.

Based on such a motif, we have considered the problem of designing a monetary system. One example was the Hokkaido Virtual Community Currency. Here "Hokkaido" is not necessarily a geographical area, but a virtual community that consists of people sharing the same value and interest. It is envisioned that the LETS type of virtual regional currency circulated in this area would allow a reciprocal exchange market economy beyond the capitalist market economy. However, even under such an innovative media design of money, there was an implicit assumption about money. The fundamental characteristic of money thus far is that it represents one-dimensional value with positive and negative values. The same is true for LETS. Even in the case of multi-LETS, where an individual or a group of individuals simultaneously participates in mutually overlapping but different LETS and is multi-attributed to many different communities, and individuals or groups of individuals belonging to the same community trade using a community-specific LETS, there are only many types of one-dimensional currency.

In other words, conventional money, including CCs, is a much simpler medium than language and mathematics and is close to numbers. However, it is not a countable set with the same cardinality as natural



numbers, but an uncountable set as the same cardinality as real numbers. The evaluation of pleasure/ displeasure or happiness/ unhappiness with a single scalar currency is to express the richly colored world in monochrome black and white (though, in reality, black and red). The time thieves in Michael Ende's *Momo* bleach the world and turn everything gray (Ende 1985). It is because even if things in the world are multidimensional and richly colored, in other words, they have qualia, the quantitative texture as individual experiences, money evaluates and expresses them all in one dimension. By doing so, we eliminate the singularities that are unique and specified to individual persons and things and reduce them all to sets that are commensurable, replaceable, and substitute. We, just like Momo, cannot feel genuine excitement and happiness in such a dull world without qualia and singularity. Is there any money that can express the most vibrant colors of the world and keep us happy? Here we call such money light-color money and carry out a thought experiment on them.

Now we explore a thought experiment on light-color money and analyze its possible merits and demerits. First, we distinguish monochrome money as conventional money and light-color money as a new one.

- 1) monochrome money (black-red money) is expressed as a scalar that is quantity without direction and has a linear measure of surplus (the black, +), deficit (the red, -), or zero. All conventional money including LETS is based on this idea.
- 2) chrome money (color money) is expressed as a vector that has three elements of three primary colors such as Red, Blue, and Green (RGB) of light, or Cyan, Magenta, Yellow (CMY) of color, each of which is a real number that is zero or larger than 0 (Figure 4).



Figure 4. The three primary colors of light (left) and the three primary colors of color (right)  
 (R: Red, G: Green, B: Blue, C: Cyan, M: Magenta, Y\* Yellow, W: White, K: Black)

Three-dimensional money expresses Light-color as a three-dimensional vector value by using digital technologies. Light-color money represents value as a three-dimensional vector, each component of which is zero or a positive real number, in a three-dimensional space in Cartesian coordinates that are not reducible to each other such as  $(R, G, B) = (1, 1, 0)$  or  $(C, M, Y) = (0.2, 0.3, 0.5)$ .

Any color of light or color can be represented as such a three-dimensional vector because it can be created by mixing three primary colors in a particular ratio. In other words, all colors are linear combinations of primary colors.

What about light-color money? The three primary colors of light make any color when red, green, and blue light are simultaneously projected on the white screen in a pitch-dark room just like a color TV or PC display. Adding light to color in this way is called additive color mixing.

$$W=R+G+B \quad C=G+B \quad M=R+B \quad Y=R+G$$

On the other hand, the three primary colors of color make any color when a mixture of cyan, magenta, and yellow pigments illuminated by white light on a white canvas just like color photographs and inkjet interpreters. Mixing paints to produce different colors means that more light is absorbed, and fewer wavelengths of light are reflected by the paint to reach our eyes. Such subtraction of light to produce color is called subtractive color mixing.

$$K=C+M+Y \quad R=M+Y \quad G=Y+C \quad B=C+M$$

It should be noted that each factor of a vector of light or color takes only zero or positive values and does not take negative values.

What should be recalled here is the relationship between the three primary colors of light and the three primary colors of color. Red, Green, Blue (RGB), which are the three primary colors of light and Cyan, Magenta, Yellow (CMY), which are the three primary colors of color, are complementary colors. Let us denote the complementary color by adding the sign “~” after the color.

In the case of additive color mixing of light, we put

$$\begin{aligned} R + C &= R + (B + G) = R + R\sim = W \\ G + M &= G + (R + B) = G + G\sim = W \\ B + Y &= B + (R + G) = B + B\sim = W \\ C + M + Y &= (B + G) + (B + R) + (R + G) = 2W \end{aligned}$$

In the case of subtractive color mixing of color, we put

$$\begin{aligned} R + C &= R + (B + G) = R + R\sim = K \\ G + M &= G + (R + B) = G + G\sim = K \end{aligned}$$

$$B + Y = B + (R + G) = B + B\sim = K$$

$$C + M + Y = (B + G) + (B + R) + (R + G) = 2K$$

Therefore, when the buyer pays in light-color money, the seller increases the paid color, and the buyer normally decrease the paid color. However, the buyer might be able to increase the complementary color according to the rule of complementary color, instead of decreasing the color. In this case, the color money of, say, Red can turn into the color money of Cyan after the payment of Red like radiation of radioactive elements. It would be possible even though it looks very strange to our common sense in which we think the money must be decreased in quantity after payment. It just depends on whether or not the rule of complementary color is permitted in the system. Also, the original color and the complementary color make “white” in additive mixing of light money and, in contrast, “black” in subtractive mixing of color money as we can see in Figure 4.

Light-color money is a three-dimensional vector written as  $m = (m_1, m_2, m_3)$  in RGB cube and CMY cube with  $K = (0, 0, 0)$  and  $W = (255, 255, 255)$  in 8-bit notation in Cartesian coordinate system depicted as in Figure 5. Therefore, we cannot compare any two vectors of light-color money in quantity. There is simply a difference in brightness of the same color. As to red, there are a dark red  $(1, 0, 0)$  and a bright red  $(255, 0, 0)$ . Similarly, there is dark cyan  $(0, 1, 1)$  or bright cyan  $(0, 255, 255)$ . For monochrome, there is darker gray or brighter gray between black and white.

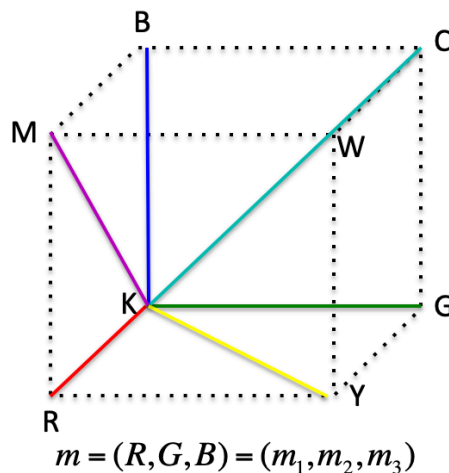


Figure 5 Light-color money in RGB or CWY cube

Both light money and color money is possible, and the difference between them lies in the initial balance of each account, “white” for light money or “black” for color money. While in light money all accounts start from white light, say,  $(R, G, B) = (1, 1, 1)$  in a unit cube, in color money all accounts start from black darkness  $(R, G, B) = (0, 0, 0)$ . Suppose a buyer of a good or service pays 1 in Red in a trade in the case of light money. The red element in the seller's money is incremented by 1 so that its balance will be  $(2, 1, 1)$ ,

and the red element in the buyer's money is decremented by 1 so that its balance will be  $(0, 1, 1)$ . The question is whether the buyer can pay by increasing its complementary color so that its balance will be  $(1, 2, 2)$ , instead of decreasing its paid color, according to the rule of complementary color. If this holds, the scarcity of money that is essential for conventional money is abandoned because the summation of seller's and buyer's accounts is calculated as  $(1, 2, 2) + (2, 1, 1) = (3, 3, 3)$  and  $(1, 1, 1)$  is created in the payment, even though the buyer cannot arbitrarily create any color money as much as possible.

Therefore, the light money is a "vector money" that microscopically represents various colors, but when aggregating all accounts macroscopically, it will always become a "scalar money" as a scalar multiple of the vector of the white light  $(1, 1, 1)$  in light money or black darkness  $(0, 0, 0)$  in color money. Therefore, macroscopically viewed, light money exists but color money does not exist, though both microscopically exist in complementary sets as "light and color", and "color and complementary color". Color money is more similar to LETS where there microscopically exist as the blacks and reds in accounts of participants but no money as the summation macroscopically, according to the zero-sum principle. The sum of the surpluses or deficits in LETS increases in proportion to the square root of the transaction volume if the transactions are randomly carried out (Kichiji, Nishibe 2012)

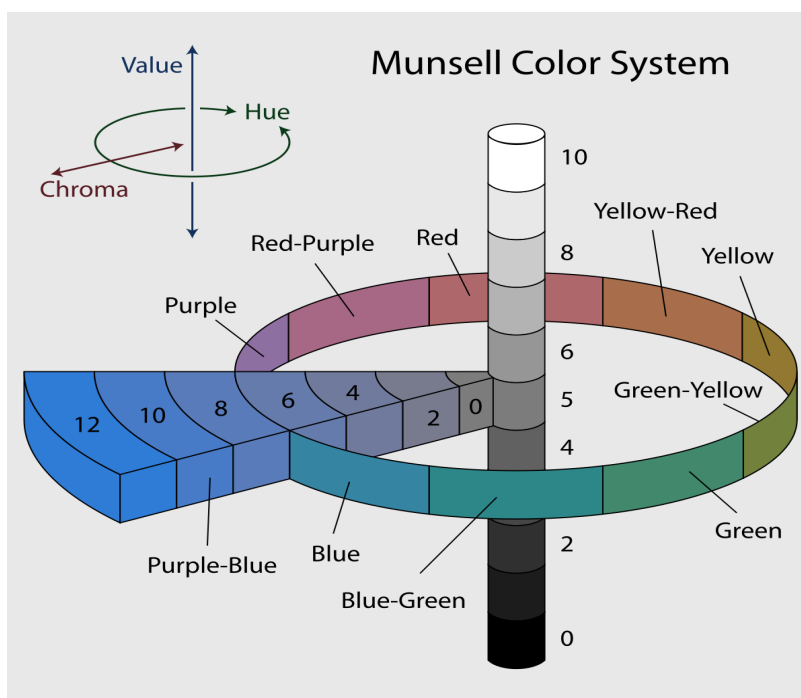


Figure 6 Munsell Color System

The Munsell Color System is a color space to determine color by three properties: Hue, Chroma (color purity), Value (lightness) as in Figure 6. This can also be used to define light-color money differently from

three dimensions in RGB and CWY cubes. In either way, three dimensions are necessary to designate light-color in a color space.

For example, full-time housewives who give birth and raise children do not receive monetary rewards of wages at present. In other words, child-rearing labor is the shadow work that is not valued by money, and this is one of the factors contributing to the ongoing declining birthrate. However, if the central government uses subsidies and evaluates them in legal tender, it cannot be a correct solution. It is because it will only result in accelerating the long-term tendency of globalization that created free investment capitalism as housewives will simply be subsumed as free investors in the capitalist labor market in the same manner that women workers are becoming free investors. However, if the red currency is necessary for the reproduction of the labor-power in the next generation because childcare labor is necessary in order to raise the labor-power in the future, not only the legal tender but also the light-color money as to the red element must be paid for the sale. In other words, wages will include a certain amount of red money. Then, it will clearly indicate that the red money in the vector representation of the price of labor-power has to be accumulated and only used to raise the next generation.

Thus, the one-dimensional price of goods and services does not tell us anything about their ingredients and contents, but it only tells us that they include the costs less than the price and if the price is raised, it tells us the demand is tight compared to the supply, and the production costs might be higher because of shortage of raw materials. However, the vector price of the commodity in light-color money can inform the consumers of more detailed and precise information on, for example, what kinds of elements of production including producible energy, exhausting resources, and labor-power and other services are used to produce the products. The introduction of light-color money naturally would force enterprises to make a broader disclosure on more detailed information on their production and investments because the cost and income have been realized in different elements of light-color money so that such divisions of cost and profit cannot be concealed anymore.

Color money indicates a point as a vector that has three primary colors as its elements. Conventional money is one-dimensional scalar money on a monochrome line. In scalar currencies, the value of a commodity can only be expressed in one dimension. That is to say, only the volume of the value is expressed by the price. However, in the famous example of water-diamond paradox which Adam Smith raised as a problem in “Of the Origin and Use of Money” of his chief book (Smith 1776), it seems to be a contradiction that the low price is given to the water that is indispensable in the life or water has “value in use” without “value in exchange”, and the high price is given to the diamond that is an ornament which is not very significant in the life, or diamond has “value in exchange” without “value in use”. And it is frequently assumed to be solved by introducing the viewpoint of utility or scarcity and, according to their marginal utility depending on the scarcity, giving prices of 100 yen and 1 million yen to each of water and diamond, respectively, and

approving the act of consumers buying them. However, it would not have been such a paradox if each value of water and diamond had been expressed multidimensionally as mutually incommensurable in light-color money from the beginning. For example, if we have two-dimensional vector money whose two components are a) reproducibility and b) scarcity, the value vector is expressed as (a, b). Then water and diamond are expressed as (1000, 0) and (0, 1000). Two factors are not exchangeable in this expression, so these two are incommensurable with vector money. We understand these vector value expressions are more correct and precise.

Now we have to consider what the three coordinates of RGB are. Three primary factors should not be mutually substituted but supplementary and are supposed to be spontaneously and endogenously determined by users, depending on the changes of the particular conditions of people's needs, scarcity, values in the time.

In Classical economics, three primary factors of production are Labor, Capital, and, Land. On the other hand, in the modern era of deindustrialization and environmental conservation, those can be changed to Reproducible (wood, water, food, heat, force, products), Exhausting/ scarce (petroleum, metal, diamond, land), and Information (skills, knowledge, fashion, data, entropy, time).

We emphasized that CCs can be interpreted as integrative communication media with dual aspects of money and language, and that, since money is the most indispensable medium of the modern capitalist market economy, CCs should be strategic targets for evolutionist institutional design in order to solve current social and economic problems caused by global capitalism. We have defined globalization as the long-run tendency of Market as the exchange principle to extensively expand and intensively deepen and of Community as the reciprocity and State as the redistribution principles to reduce and get shallower. We need to coordinate and regain the balance of these three principles such as Market (exchange, freedom, private, blue), Community (reciprocity, fraternity, common, red), State (redistribution, equality, public, white) so as to make the modern capitalist market economy be more non-capitalistic, sustainable and diverse. The introduction of light-color money would include these three principles in the three-dimensional elements and lead to the realization of such harmonized socio-economy.

This is not just the hopeful imagination of the present author. Now we all know that commodities as products or services themselves carry various cultures and values, and we have also experienced that purchase and investment, including buying products related to sustainable development goals (SDG) and environmental, social and governance (ESG) investment, convey not only economic but social-cultural values and messages. Therefore, RGB can be interpreted as the same factors as ESG in investment evaluation, that is, Environment (climate change, biological diversity, conservation of water resource), Social (human rights, labor custom, labor safety, human development, customer responsibility, community,

diversity), and Governance (corporate governance, compliance, risk management). We regard this as the symptom of ascension to higher dimensions of consumption and investment in which both are transformed into the activities searching for multi-dimensional values in terms of social, environmental, and governance satisfaction, not just seeking more diverse products and services and more money. In short, the modern trend of free investment is starting to show that it moves into the direction in which vector money is needed to go beyond capitalism.

## 6. Conclusion

The media design of light-color money as CC is an attempt to reduce the money side as “uniform media” or “one-dimensional media” and add the language side as “diverse media” or “multi-dimensional media” so as to escape from the disaster caused by global capitalism and enrich CCs as integrative communication media.

The introduction of light-color money would 1) prevent money capital and fictitious capital to only seek profit and self-augmentation in terms of quantity as global, speculative, and financial capital (Nishibe 2019), 2) urges corporates and governments to make more complete disclosure on usage of energy, resources, and labor so that consumers and investors can know more about the detailed ingredients of products and investment, 3) enables to conduct more abundant and diverse communication among people and companies based on qualitative information so that they mutual understanding and respect can develop based on exact knowledge on each other, and 4) build more sustainable and diverse society in the non-capitalistic, cooperative market economy.

We expect that it is not difficult to implement and use light-color money in the network of smartphones and computer servers under the current ICT environments and that the representation of light-color money as color symbol similar to QR codes, which are two-dimensional machine-readable barcodes now widely used in cryptocurrencies and digital CCs in Japan and the world, facilitate it to be diffused once it can attract the interests of people. It is worthwhile to conduct a social experiment with the younger generation, who are relatively free from traditional fixed ideas of money and easy to accept an innovative concept of communication media, to test its feasibility and applicability in the real world.

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