# EMBRACING THE COMPLEXITY: MULTIPLE INTERESTS AND DEBATED RESOLUTIONS IN THE PINEAPPLE VALUE CHAIN IN UGANDA

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## ABSTRACT

Strengthening horticultural value chains can be used for improving food and nutrition security while reducing rural poverty. However, the complexity of local situations challenges the effectiveness of blueprint development strategies and calls for actor-oriented approaches. The fresh pineapple value chain in Uganda is illustrative of such a complex situation. The market supply is not organized by dominant lead firms. In contrast, individually negotiated and context specific actor relationships and their purposeful activities form and sustain this human activity system. As value chain actors take multiple factors for their business activities into account, the aim of our system analysis is to elicit their perspectives on the influence of these factors. This provides a more contextualized understanding to inclusively increase local actors' benefits.

We used a systems learning approach, in which farmers, traders, brokers and scientists were seeking a better understanding of the local value chain. Cognitive mapping and additional qualitative methods were used to reveal internally held perceptions about the factors and their influences on income generation from engaging in the pineapple value chain. Several meetings with participants from single actor groups informed subsequent multi-actor meetings: four with farmers (4-8 each) and four with traders (2-7 each). Group cognitive maps served as a starting point for ten meetings which included participants from several actor groups (4-13 each). To foster a feeling of connectedness between actors along the chain, these consecutive multi-actor meetings evolved around the factors and situations that participants had identified as influential to all actor groups, such as prices, markets, quality and communication. Semi-structured interviews and participant observation further complemented the analysis.

The approach resulted in a contextualized picture of how multiple natural, technical and social factors influenced actors' income generation in the pineapple value chain, e.g. farm and market price, market size, quality, seasonality, production methods and skills, buyer-seller relationships and transportation. There was little disagreement about the rationale of the influence of factors during the single actor group meetings. However, the number of factors and the perceived cause-effect relations differed markedly between actor groups. The dialogue during multi-actor meetings revealed different aspects of problem-situations. Participants expressed solutions and also explained barriers to them. For all actors in the chain to profit from their respective business activities, awareness of prices and other

market information is particularly important. However, problematic communication patterns between actors pose current challenges and dissatisfactions. The flow of information was disrupted by the intertwined patterns of changes in prices, supply and demand, along with structural constellations, such as many small-scale farmers, relatively few brokers linking production areas to distant market centers and many, dispersed traders in different markets. Moreover, prices were individually negotiated and generally competitively formed. The occurring fragmentation among actors is a result and also a cause for communication problems, fluctuations and actor relations. The controversial debates regarding proposed solutions, showed that the feedback cycles are difficult for actors to break given the contextual constraints and their conflicting interests.

The participatory activities and shared explanations allowed surfacing of problematic patterns and value chain structures that caused friction and hindered broader collaboration. The approach helped to trigger dialogue and understanding between otherwise often competing market actors. While actors are aware of the benefits from improved collaboration, the gained contextualized system understanding revealed why this is difficult to implement. Participatory system learning can reveal actors' room of maneuver, and contribute to a process that enables actor-driven system change.

## INTRODUCTION

In Uganda, the agricultural sector contributes about one quarter of the Gross Domestic Product (GDP) and the current Agriculture Sector Strategic Plan 2015/16-2019/20 emphasizes the economic potential of improving the horticultural sector, including pineapple production and commercialization (MAAIF, 2016). Strengthening horticultural value chains can be used for improving food and nutrition security while reducing rural poverty.

However, the complexity of local situations challenges the effectiveness of development strategies. Illustrative of such a complex situation, the fresh pineapple value chain in Uganda is not organized by dominant lead firms, but rather, is organized through individually negotiated relationships and actions. Through an actor-oriented systems approach these context specific actor relationships and their purposeful activities form and sustain a human activity system, in this case the pineapple value chain. As value chain actors take multiple factors for their business activities into account, the aim of our system analysis is to elicit their perspectives on the influence of these factors. This provides a more contextualized understanding to inclusively increase local actors' benefits.

We used a systems learning approach, in which stakeholders and scientists seek a better understanding of the local system. Cognitive mapping and additional methods were applied to reveal internally held perceptions about the factors and their influences on pineapple value chain-related income generation. Several meetings with participants from single

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actor groups informed subsequent multi-actor meetings that served as a starting point for meetings which included participants from several actor groups. To foster a feeling of connectedness between actors along the chain, these consecutive multi-actor meetings evolved around the factors and situations that participants had identified as influential to all actor groups, such as prices, markets, quality and communication.

By following an actor-oriented approach and putting actors' perspectives at center, our study aim is two-fold; first to strengthen cooperation and enhance mutual understanding among local value chain actors to encourage actor-driven change and secondly, to gain academic understanding about the complexity of problem-situations and perceptions of value chain actors to identify leverage for systemic value chain improvements. The next section situates our research within value chain conceptualizations from a systems perspective and their respective participatory methods, such as cognitive mapping, to elicit underlying mental models. Thereafter, we describe the study area and the methods used during fieldwork, data collection and analysis. In the results section we start by describing the general actors and activities involved in the pineapple value chain and present then examples from the revealed factors as well as problem-situations. Finally, the results are discussed related to other empirical work on value chain management and participatory value chain approaches.

## LITERATURE REVIEW: SYSTEM LEARNING IN VALUE CHAINS

Food value chains "comprise all activities required to bring farm products to consumers, including agricultural production, processing, storage, marketing, distribution, and consumption" (Gómez et al., 2011, 1154). When commercializing pineapple in Uganda, necessary activities are carried out by multiple actors of different scales, such as farmers, brokers and traders. Their purposeful activities and relations ensure that fresh pineapple reach interested customers. Therefore, the value chain can be conceptualized as a human activity system. A characteristic of such a system is that humans carry out goal-oriented activities to create and transform context dependent situations (Ropohl, 2009). It is through these purposeful activities that actors form the system as a whole (Checkland, 1981) which "serves the purpose of its collective entity, it serves the purpose of its members, and it serves its environment or the larger system in which it is embedded" (Banathy, 1992, 14). Such an understanding leads towards a strong actor-orientation for research operationalization and analysis.

The Ugandan pineapple value chain is a real world situation analyzed as an example to be investigated "with its complexity and uncertainty, where an acknowledged part of the problem is to establish and agree what the problem is, and where there will rarely be a single 'right' resolution" (Reynolds and Holwell, 2010, 8). Problems unfold according to the specificities of the system and the involved stakeholders. Systems can be differentiated in a continuum from simple to complex. When diverse participants play a role, such as in value chains, soft systems methodology is particularity recommended for such complex systems (Jackson, 2002, 359; Reynolds and Holwell, 2010). However, the term complexity is not universally defined. Our understanding draws on complexity theory as "an approach to the modelling of highly complicated and interconnected systems using techniques derived from the physical sciences, with a focus on self-organization, emergence and

nonlinearity" (Ramage and Shipp, 2009, 7). Complexity leads to emergence, which "refers to the arising of novel and coherent structures, patterns, and properties during the process of self-organization in complex systems" (Goldstein, 1999, 49).

To improve system understanding, it is important to bring different epistemologies together (Stokols et al., 2013) and to inspire academic and practitioners' learning. This can motivate sustainable and systemic change. Loeber et al. (2007) explain the potentials of attaining such change through 'system learning'. A concept which is similar to 'system thinking' (e.g. Senge, 1990) and an approach which makes use of the practical value of learning theories (e.g. experimental learning (Kolb, 1984), single, double- and triple loop learning (Schön and Rein, 1994), second order learning (Forester, 1999; Grin and Hoppe, 1995), organizational and system learning (Senge, 1990) and social learning (Röling, 2002)). Aiming for system learning or system thinking in participants, "a project may help actors challenge and redefine the very structures that hinder their progressing…" (Loeber et al., 2007, 97) and "enabling participants to look at the interrelationships between the structures in which they operate and their own practices in a new light…" (Loeber et al., 2007, 95). Typically, participatory (action) research methods are applied to involve numerous people in different social contexts and for different objectives, e.g. methods of rapid rural appraisal, such as participatory mapping and modelling or seasonal calendars, or methods for learning in action, decision analysis and system understanding (Chambers, 1994; Chevalier and Buckles, 2013). An important feature of those methods is visualization and communication through group based analysis, which reveals participants' assumptions and triggers mutual understanding, knowledge integration and learning.

Illustrated by the iceberg model of systems thinking, mental models underlie a systems' structure and the patterns and events it is producing. A mental model is the internal representation of a person's thought process of how something works in the real world and is grounded on individual knowledge, experiences and perception. It is the reasoning about a situation or problem and helps shape behavior including how tasks are carried out and decisions about which strategy to use for problem-solving (Johnson-Laird, 1983, 2004). Mental models reflect beliefs, values and assumptions that persons hold as the underlying reasons why things are done a certain way (Kim, 1999). They are, at the same time, the filters through which experiences and decisions pass and therefore, affect what is seen, and shape perceptions. With regard to the pineapple value chain, actors' mental models influence their actions and thus, shape and sustain this human activity system, with its structures, patterns and events. Even though mental models only exist in the mind, they can be externally represented such as through cognitive maps. This can then be used as a common ground for dialogue and learning.

Cognitive mapping (also called causal mapping) is grounded in the analysis of causal assertions between concepts and an application of Graph Theory. Axelrod (1976) introduced it as a method to understand and improve decision-making in socio-political systems. Additionally, cognitive mapping plays a key role in the canon of problem-structuring methods such as Strategic Options Development Analysis (SODA) (Eden, 1988; Eden and Ackermann, 2004). Eden (1988) builds on the Theory of Personal Construct from Kelly (1955), whereby people continuously strive for sense-making of the world by building a construct system out of detected and repeated themes. Humans seek to explain and understand the world through hierarchically organizing the constructs. Such

systems, or sense-making are specific to each individual person, resulting in different perspectives which are important to share in order to arrive at a common understanding for effective problem-solving (Eden, 1988).

# METHODOLOGY

## Study area

In Uganda for pineapple production are Mukono, Kayunga, Luwero and Masaka districts in the Central Region, and Ntungamo and Kabale districts in the Western Region. These pineapples are produced by smallholder farmers and then are traded through a series of small-scale traders and brokers who differentiate them into chains for local markets, neighboring countries, such as Kenya and South Sudan, and more rarely to Europe, the Middle East and the USA. Most fruits are eaten fresh although some are processed through drying, canning or beverages such as wine and more commonly as *munanasi*, a local cold spiced fruit tea drink.

Even though fieldwork in the frame of the entire research project was carried out in different regions, for the purpose of this paper, we report on the results of the pineapple value chain in Ntungamo District, Itojo Sub-County in the South West. In this region, farmers, traders and brokers mostly belong to the Banyankole ethnic group. Pineapple production, predominantly Smooth Cayenne, is relatively new to this area due to banana bacterial wilt problems without synthetic inputs. Pineapples grown in this region are traded locally throughout the year, marketed to Kampala during the peak seasons and also exported for instance to Rwanda. Further descriptions are given in the results section below.

## Methods and data analysis

The fieldwork done by the first author[1] aimed to trigger system learning by providing space for social learning and knowledge integration. Meetings were organized with participants from actor groups of only one stage of the chain, e.g. only farmers, and with actors from different stages, e.g. farmers, brokers and traders together (see Table 1 for an overview of the meetings). To encourage participation, the methods used and the sequence of meetings were constantly adapted based on the needs of the participants. Therefore, the sequence of the topics to be discussed during the meetings was not predefined by the researchers but emerged from the process through interaction with the participants. These group meetings typically lasted from 2 to 4 hours. Some participants repeatedly came to the group meetings that were organized and others attended only one. Semi-structured interviews with both participants of the group meetings and strategically with individuals who did not attend broadened perspectives considered. Participant observation by the first author informed the organization of subsequent meetings.

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**Table 1 Sequence of meetings in the Ntungamo study site**

| Meeting ID - month and year | Participating actor group(s) | N (m/f) | Method / topic |
|---|---|---|---|
| S1 - 07.2015 | Farmers | 8/0 | Cognitive mapping / factors affecting income |
| S2 - 07.2015 | Traders from collection center Nyaruteme | 6/1 | Cognitive mapping / factors affecting income |
| S3 - 07.2015 | Traders from Mbarara | 2/0 | Cognitive mapping / factors affecting income |
| S4 - 07.2015 | Farmers | 2/2 | Knowledge analysis / causes for low profit |
| S5 - 07.2015 | Traders from collection center Nyaruteme, Ntungamo | 4/3 | Knowledge analysis / causes for low profit |
| S6 - 09.2015 | Farmers | 5/0 | Knowledge analysis / causes for low profit |
| M1 - 07.2015 | Farmers, brokers, traders from Nyaruteme | 8/5 | Group discussions / sharing individual cognitive maps, identification of connecting points |
| M2 - 09.2015 | Farmers, brokers, traders from Nyaruteme | 6/4 | Group discussions / How connecting points relate to different actor groups and selecting one (value addition) |
| M3 - 09.2015 | Farmers, brokers, traders from Nyaruteme | 7/3 | Opportunity tree / ranking of preferred option, causes and effects of making electricity available |
| M4 - 03.2016 | Farmers, brokers, traders from Nyaruteme and Mbarara | 9/3 | Cognitive mapping / factors affecting income |
| M5 - 04.2016 | Farmers, brokers, traders from Nyaruteme | 9/1 | Group discussions / factors influencing pineapple quality |
| S7 - 04.2016 | Traders from Mbarara | 4/0 | Group discussions / factors influencing pineapple quality |
| S8 - 04.2016 | Farmers | 3/3 | Group discussions / information flow table |
| M6 - 04.2016 | Farmers, brokers, traders from Nyaruteme | 5/1 | Group discussions / causes and effects of poor communication |
| M7 - 04.2016 | Farmers, brokers, traders from Nyaruteme | 7/1 | Group discussions / ranking of communication problems and analysis |
| M8 - 05.2016 | Farmers, brokers, traders from Nyaruteme | 6/2 | Group discussions / feedback and reflection of process |
| M9 12.2016 | Farmers, brokers, traders from Nyaruteme | 8/2 | Group discussions / price data and fluctuations |
| M10 12.2016 | Farmers, brokers, traders from Nyaruteme | 4/0 | Group discussions / reporting back from Masaka district visit |

To facilitate system understanding and learning, different participatory and visual methods were used. Group cognitive mapping was a key method and used as starting point for consecutive actor dialogue and learning. Since our aim was to better understand the current situation, the cognitive maps were built around the starting question of *'what influences your income from engaging in the pineapple business'*. Thereafter, participants explained the rationales of these influences, and explained their cause-effect relations. This resulted in the identification and explanation of various influencing factors. By anchoring the start of the model building from the actor groups' specific income generation, and not taking the concept of a whole chain into consideration from the beginning, we aimed to lower the level of abstraction for participants to bring the system influences to light.

Facilitation of group meetings also included team building exercises and systems thinking games, e.g. from Booth Sweeney and Meadows (1995) or other similar activities. These activities were important to increase trust among the participants, since they would not normally meet to discuss and reflect upon their activities and assumptions. In addition, it was supposed to inspire the development of a relational perspective, increase the feeling of connectedness as well as self-efficacy. These games aimed at sparking the participants'

sense of participation in the system (see Scharmer, 2009) and increase empathy to "see the world through the eyes of another" (see Churchman, 1968, 231).

All activities were supported by local assistants for translation and facilitation from the Runyakole language to English. Visual methods to complement the meetings were initially done by the facilitators but later by the participants themselves. Meetings and interviews were audio recorded and later translated and transcribed. Whenever audible, the transcripts indicated male or female voice or the actor group respectively. Maxqda was used for coding, Gephi and Excel for cognitive map graphical data analysis.

## RESULTS

### Ntungamo's pineapple value chain system

In Ntungamo district, pineapple production is seasonal, with harvesting peaks in March-April and September-November. During the 2015-16 fieldwork, two general marketing channels existed: a short local chain and a long-distance chain. The short local chain operated during peak and off-peak seasons although with fluctuations in trade volumes. In this chain, farmers sold to local traders from a nearby collection center (Nyaruteme) and a market place located along the main road. These traders would then grade the pineapples, mainly according to size, and then sell them in bundles of four to passing cars or sell them in bulk to other traders (often wholesalers) from nearby towns, such as Mbarara or Ntungamo. In addition to purchasing from that collection center, traders from nearby towns would also buy directly from farmers. Such relationships mainly existed with farmers who had bigger pineapple gardens. The long-distance chain connects the production area to markets in Kampala, during peak seasons. Thereby, traders from Kampala used local brokers to coordinate the purchases from farmers. Typically, brokers received an order from traders along with the respective deposit. Afterwards, they would purchase the requested amount of pineapples from farmers. In addition to a lump sum which was paid from traders to brokers for their service, brokers would pay for the required logistics to collect the pineapples from the margin between the prices when buying from farmers and selling to the traders. Depending on the volume of pineapples traded to Kampala, the collection of pineapples was organized through several stages of brokers. Recently, the number of brokers in the area increased because of the expansion in demand and production.

A general overview of primary and supporting actor connections is given in Figure 1. Although the actor categories may look discrete in the figure, it is possible for individuals to fulfil functions associated with multiple actor categories e.g. brokers and traders can also farm pineapples or traders from the collection center and farmers could also act as brokers. The overall system is rather flexible such that the final trading channels of most pineapples produced in this region are not predefined but rather depend upon the specific constellation once they are ready to harvest. Most farmers only use natural inputs for production, irrigation is not carried out and flowering is also not forced. Therefore, harvesting happens consecutively whenever fruits are ready.

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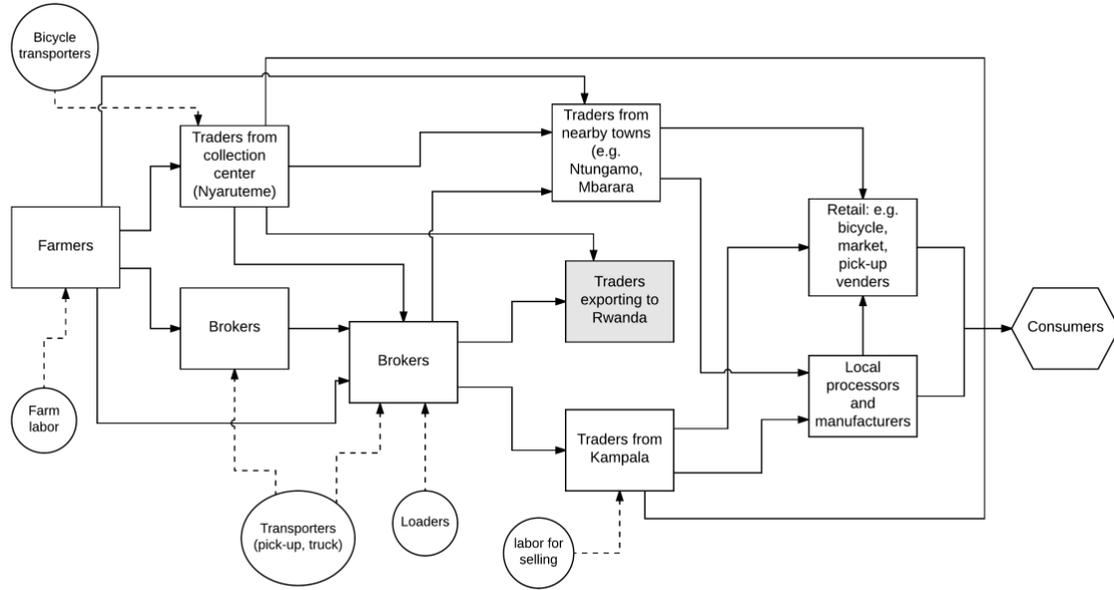


* Rectangular shape for primary actors, round shape for supporting actors, exporters are in grey as their connections were not followed up further

**Figure 1 Overview of connected value chain actors in Ntungamo**

## Cognitive maps revealing factors influencing income

The mapping activities revealed factors (or system components) that farmers, brokers and traders perceived as influential for their income generation. The factors included in the various maps were comprised of natural, social and technical aspects, e.g. farm and market price, market size, quality, seasonality, production methods and skills, buyer-seller relationships and transportation. In table 2 below, a summary of factors that were explained during the cognitive mapping process is presented along with one illustrative quote selected for each actor category. However, these quotes are either from single or multi actor meetings in which the cognitive mapping was done, or from follow-up interviews on themes that emerged during the mapping activities.

**Table 2 Examples of participants' voices in relation to factors that influenced their income generation from pineapple**

| Farmers | Traders (collection center) | Traders (towns) |
|---|---|---|
| Natural factors: climate, soil properties, weather | | |
| *One, now like it's a dry season, the pineapples are very few in the gardens implying that the incomes are low. And in the wet seasons, automatically the pineapples are* | *When it's rainy season, when the bicycles fail to pass in mud, you have to put in a sack and you really sweat a lot. So during the rainy season, it's worse because the* | *That one is because of the, can I call it the area, or the soil. The weather. For us we have a hot weather. We are most times hit by the sun so our soils they differ. So that's why ours* |

| | | |
|---|---|---|
| *many though they are sold at low prices, at least you sell very many and get some good money. (N/f/sm/S1)[2].* | *bicycles can't get their way here [to the collection center] because of the poor roads there [near the farms], so it disturbs (N/t/sm/S2).* | *at least they are harder than those ones of Nyaruteme because we have too much sunshine than those areas of Ntungamo (N/t/sm/S3).* |

Technical factors:
transportation infrastructure, quality, perishability, processing, cultivation methods, handling, market, dominance of pineapple production, technical skills about production and business management, price

| | | |
|---|---|---|
| *When you plant pineapples and you also have to put labor, you find it requires a lot of costs and so when you balance with selling, you find its making you get little money (N/f/sm/S1).* | *Since most of the transportation is by bicycle, the chain could get off and in case you have overloaded the bicycle, it could get a mechanical breakdown or even fully incapacitated before the rider reaches the market. If you look into it carefully, a mechanically broken bicycle increases damages because there are some pineapples that would be quite ripe and some would let off the juice before you reach the market destination. Damaged pineapples fetch very low prices (N/t/mm/M1).* | *When the season produces a lot of pineapple. So you find that sometimes you have nowhere to sell them. We have no factories, whereby we can transport them. We depend on just the local consumers (N/t/sm/S3).* |

Social factors:
communication, relationship management, access to credit, reneged debts, motivation, experience

| | | |
|---|---|---|
| *We sell as individuals but if we were a cooperative, we would say we want 1000 for each pineapple and traders will be forced to buy from us at whatever price we set but I will sell at 1000, the other one will sell at 200. And then it affects us (N/f/sm/S1).* | *If the trader is loyal to the farmer and pays the farmer on time as per agreement, the trader does not stir conflicts between them, it implies that the farmer would give pineapples because of the trust and even if the trader asks for a discount, the farmer would be more willing to give the discount. If the famer reduces for you the prices, it increases the chances of a higher profit margin (N/t/mm/M1).* | *There is also, lack of enough capital. Sometimes, you find that it has taken long without coming to the next season. So the scarcity has prolonged two, or three months. So you have eaten the whole of your capital. So when the season is starting, you have no money… to go and buy in plenty from the farmers, transporting them (N/t/sm/S3).* |

The mapped factors had multiple interrelations and varied according to the degree of how actors were able to influence them. Those, considered of high relevance with regard to how activities were carried out to generate income while actors had little possibility to influence them were particularly constraining. These constraints revealed contextual conditions to which actors adapted. As such, they were system driving and shaping influences. Namely, infrastructure, seasonality, perishability and weather. Examples are presented below (table 3). These are organized to summarize how they influence certain other factors relevant for income generation of the different actors along the chain.

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**Table 3 Influences of selected constraints on the different actor groups**

| Actors \ Constraints | Farmers | Brokers | Traders (collection center) | Traders (towns) |
|---|---|---|---|---|
| Infrastructure (transportation, i.e. road network, road quality, means, distance) | Influences production costs (transport of farm input e.g. mulch), price negotiation, being preferred by buyers, access to information, level of damages | Influences transportation costs, price negotiation, level of damage, buying price, costs for surveying production situation, reaching the field site in person, supplier selection | | |
| Seasonality | Influences quantity of ripe pineapples, farm gate price, price negotiation | Influences activity level, buying and selling price, price negotiation, level of damages | | Influences buying and selling price, turnover, which region to source from, level of damage |
| Unpredictable weather changes | Can cause interruptions of prior arrangements with a buyer, can influence pineapple quality (e.g. sun damage) | Influences available time for activities, can cause interruptions with buyer, transportation problems | Influences selling price, number sold, number to be stored, level of damage | |
| Perishability (defined as something cannot be stored and is subject to fast decay and loss of value, limited shelf-life) | Influences buyer relations, price negotiation, business risk in case pineapples are already harvested and a buyer fails to comply to an earlier agreement | Influences price negotiation, need to work fast and employing additional labor for collection | Influences price negotiation with supplier and customer, speed of selling price reductions, payment of deposits to demonstrate serious buying intension and ensuring supply | Influences the preferred region to buy from, the pressure to sell quickly, the speed of price reductions, payment of deposits to demonstrate serious buying intension and ensuring supply |

The explanations from the actor perspectives showed the different rationales of how the factors influenced their business and led to changes in other factors. Thus, the cognitive mapping activities elicited patterns in certain system components. For example, bargaining power during price negotiation between sellers and buyers shifted between these actors in relation to seasonal fluctuations of production and the particular degree of competition. The strength of this effect was also influenced by the location and accessibility of a farmer and the offered quality and quantity of pineapples. The more remote and inferior the pineapples, the lower the bargaining power of such farmer. Other patterns in system components related to price are outlined further below.

When farmers, brokers and traders mapped their entire chain, the following was identified as influential to all: price (buying and selling prices, price fluctuations), pineapple quality, market and communication. Moreover, a farmer explained that "they are all related because the example of having good quality you need to be having capital and when you have capital you weed in time, add manure and that brings you super quality and all these points we have talked about are related" (N/f/mm/M4) and a trader confirmed "the points connect

everywhere most of them affect each other" (N/t/mm/M4). This shows the awareness of actors about the complexity of influences and the difficulty to disentangle cause from effect, as the factors are linked to each other in feedback loops. Moreover, the activities of the different actor groups relate and influence each other. The identified connection components overlapped with problem-situations, as will be outlined in the next section.

**Identified problem-situations and proposed resolutions**

Problem-situations were identified by asking actors individually about challenges they faced, or they were revealed when actors explained the influence of certain factors during single actor group meetings or, when debate arose during multi-actor meetings. For example, when one actor group expressed a certain need or explained a factor which would improve their situation, the reaction of the other actor groups could indicate to what extent this related to a more general problem-situation in the chain. A constantly erupting point of discussion related to profit margins for different actor groups and price fluctuations. Other debates revolved around the effects of seasonality on the income of farmers versus brokers and traders or to what extent the market would be lacking. In the following sub-sections, different problem-situations with a focus on prices are explained in more detail.

*Debated perspectives between farmers and traders about farm-gate prices*
Farmers commonly perceived the farm-gate price as too low compared to the selling prices in markets. Traders agreed to the relatively high difference, but also explained the reasons for it. Explanations were not only given by traders as to why they increase their selling prices, but also by some farmers who had sympathy with traders and their need to sell for higher prices. This is shown, for example, in the following dialogue from a multi-actor group meeting:

> *Trader: yes you may purchase someone's pineapples and they give them to you at Ugx. 700, and the same individual goes to the market and sells four pineapples at Ugx. 16,000 which is divisible to be Ugx. 4000 per sold pineapple. So, the farmer would logically be at a loss compared to the trader* (N/t/mm/M1).

> *Farmer 1: ...The trader has managed to even double the prices of the pineapples. The farmer will remain disadvantaged all the way because the trader still remains to get more* (N/f/mm/M1).

> *Farmer 2: the farmer faces very negligent loss potential. Traders on the other hand have a lot of challenges they face. This is because they will have to pay off the farmer, then unfortunately they could have transport problems such as mechanical breakdown. ... It is not however right to think that traders are all about making profits all the time. Actually, traders technically make more losses compared to the farmer (laughter among group)* (N/f/mm/M1).

> *Farmer 3: I have an experience with this because I am a pineapple farmer and a trader. Traders get astronomical profits while farmers get negligible profits or losses. Farmers have to budget their capital. To produce pineapples, the farmer has to get suckers, plant them, and take care of them for quite a long time, which is about 1 and a half years. Then the farmer sells each pineapple at Ugx. 700. A trader on the*

*side would come in the morning and buy pineapples from you at Ugx. 700 and sells it at Ugx. 1500 with a margin of Ugx. 800 and profits within about three and four hours. So, if you compare the time invested by the farmer and that invested by the trader, the trader is at a profitable level. So, the trader makes much more profit than the farmer… That's why you see that if someone is trading pineapples, they shall approach the farmer and within 5 years, they shall be much better economically than the farmer. That's why you may typically see traders to be more rich than farmers* (N/f/mm/M1).

As shown in the multi-stakeholder dialogue, prices and respective market information were of high concern to all. Actors had different assumptions about how prices were built and what influenced the price they received and hence, their income. Prices were commonly individually bargained between buyers and sellers. Hence, price information was only valid for a very short period of time which limited planning reliability and increased business risk. This price uncertainty particularly challenged farmers who described it in the following way:

> *Now that's the problem with traders. Because you will come tricking and convincing me that the price has gone down and you are buying at Ugx. 800 but on the same day, you buy from another farmer at Ugx. 1,000. Now, at my field, the pineapples had no market while at the other farmers', the pineapples gained market? What is that, yet it's the same day?… [So, since…] we [farmers] don't know how much they [traders in Kampala] will give you [a broker] once you deliver pineapples in Kampala. Now what we require of you is that if you buy from one farmer at Ugx. 1,000, also buy from the other farmer at Ugx. 1,000!* (N/f/mm/10).

Traders as well as other farmers responded and provided several reasons, for such differences. For example, "people are not the same because if I [broker] come to you and offer Ugx. 1,000 and you accept, that's ok. But there is another farmer where I will offer Ugx. 500 to clear the whole garden and he will accept even if I was buying at Ugx. 1,000. And I will still buy even if he wants Ugx. 700. That's what he wants though my limit is Ugx. 1,000" (N/b/mm/M10). It indicated that because every person had their own restrictions, price variations seemed inescapable while each transacting partner sought to maximize their own profit.

Other reasons for spatially different farm-gate prices included variations between brokers and traders with regard to their experience. Those with less experience tended to anticipate unrealistic market prices and would send misleading price signals to farmers. As residents of the farmers' communities, brokers had relationships with farmers. This allowed both sides to learn and understand the other partners' bargaining. For instance, brokers could agree to pay higher prices to a certain individual while paying a lower price to another one. Vice versa, farmers would also take advantage of such assessments. Location is another example that led to price differentiation. Transportation costs and logistics to reach each farmer varied. Another reason for price differences was pineapple quality; in terms of size and the number that could be bought from one farmer. A higher number eased logistics and therefore allowed brokers to pay a higher price. Furthermore, brokers would buy for different end markets in which prices were also different. Urgency on the part of buyers to collect a certain number of pineapples increased their willingness to pay higher prices.

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Farmers and brokers assessed the general situation in terms of the ratio between suppliers and buyers, influencing price negotiation on both sides. Prices would also vary when buyers took advantage of farmers who did not know the current price for pineapples. Especially prone were farmers located in more remote areas. Related to this problem, a broker openly responded to farmers during a meeting, "For example I know that you [farmer] don't have a phone and the last price you know is Ugx. 500, yet today, the pineapples are at Ugx. 1,000. So I will quickly rush to you and convince you how bad the market is, and we agree on the price" (N/b/mm/M10). However, traders were also aware, that in order to establish long term relationships, price offers could not be too discriminatory.

Partly because of the spatially different farm-gate prices, another problematic situation would occur when farmers received higher price offers from buyers unexpectedly. In such situations, farmers could choose to sell to a buyer with a higher price offer, despite an earlier agreement with another buyer. This then posed a particular challenge to buyers, i.e. brokers or traders who could get 'cut out' from the chain. A farmer explained:

> *Why it's like that is because the first broker will be convincing that really the market has gone down, and you will fall for that. So when another one comes and adds Ugx. 200, you don't bother to call the first broker because he offered his best [price] yesterday... which means you will sell to the one that offers the highest price. So when they [brokers] reach the market and the pineapples flop or don't sell as expected. It's on them because they are the ones that started the different price* (N/f/mm/M10).

Actors had different perceptions as to what was the root cause of these disagreements. While traders and brokers would blame farmers for not being honest, farmers would still dedicate the cause to the buyers because their different price offers were perceived as not giving the correct information in the beginning.

Other problem-situations arose when price agreements were broken. Reasons for this included challenges in transportation; the unmaintained road network could influence the buyers' ability to inspect the pineapples prior to making the price negotiation to assure quality. A broker explained during a meeting how this could result into a dilemma for him: "even me who is going to talk to a farmer and give him information, I might refuse to go there because it's far and very bad roads, you have not even known the size of the pineapples you are going to buy from that area but you just accept but when you come tomorrow to get the pineapples after cutting them, you start wondering, you find I said Ugx. 500 yet they [the pineapples] should be at Ugx. 300 only and so you find I have not spoken the truth. And you find my relationship with the farmer is not good" (N/b/mm/M7).

*Debate over suggested measures to resolve price problems*
Spatial differences in prices were potentially negative to either buyer or seller. From the perspective of farmers, potential solutions proposed included methods to inform them of prices in a more timely manner, or the enforcement of uniform prices through cooperative societies. A farmer explained how such a cooperative could advantage different actor groups: "when we form cooperatives, there would be a chance to sell our pineapples at fixed prices and on the other side the buying party [trader] would be compelled to seek

other markets regionally and internationally. They would… seek these other higher level markets and this would be beneficial both to the farmers and the traders" (N/f/mm/M1). Additionally, farmers perceived cooperatives as a possibility to mitigate some of their marketing risks. Despite such compelling advantages, dialogue shed light on perceived constraints to such resolutions, such as explained by a trader: "Now, if you say that farmers should have a fixed price for the pineapples, it will affect me so much as a trader because my customers may be used to my price so if a farmer charges me a lot, I may bring them here and get losses and my business will collapse" (N/t/mm/M2). Traders retorted that different end market prices and logistics costs for supplying certain markets necessitated flexibility for their price setting. Farmers also expressed reasons why it would be difficult to implement uniform prices or bargain collectively. For example:

> *As a farmer I don't like it because I may be having a good garden and big pineapples and I say that they are Ugx. 1000 each. Then the person who has a bad garden and small pineapples will also sell at Ugx. 1000, so that means the person who grows pineapples well and the person who doesn't grow them well will have the same amount of Ugx. 1000. So, I think the price should be set depending on the size of the pineapple and the appearance. That should determine the price (N/f/mm/M2).*

Offering a constructive resolution, another farmer suggested developing a grading system through which there could be different prices for different grades. More difficult to overcome, however, were negative past experiences with cooperatives. A farmer highlighted why cooperatives were not common, "I would say, it's because of the bad incidents that were set by coffee farmers… they had a strong cooperative union but it broke away because of politics, it broke down and now because of that example, when you tell people to sell as a group, they seem to say that but… our organization for coffee was destroyed on the way and what about this one now" (N/f/sm/S1).

In problem-situations, in which farmers received higher price offers and sold their pineapples despite prior agreements, brokers were negatively affected. As resolution, brokers asked farmers to inform them in such cases and to allow them to offer them a higher rate through a counter offer. Some farmers additionally stressed the need for a strong relationship between farmers and brokers, so that such tensions could be avoided. Improved collaboration also related to agreeing to a fair distribution of profit margins. For example, a farmer explained, "when the Baganda people [outside traders] come to me; I will call... the broker, and tell him about the current Baganda situation so we can all work together. Like I have set aside Ugx. 100 for you as a broker and the rest from the Baganda go to me, so that you don't fail to earn a living" (N/f/mm/10). However, such communication appeared to be rare, as brokers, on the other hand shared their experiences. According to them farmers would hardly be willing to compromise some of their profits. Another proposed resolution to this problem was for farmers to be held to the first agreement and then to only sell any pineapples that were left after the first buyer. An overall constraint was that each resolution discussed above would mean that at least one side would have to forgo profits.

For prices not to change after an agreement was set, a farmer suggested that: "if he [buyer] comes to the garden by himself, he would be able to inform him in time and also… he

would have to tell him [farmer] the truth" (N/f/mm/M7). This was supported by a trader: "because if someone could come in person to the garden and look at the size of the pineapples, he could not be able to change his words" (N/t/mm/M7). However, participants agreed that it would actually be hard to enforce buyers visiting their suppliers. Partly because of the already described infrastructural constraints.

The different participatory activities helped to elicit actors' views and assumptions on factors influencing income generation. While single group sessions often did not result into much debate on the cause-effect relations of certain influences, multi-actor meetings by contrast did. They helped revealing problem-situations as well as opportunities relevant for all actors along the chain. Even though the process did not result into documented collaborative action and testing, the consecutive meetings and dialogue improved the understanding about the functioning and set of contextual constrains of the value chain. The positive feedback, which participants shared during meetings and individual follow-up underpinned the importance of participatory research. During meetings, participants expressed a desire for more learning opportunities. They specifically appreciated the opportunity to meet and discuss with other actors from the chain. For example, a farmer said: "this meeting has been impactful… it has made me happy because it was two sided. You see you used to meet us and you find maybe it's the farmers alone, or the traders alone. But today, we are all represented and it's good" (N/f/mm/M10). Traders alike valued "that we meet and shared knowledge as a group so that she [researcher] gains and we also gain from it" (N/t/mm/M8).

## DISCUSSION

Value chain approaches are an important market-oriented instrument for strengthening agriculture based economies, improving food security and increasing income generation. They are indispensable in international development policy and cooperation (Altenburg, 2007; Stamm and Drachenfels, 2011) and the investigation of food value chains has been gaining momentum. However, how to design effective interventions and facilitate innovations is still controversial (Devaux et al., 2016; Humphrey and Navas-Alemán, 2010; Stoian et al., 2012). Even though the importance of considering the context and ensuring participation is widely acknowledged, understanding the constraints perceived by value chain actors, how they influence their activities and would relate to potential interventions, is still limited. In addition, research specifically addressing issues on agri-fresh produce is still less well explored and often only looking at specific problems in isolation rather than being integrative (Shukla and Jharkharia, 2013). The authors argued that unravelling interdependencies would be needed to better understand supply chains[3]. To better understand messy real world situations and build systemic change on actor's agency, i.e. within their current scope of activities, our study addressed these gaps by using a systems approach and participatory investigated the complexity of the pineapple value chain. The analysis revealed several natural, technical and social factors that actors of the pineapple value chain considered influential to income generation and hence, shaped their activities and the pineapple value chain as a whole system. The influences and their cause effect relations were highly interrelated. This complexity underlines that before interventions to improve actor's benefits can be suggested, it is necessary to understand the current situation better.

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Particularly influential for the system were: infrastructure, especially transportation; seasonality; weather changes; and perishability. The relevance of these factors is acknowledged in supply chain and value chain management literature and especially for agri-fresh produce (Shukla and Jharkharia, 2013). For example, perishability and short shelf life of the commodity is seen as an intrinsic and typically challenging issue, especially in the absence of temperature controlled transportation and storage facilities or pricing pressures (Chandrasekaran and Raghuram, 2014). Taking the example of India Chandrasekaran and Raghuram, concluded that constraints "arise more out of economic issues rather than the lack of understanding or will" (Chandrasekaran and Raghuram, 2014, 176). They further suggested that gaps should be filled by "levers such as product conversion and pricing and information technology, rather than by focusing on storage and inventory issues" (ibid, 176). These system drivers make venturing into the pineapple business potentially risky and need particular attention before attempting interventions in highly competitive and resource-constrained business environments.

Several problem-situations were identified for the pineapple value chain, and of particular importance were interrupted communication and information barriers. In their literature review on agri-fresh supply chains, Shukla and Jharkharia (2013) identified fragmentation and the lack of information sharing between stakeholders particularly detrimental because if led to a mismatch between supply and demand. In the context of emergent markets and in a whole chain study on Greek organic citrus, Anastasiadis and Poole (2015) found the flow of information also specifically problematic and hindering transformations in the value chain. They suggested promoting human predispositions and learning processes instead of only focusing on external environment or policy interventions. In the pineapple supply chain in Benin information asymmetry between farmers and buyers and along low bargaining power of farmers, was a major factors affecting the income generation of farmers (Arinloye et al., 2016). Therefore, farmers' willingness to pay for mobile phone-based market information on price and quality was assessed. They found that farmers would be willingness to pay a premium of up to US$ 2.5 per month. However, Arinloye et al. additionally stressed the need for strengthening infrastructure and a more supportive institutional environment. Likewise, our analysis also highlighted the relevance of improving information flow. Participatory methods, including cognitive mapping, triggered dialogue and revealed how various factors and different actor perspectives resulted in particular patterns and challenges experienced in agri-fresh value chains.

Applying actor-oriented and participatory approaches, such as multi-stakeholder dialogues or participatory action research, in value chain analysis bears benefits and risks. Ribeiro and Zwirner (2010) assessed a participatory supply chain analysis which also included causal mapping for the commercialization of paper mulberry bark in Laos and concluded that this method facilitated joint problem-solving and "allowed participants to evaluate their initial assumptions, investigate institutional barriers, gather new information and realize some of the interdependencies among supply chain participants" but due to the "lack of legitimate representatives, the failure to convince important stakeholders to participate, distances between participants, the length and breadth of the supply chain", joint action was limited. The same authors recommended to use this method therefore only when studying supply chains of niche products. A participative and systemic approach had been used for example in the development of the livestock sector development plan in Nepal and the authors concluded that it would be still necessary to continue the process of learning in

order to achieve the required shift in institutional strategy and that it was necessary to improve participation and ensure critical reflection between planning and action iterations (Macadam et al., 1995). Similarly, a systems learning approach was also used to encourage innovation in two poultry subsectors in the Netherlands. In this case participants also only defined few innovation opportunities and no options for collective action, which may have resulted from the representation of actors in the workshops. However, collective system analyses was still valuable even if not all relevant actors can be brought together at the same time (van Mierlo et al., 2013). Such putative drawbacks could, however be seen in light of reflexive research. It has been emphasized that in order to support empowering participation "researchers must 'let go' of their power, control and personal agenda" (Godden, 2017). Córdoba-Pachón (2011) reflected on the use of systems methodologies to facilitate intervention and the integration of human experience based on Varela's ideas of autopoiesis. He similarly concluded that facilitators "need to let go of the absolute nature of their roles and methods employed", they need to attach and detach from it according to the situation, and not stringently follow system methodologies prescriptions but rather improve based on experience. It highlights a potential dilemma when participatory projects are bound and need to hold too strongly to pre-set objectives. In this respect, the engagement of actors in our study adapted to the pace and needs of participants, which at times challenged the researchers own set of constraints, required the revision of initial plans and limited the possibilities to arrive and joint action or experimentation. However, despite that the study remained at an analytical level, based on participant's feedback and their learning experiences it can serve to stimulate actor-driven change.


## CONCLUSIONS

We used a systems approach, including participatory cognitive mapping, to elicit the perspectives of actors in the Ugandan pineapple value chain on how multiple factors influence and shape their income generation from engaging in the chain and to facilitate dialogue and knowledge integration among participants. We demonstrated how this revealed the complexity of the current situation. It resulted into a contextualized picture of interrelated issues, including natural, technical and social factors, e.g. farm and market price, market size, quality, seasonality, production methods and skills, buyer-seller relationships and transportation. Often, these issues are addressed in isolation in supply chain management literature and this study contributes an integrative perspective and highlights interrelations, which reveal potential trade-offs and challenges of single-sided interventions.

With a focus on actor connecting issues, the possibility of dialogue among actors from within the system, helped improve mutual understanding and brought internally held assumptions to light. It showed congruent and contradicting perspectives between actors. The multi-actor meetings revealed problem-situations in the value chain and how respective suggested resolutions would be constrained. Communication and information flow was particularly debated and difficult to disentangle in terms of cause-effect relations and which actors would influence. The analysis however showed, that the flow of information was disrupted by the intertwined patterns of changes in prices, supply and demand, along with structural constellations, such as many small-scale farmers, relatively few brokers linking production areas to distant market centers and many, dispersed traders

in different markets. This was amplified by the competitive and individually formation of prices. A feedback cycle emerged whereby, the occurring fragmentation among actors is the result and also part of the causes for communication problems, observed fluctuations and actor relations. Proposed solutions, such as collective bargaining or establishing uniform prices was controversially debated. This highlights how establishing closer collaboration among actors is difficult when contextual constraints and conflicting interests are taken into consideration.

The presented approach did not result in joint action or problem-solving among actors. This can partly be attributed to the limited time frame of the research and also to the complexity which emphasized the importance of gaining a deeper understanding and iteratively adopting to the needs of participants. However, both scientists and participants learned by sharing explanations. This allowed the surfacing of problematic patterns and value chain structures that caused friction and hindered broader collaboration among the value chain actors. The approach initiated dialogue and understanding between otherwise often competing market actors. Despite the challenges and limitations, participatory system inquiries are important for paving the way for actor-driven system change.

### ENDNOTES

[1] Field work during July to October 2015 was jointly carried out with the Master's student Katharina Bitzan.

[2] To anonymize the respondents, the code behind direct quotes in the results section abbreviates where the interview or meeting took place, if in Ntungamo (N), Masaka (M) or Kampala (K), whether the statement was given by a farmer (f), broker (b) or trader (t), during a multi actor meeting (mm) or a single actor meeting (sm) and the respective record number. For example, N/f/mm/M10.

[3] Since the term value chain is not used consistently in the body of literature relevant for our discussion, we also remained with the term supply chain whenever the particular literature was using this term.

### ACKNOWLEDGEMENTS

# REFERENCES

Altenburg, T. (2007). *Donor approaches to supporting pro-poor value chains. Report pre-pared for the Donor Committee For Enterprise Development, Working Group On Linkages And Value Chains,* German Development Institute, Bonn, Germany.

Anastasiadis, F., and Poole, N. (2015). Emergent supply chains in the agrifood sector. Insights from a whole chain approach, *Supply Chain Management: An International Journal*, 20(4):353–368.

Arinloye, D., Linnemann, A.R., Hagelaar, G., Omta, S., Coulibaly, O.N. and van Boekel, M. (2016). 4. Willingness to pay for market information received by mobile phone among smallholder pineapple farmers in Benin, in *Quality and innovation in food chains*, (J. Bijman and V. Bitzer, eds.), Wageningen Academic Publishers, The Netherlands.

Axelrod, R. (1976). *Structure of decision: The cognitive maps of political elites,* Princeton University Press.

Banathy, B.H. (1992). *A systems view of education. Concepts and principles for effective practice,* Educational Technology Publications, Englewood Cliffs, N.J.

Booth Sweeney, L., and Meadows, D. (1995). *The systems thinking playbook. Exercises to stretch and build learning and systems thinking capabilities,* University of New Hampshire, Durham, N.H.

Chambers, R. (1994). The origins and practice of participatory rural appraisal, *World Development*, 22(7):953–969.

Chandrasekaran, N., and Raghuram, G. (2014). *Agribusiness supply chain management,* CRC Press, Boca-Raton.

Checkland, P. (1981). *Systems thinking, systems practice,* Wiley, Chichester.

Chevalier, J.M., and Buckles, D.J. (2013). *Handbook for participatory action research, planning and evaluation,* SAS2 Dialogue, Ottawa.

Churchman, C.W. (1968). *The Systems Approach,* Dell Publishing Co., New York.

Córdoba-Pachón, J.-R. (2011). Embracing Human Experience in Applied Systems-Thinking, *Systems Research and Behavioral Science*, 28(6):680–688.

Devaux, A., Torero, M., Donovan, J. and Horton, D., eds. (2016). *Innovation for inclusive value-chain development: Successes and challenges,* International Food Policy Research Institute, Washington, DC.

Eden, C. (1988). Cognitive mapping, *European Journal of Operational Research*, 36(1):1–13.

Eden, C., and Ackermann, F. (2004). *Making strategy. The journey of strategic management,* Sage, London.

Forester, J. (1999). *The deliberative practitioner: Encouraging participatory planning processes,* Mit Press.

Godden, N.J. (2017). The Participation Imperative in Co-operative Inquiry. Personal Reflections of an Initiating Researcher, *Systemic Practice and Action Research*, 30(1):1–18.

Goldstein, J. (1999). Emergence as a construct. History and issues, *Emergence: Complexity and Organization*, 1(1):49–72.

Gómez, M.I., Barrett, C.B., Buck, L.E., Groote, H. de, Ferris, S., Gao, H.O., McCullough, E., Miller, D.D., Outhred, H., Pell, A.N., Reardon, T., Retnanestri, M., Ruben, R., Struebi, P., Swinnen, J., Touesnard, M.A., Weinberger, K., Keatinge, J.D.H., Milstein, M.B. and Yang, R.Y. (2011). Agriculture. Research principles for

developing country food value chains, *Science (New York, N.Y.)*, 332(6034):1154–1155.

Grin, J., and Hoppe, R. (1995). Toward a comparative framework for learning from experiences with interactive technology assessment, *Organization & Environment*, 9(1):99–120.

Humphrey, J., and Navas-Alemán, L. (2010). Value Chains, Donor Interventions and Poverty Reduction. A Review of Donor Practice, *IDS Research Reports*, 2010(63):1–106.

Jackson, M.C. (2002). *Systems Approaches to Management,* Springer US, Boston, MA.

Johnson-Laird, P.N. (1983). *Mental models: Towards a cognitive science of language, inference, and consciousness,* Harvard University Press.

Johnson-Laird, P.N. (2004). The history of mental models, in *Psychology of reasoning: Theoretical and historical perspectives*, (K. Manktelow and M.C. Chung, eds.), Psychology Press.

Kelly, G.A. (1955). The Psychology of Personal Constructs. A Theory of Personality, Norton, New York.

Kim, D.H. (1999). *Introduction to systems thinking,* Pegasus Communications Waltham, MA.

Kolb, D.A. (1984). *Experiential learning: experience as the source of learning and development,* Prentice Hall, Englewood Cliffs, NJ.

Loeber, A., Mierlo, B. van, Grin, J. and Leeuwis, C. (2007). The practical value of theory. Conceptualising learning in the pursuit of a sustainable development, in *Social learning towards a sustainable world. Principles, perspectives, and praxis*, (A.E.J. Wals, ed.), Wageningen Academic Publishers, The Netherlands.

MAAIF (2016). *Agriculture Sector Strategic Plan 2015/16-2019/20.*

Macadam, R., van Asch, R., Hedley, B., Pitt, E. and Carroll, P. (1995). A case study in development planning using a systems learning approach. Generating a master plan for the livestock sector in Nepal, *Agricultural Systems*, 49(3):299–323.

Ramage, M., and Shipp, K. (2009). *Systems Thinkers,* Springer London, London.

Reynolds, M., and Holwell, S. (2010). Introducing Systems Approaches, in *Systems Approaches to Managing Change: A Practical Guide*, (M. Reynolds and S. Holwell, eds.), Springer London.

Ribeiro, M.M., and Zwirner, W. (2010). Applying Participatory Processes. Findings from a Supply Chain Analysis on the Commercialisation of Paper Mulberry Bark in Laos, *Systemic Practice and Action Research*, 23(4):323–340.

Röling, N.G. (2002). Beyond the aggregation of individual preferences. Moving from multipe to distributed cognition in resource dilemmas, in *Wheelbarrows full of frogs: social learning in rural resource management: international research and reflections*, (C. Leeuwis, R. Pyburn and N.G. Röling, eds.), Koninklijke van Gorcum.

Ropohl, G. (2009). *Allgemeine Technologie. Eine Systemtheorie der Technik,* Univ.-Verl. Karlsruhe; Univ.-Bibl., Karlsruhe, Karlsruhe.

Scharmer, C.O. (2009). *Theory U. Learning from the futures as it emerges,* Berrett-Koehler, San Francisco, Calif.

Schön, D.A., and Rein, M. (1994). *Frame Reflection. Toward the Resolution of Intracable Policy Controversies,* Basic Books, New York.

Senge, P.M. (1990). *The fifth discipline. The Art and Practice of the Learning Oganization,* Currency Doubleday, New York.

Shukla, M., and Jharkharia, S. (2013). Agri-fresh produce supply chain management: a state-of-the-art literature review, *International Journal of Operations & Production Management*, 33(2):114–158.

Stamm, A., and Drachenfels, C. von (2011). *Value chain development. Approaches and activities by seven UN agencies and opportunities for interagency cooperation,* ILO, Geneva.

Stoian, D., Donovan, J., Fisk, J. and Muldoon, M. (2012). Value chain development for rural poverty reduction. A reality check and a warning, *Enterprise Development and Microfinance*, 23(1):54–60.

Stokols, D., Lejano, R.P. and Hipp, J. (2013). Enhancing the Resilience of Human-Environment Systems. A Social Ecological Perspective, *Ecology and Society*, 18(1).

van Mierlo, B., Janssen, A., Leenstra, F. and van Weeghel, E. (2013). Encouraging system learning in two poultry subsectors, *Agricultural Systems*, 115:29–40.