

**DOES MODERNIZATION OF THE RICE VALUE CHAINS IN SENEGAL ILLUSTRATE A MOVE TOWARD
THE ASIAN QUIET REVOLUTION?**

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Abstract

Research conducted in Asia by Reardon et al. (2012) reveals the modernization of value chains, brought about by the midstream segment which implements technical changes and integrates new functions. The purpose of this paper is to analyze the dynamics of the rice value chain in Senegal, in order to assess if it follows the same trends as in Asia. We use the “Global Value Chain” theoretical framework (Gereffi, Humphrey et Sturgeon, 2005), which highlights the influence that one actor can have on the distribution of tasks and skills among the various partners. The dynamics of governance was analyzed from a historical point of view, based on previous research and 121 in-depth qualitative interviews. Our work also calls upon 975 quantitative interviews with farmers, rice millers and traders. We find that historically, public policies and links to global markets are the main drivers of changes in governance. Since 2007, the rice value chain is in step with the modernization taking place in Asia, with increased investments being made in processing and vertical integration. Nevertheless, the modernization is vulnerable to competition from global markets, and therefore dependent from State intervention. These results raise the question of performance: we present our ongoing quantitative research on the impacts of governance on the income and food security of producers, the distribution of added value along the chain and the impact of agribusinesses on small scale producers.

Key words: Value Chain; Modernization; Rice; Africa; Governance;

Code JEL: B520 ; O14; O17; O33 ; O55 ; Q13

1. Introduction:

Domestic food chains (DFCs) in developing countries are called upon to connect unstable production sources with growing demands in terms of quantity and quality. The modernization of food chains in Africa (in terms of standards and contractual arrangements) was mainly documented for global value chains (see for example Jaffee et Gordon, 1993 ; Maertens et Swinnen, 2009 ; Minten, Randrianarison et Swinnen, 2009). This modernization may have significant impact on small-producer inclusion and incomes, but its effects remain uncertain (Reardon et al., 2009) and few works were realized about domestic food chains.

In Asia, research conducted by Reardon et al. (2012) revealed that the modernization of rice and potato value chains was enhanced by State interventions and fueled by the midstream segment that invested in modern rice milling machines and cold storage facilities. This segment also brought in certain functions.

In Africa, scientific evidence on transformations of agricultural value chains along the same path is limited. Available research rather documents the dominance of relational governance as a way of coping with high instability of supply and demand (Soullier, 2013). Yet, since the first world food crisis, governments in Africa aim at modernizing domestic value chains to reach self-sufficiency.

The history and present situation of the rice value chain in Senegal seems to provide a good case reflecting what has been observed in Asia. The purpose of this paper is to review the dynamics and organization of this value chain, in order to assess if it follows the same trends as what has been described by Reardon et al. (2012). A comparison can highlight the conditions under which the institutional and economic environment (such as State intervention) enhances the modernization of food chains. We use the “Global Value Chain” (GVC) analysis framework (Gereffi, Humphrey, and Sturgeon, 2005), which highlights the influence that one actor in a steering position within the food chain can have on the distribution of tasks and skills among the various partners.

In what follows (section 2), we go into more detail on the modernization described in Asia. Then we outline the conceptual framework (section 3) and methodology (section 4) of our analysis. We further present (section 5) the functional organization of the value chain and (section 6) the change in governance. We then discuss (section 7) if the “Quiet Revolution” is ongoing in Senegal by comparing with the Asian change, and present policy implications. Finally (section 8), we conclude and introduce the next step of our work which aims at assessing the impact of contracts on farmers’ income and food security.

2. Documented changes in food chain governance in Asia and Africa

2.1 The Quiet Revolution in Asia

The modernization of rice and potato chains was recently documented in India, Bangladesh and the People's Republic of China (Reardon et al., 2012a). The issues addressed are the transformation of the organization of these chains, the change of behavior in the different segment members and the inclusion of small-scale actors. The benchmark situation is little described. It refers to two types of value chains, the most traditional one being "geographically and intermedationally short", and located in rural areas, and the second one being "geographically and intermedationally long", and supplying cities (Reardon et al. 2012, p271).

"The Supermarkets revolution" highlighted a change in the organization of food chains as the result of increased power from the downstream segment (Reardon et Berdegué, 2002 ; Reardon et al., 2003 ; Hernández, Reardon et Berdegué, 2007, etc.). On the contrary, "the quiet revolution" (Reardon et al., 2012a) shows a change in governance driven by the midstream segment.

Two factors exogenous to food chains in Asia were determinant in their evolution. First "public policies were important in enabling and at times providing incentives for the transformation" (Reardon et al. 2012, p22). The governments invested in infrastructures (irrigation canal, road, power grids and mobile phone communication grids), but also in research and development and land extension. Government also subsidized investments in order to support the technological change. For instance, it paid for half the conversion cost in India. Finally, the government subsidized (and sometimes distributed) inputs such as rice seeds and fertilizers. Second, financial capital from the agricultural and industrial sectors was available for investment, and the increase in average household income drove the demand for products of higher quality.

The chains followed relatively similar development processes: expansion of the activity, followed by technical change in the midstream segment and by its concentration. This change in technology increased husked rice volumes (up to three tons per hour) and the average capacity of the storage facilities went from 180 to 3,000 tons from the 1990s to 2010 (Reardon and Minten, 2011). The number of large rice millers increased and the number of small rice millers decreased (Reardon et al., 2014). Producers also intensified their practices: almost 100% of farmers use fertilizers (Reardon et al., 2014). Disintermediation is the second criterion for change. Collection operations with producers and commercialization on rural wholesale markets were internalized by some of the mills and storage facilities.

In the case of rice, mills add value to quality varieties, through packaging, branding and traceability (Minten, Reardon et Sutradhar, 2010 ; Minten, Singh et Sutradhar, 2013). This change in organization has made quality rice available. The quality of rice is defined by the size and shape of the grain, and other attributes such as the degree of whiteness, the taste and cleanliness (degree of foreign matter), amount of broken rice, and age of the grain. In the case of potatoes, wholesale markets have been moved to the storage facilities (Reardon and Minten, 2011). For rice, the unit margin in the final selling price has increased, for example, from 46% to 55% in India. Nevertheless, the change to quality rice is more advantageous for non-farmer actors (Minten et al., 2013a). For instance, their share decreases from 69 to 38% in Bangladesh. This can be explained by the inclusion of additional processing in the chain and the concentration of the midstream segment. Furthermore, the dissemination of cold storage facilities increases the share of value added passed on to the farmers. The tables in appendix presents the distribution of rewards, costs and margin along the rice value chain in the three countries (Reardon et al., 2012a). We will discuss the Quiet Revolution with the Global Value Chain framework at the end of the paper.

2.2 Limited evidence for Africa

Reardon, Timmer et Berdegue (2004) showed that the “Supermarket Revolution” occurred by successive waves across the world. It started in the early 90’s in South America, East Asia (without China) and South Africa. The second wave happened in the mid 90’s in Mexico, central America and South-Est Asia. The third one started in the 2000’s in PRC, India and Vietnam.

But the supermarket revolution is not on going in many countries in Africa (Tschirley et al., 2010), and the literature suggests that there has been a dominance of market and relational governance in food chains since the 1990s (Soullier, 2013). The institutional environment is uncertain (Hugon et al., 1995) due to various constraints: low investment in road infrastructure; unstable production due to climate conditions; and unstable demand due to low purchasing power (Fafchamps, 2004; Hugon, Pourcet and Quiers-Valette, 1995; Moustier and Chaléard, 2002). Farmers and traders are limited in capital, and carry out transactions based on trust. Interactions are frequent and the choice of partners is made on the basis of social linkage and reputation (Galtier 2002; Dieye 2006; Lie et al. 2012). This proximity enables the sharing of risks and benefits among economic partners (Moustier, 2012).

However, specific value chains in Africa seem to be modernizing (Reardon et al., 2013). In Ethiopia, the increasing adoption of modern inputs and the rise in demand for high-quality products were

observed in the teff value chain (Minten et al., 2013c). In the cases of maize and wheat, the growth of private commercial millers was reported (Shahidur and Asfaw, 2011). The segment of maize processors is currently expanding in Kenya, Zambia and Zimbabwe (Jayne et al., 2010). Other cases seem to present features of modernization but these changes are not enough documented.

Following the world price crisis, the Coalition for African Rice Development (CARD) was set up in order to double rice production in sub-Saharan Africa between 2008 and 2018. Some West African States set up policies aiming at self-sufficiency: the National Program of Rice Self-sufficiency in Senegal, the National Development Strategy of the Rice Value Chain in Ivory Coast, the National Rice Development Strategy in Nigeria... Strong public interventions are currently supporting the modernization of domestic food chains.

Since the “Supermarket Revolution” is not happening in Africa, and there are strong policies to modernize domestic food chains, we investigate whether the modernization happening in Asia is in progress in certain domestic food chains in Africa. In this paper, we propose the in-depth analysis of the rice value chain in Senegal which presents modernization criteria close to the Quiet Revolution. Our assumption is that policies enhance the technical change of midstream segment and the appearance of new modes of coordination with their suppliers. This case is an opportunity to understand the conditions of DFC modernization in Africa. We investigate the historical factors of change and describe new types of coordination between producers and processors within the rice value chain.

3. Conceptual framework

The Supermarket and Quiet Revolutions are characterized by the influence that one actor in a steering position within the food chain has on the distribution of tasks and skills among the various partners and on the achievement of greater performance levels. We therefore call upon in our work the “Global Value Chain” (GVC) analysis framework (Gereffi, Humphrey, and Sturgeon, 2005), which is centered on this aspect. Our work is one of the few attempts to explain the dynamics of governance in domestic food chains based on this approach (Moustier, 2009).

The Global Value Chain framework is rooted in literature about world systems (Hopkins and Wallerstein, 1982), which strives to understand “the unequal distribution of rewards among the various activities that constitute the single overarching division of labor defining and bounding the world economy” (Arrighi and Drangel 1986, p16). It analyzes the Global Commodity Chains, “a

network of labour and production processes whose end result is a finished commodity” (Hopkins and Wallerstein 1986, p159). The Global Commodity Chain will become a coherent paradigm (Daviron and Ponte, 2005) through the work of Gereffi and Korzeniewicz (1994), “Commodity chains and global capitalism”. It can be characterized by four dimensions: their input-output structure, the territory covered, their governance structures and the institutional framework. The governance, which will later become the core concept of value chain research, is defined by Gereffi et Korzeniewicz (1994, p97) as “authority and power relationships that determine how financial, material and human resources are allocated and flow within a chain”. A dual typology is proposed by the authors, based on the criterion of the dominant firm, which determines the parameters according to which the others operate (Humphrey and Schmitz 2001). On the one hand, producer-driven chains have high capital intensity and are often vertically integrated in order to secure risky transactions. On the other hand, buyer-driven chains are relatively labor-intensive and the organization is structured by downstream businesses, due to their market power (brand-named merchandisers). We will see in our research that this notion of driving is very important, but that in the case of domestic chains it can also be pulled in by the midstream segment (rice millers, storages, etc.) or by an actor outside of the chain (the government).

Following Gereffi et Korzeniewicz (1994), a large number of empirical studies were implemented and some of them highlighted forms of organization that could not be explained by the dual typology. Sturgeon (2002) observed in the electronics industry relatively balanced relationships as to power between suppliers and their purchasers, due to the use of flexible equipment that enables the production of turn-key products. On the other hand, Humphrey and Schmitz (2002; 2000) identified suppliers in quasi-hierarchical relationships with their buyers. Furthermore, following Coase (1937), Williamson (1983; 1994; 1985...) proposed the transaction costs economics to theorize the strategies of firms to get their supplies. Their choices between market, contracts and hierarchy are made through the understanding of three variables: asset specificity, uncertainty (a shock whose probability is unknown) and frequency of transactions. This theory was criticized by Granovetter (1985), for its under-socialized aspect. He emphasized in his work the role of social relationships constituting networks that firms use to get their supplies.

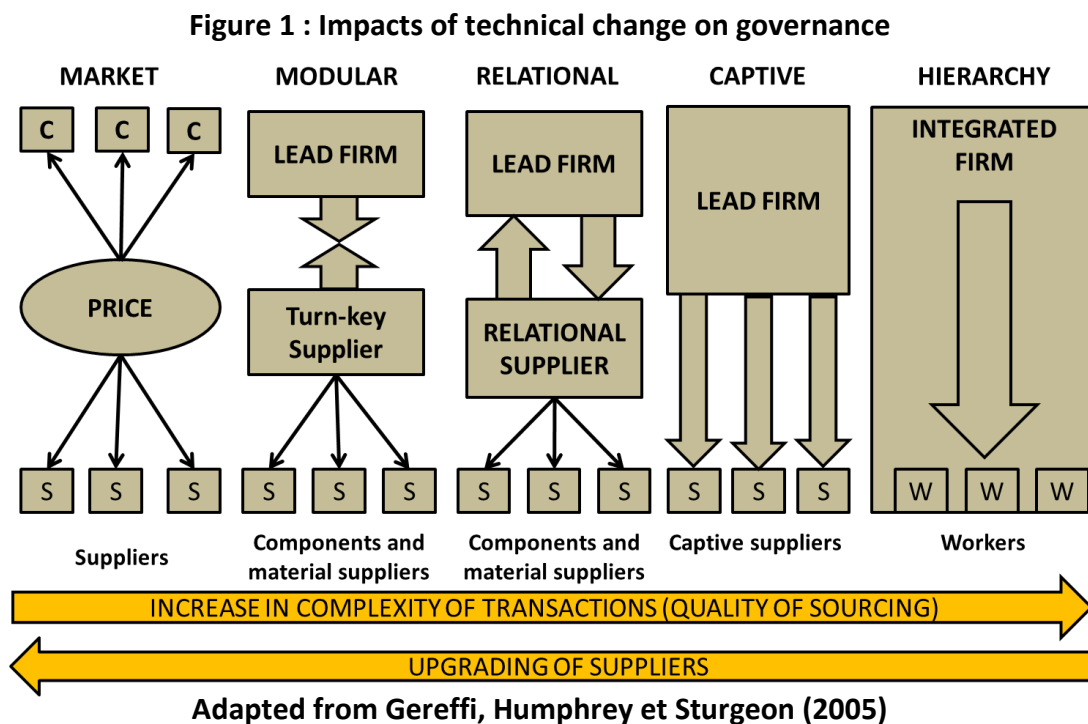
Considering that large diversity of observations, Gereffi, Humphrey et Sturgeon (2005) put forward a theoretical framework, enabling more finely-tuned analyses, that continues to take into account the networks theory and the literature on firm capabilities and learning, but also transaction costs economics (Bair, 2009). They developed the Global Value Chain approach, which is focused on the

governance dimension. This framework links the distribution of skills and the innovations in terms of quality with the distribution of value added along the chain (Moustier, 2009). Its main contribution is to theorize the GCC approach by integrating transaction costs economics (TCE). It is also more specific than TCE since it presents three specific types of governance between market and hierarchy. Three variables, representing the characteristics of the industry and production process explain the dynamics of value chains by assigning “high” or “low” values: the complexity of transactions, the ability to codify these transactions and the capabilities of the supply base. These variables are close to the ones in Williamson’s research. They determine five types of governance, which we use to explain the form of organizations observed in African DFCs. *Governance by the market* concerns simple transactions in which the price is the only element of coordination. When transactions are complex, but the suppliers are able to meet different forms of demand, this is referred to as *modular governance*. The authors use the term *relational governance* to describe transactions, often informal, in which the actors are socially close, exchange information and may put in place personalized relationships, thus reducing uncertainty but also creating a situation of interdependence. We characterize that type with the concept of proximity, which concerns the extra-economic links between value chains partners. Proximity enables coordination based on the position of actors within social networks and the distribution of risks and benefits along the chain. When the complexity of transactions needs the strong involvement of the leading firm in the operations of certain other actors, this is *captive governance*, because this firm promotes the dependence of its partners in such a way that its competitors do not benefit from its efforts. Finally, in *hierarchy governance*, the body of operations is controlled by the same actor.

The typology is dynamic because innovation provokes changes of value in the three determining variables. Technical change, understood as the use of new technologies, may be brought about by the innovation of a leading actor, or by upgrading of suppliers, understood as the process of acquiring new skills and accessing new markets through participation in a particular value chain (Humphrey, 2004). In the case of the rice value chain from the Senegal River Valley, technical change concerns the shift from (1) small-scale units using traditional mechanized technologies which process up to 1 ton per hour, and which most of the time operates only the function of husking to (2) large-scale units using industrial technologies, which can theoretically process up to 4 tons per hour, and which operate several functions (husking, but also cleaning, grading, polishing...). Semi-industrial technologies (lower yields and fewer functions) are also included in the second category.

In the GVC framework, technical change may tend to steer governance toward integration. It makes transactions more complex since it must be combined with quality paddy to provide quality rice. New criteria of quality of paddy are measured in terms of homogeneity of variety, rate of humidity and rate of impurity. To enhance their technology, rice millers set up new forms of coordination with suppliers to secure sourcing in terms of quality and quantity. Nevertheless, technical change may also turn governance toward a more relaxed form, when it strengthens the skills of suppliers (Gereffi, Humphrey, and Sturgeon, 2005). Innovation generates barriers to entry, for instance through the improvement of quality, labelization and strategies of integration. These barriers to entry determine the distribution of rent between the actors, the ones setting up the innovation obtaining the most important part (Kaplinsky, 2000). Nevertheless, Reardon and al. (2009) conclude that producers participating in modern value chains obtain higher revenues than producers involved in traditional value chains. The literature tends to conclude that contracts improve farmers' revenues (Prowse, 2013).

Figure 1 shows the influences that technical change can have on governance.



The modernization of the value chain is understood as in the work of Reardon et al. (2012): an expansion and concentration of the midstream segment, which carries out some technical change and sets up new forms of coordination. The midstream segment becomes the driver of the value chain and improves the quality of the final product, defined in terms of homogeneity of grains and impurity and humidity rates.

4. Methodology

We selected the rice value chain from the Senegal River Valley because it displays characteristics similar to the value chains studied by Reardon. It provides 80% of the national production of the main staple consumed in Senegal (USDA, 2015). It connects a major producing area with the main cities of the country.

Changes are analyzed from a historical point of view, based on several research carried out during the last three decades, such as Belières and Touré (1999) and Fall (2006). These secondary data were rounded out with 121 in-depth interviews that we implemented during three stays in Senegal between June 2014 and June 2015, for a total of 21 weeks. We carried out 35 interviews with producers, 25 with small-scale and industrial rice millers, 15 with traders, including wholesalers and importers and 46 with agents of public and private research and development organizations. Topics discussed with these key informants were the past and current organization of activities, quality management and changes in coordination with their partners.

Furthermore, our work calls upon 975 quantitative interviews with actors of the value chain. The reference year is 2014, which is a “normal year” in terms of production¹. The agreement set up in March 2015 between rice millers and importers enabled the marketing of rice produced in 2014. We use the database we set up to assess the impact of contracts on farmers’ income. It gathers 607 rice growers randomly selected after the stratification according to their marketing strategies, in order to implement non-parametric econometrics models. Surveying the farmer sample was carried out by using exhaustive databases from the national development agency for irrigated agriculture in the Senegal River Valley (SAED) and lists of suppliers provided by the main rice millers. We purposely selected the five main rice millers operating in 2014. Since there was no existing exhaustive census of small scale processing units in 2014, we geographically stratified the department of Dagana in terms of rural and urban areas, and randomly selected 49 units. We also called upon the database from FRANCOIS et al. (2014), who carried out an analysis of the profitability of marketing networks for the same reference year. This survey concerns 85 retailers and 169 wholesalers and semi-wholesalers. Retailers were randomly selected and indicated their suppliers. We completed this database to include domestic whole grain rice with 60 quantitative interviews. We asked questions in order to analysis the profitability of value chain’s stakeholder: income and charges from their activity, including depreciation of capital, wages and financial fees.

¹ Not particularly different from the production during the four previous years

5. The rice value chain in Senegal

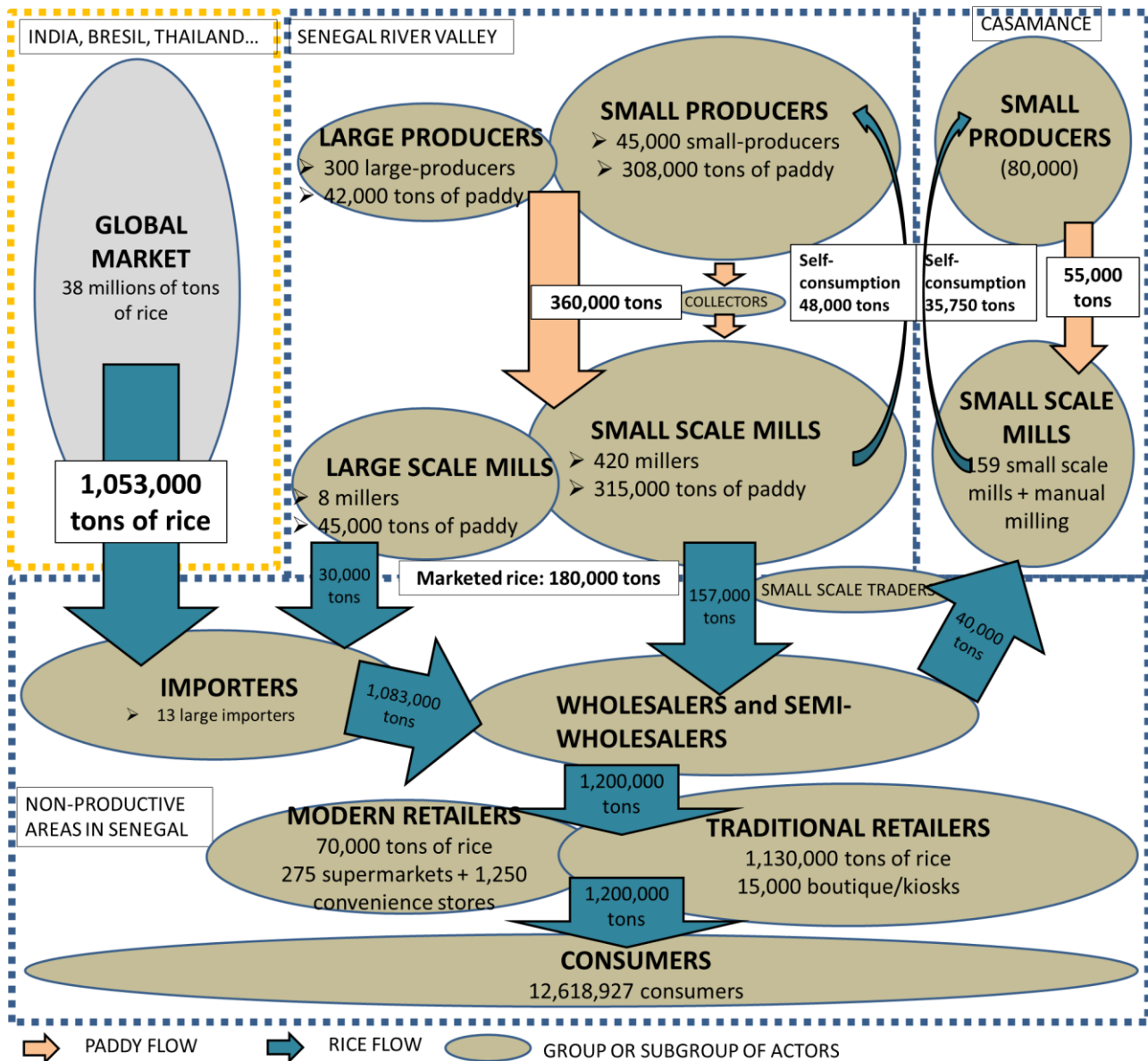
We study the rice value chain in Senegal, which shares some characteristics with other food chains of West Africa. The countries of this region mainly depend on global markets: the national rice production covers 20.5% of the consumption in Senegal, 35.1 % in Ivory Coast, 31.1 % in Ghana. The yearly per capita consumption is high (95kg in Senegal, 73kg in Ivory Coast and 100kg in Guinea according to Fofana, Goundan, and Magne, 2014, based on UN-DESA data). Following the world price crisis, several States set up policies aiming at self-sufficiency through the modernization of food chains.

In Senegal, rice is produced in the Senegal River Valley (SRV) and in Casamance, the other parts of the country producing less than 1% of the national production (Niang et al., 2014). In 2014, 60,000 irrigated hectares (SAED, 2015a) were cropped in the SRV, which reached according to our farmers' study yields of 6,6 T/ha during the dry season and of 5,3T/ha during the wet season. The production from the SRV was therefore 360.000 tons of paddy. The valley supplied 87 % of the national rice yearly production, 88% of which is produced by 45,000 small producers (Gergely and Baris, 2009). In 2014, we identified 8 medium and large-scale mills, which according to our calculations process 45,000 tons of paddy. Industrial capacities increase quickly since these millers were 12 in mid-2015. 420 small-scale units husked the remaining 87.5% of paddy. Medium and large millers stated rates of transformation averaging 66 % and small units 65%. Since the rural population in the valley reaches 500,954 individuals (ANSD, 2015) and the per capita consumption in Senegal is 95 kg/capita/year (Fofana et al., 2014), we estimate that the valley supplies 187,000 tons of rice to the rest of Senegal once self-consumption is withdrawn. Casamance is the second productive area in Senegal, with mainly rain-fed crops. With the same calculation we find that Casamance had to purchase 40,736 tons of imported rice.

In 2014, the national production of 271,750 tons of rice was completed with 1,053,000 tons of broken rice, imported mainly from India (598,000 tons), Thailand (197,000 tons), and Brazil (52,000 tons), through 13 importers (USDA, 2015). In March 2015, these importers signed an agreement with the government and rice millers, in which they commit to purchase all the output from the SRV processed by industrial millers (SAED, 2015b), which we estimate at 30,000 tons of rice. These importers sell local and imported rice to a network of wholesalers and semi-wholesalers. Then, 15,000 small boutiques, kiosks, and traditional open air markets (USDA, 2013) sell almost 95% of rice volumes (Gergely and Baris, 2009). There are also between 250 and 300

supermarkets in Senegal, and between 1000 and 1500 other modern retailers selling the remaining part. The organization of the rice value chain in Senegal is summarized in Figure2.

Figure 2 : The rice value chain in Senegal



In the following part, we address the governance with a historical approach in order to identify the factors of change and describe the present modernization.

6. Changes in the rice value chain

6.1 Historical factors

We reckon that two factors over three periods both hindered and fostered the modernization of the rice value chain by their effects on value chain actors: public policies and links to global markets. The first period was characterized by hierarchical governance driven by the state. It was

followed by liberalization and market/relational governance. At present, we observe patterns of vertical integration and modernization.

Hierarchy governance driven by the State (1964 –1987)

The first period is one of strong public intervention in the value chain. Rice consumption had been introduced in Senegal during the colonization, with flows coming from Indochina. Since 1822, several attempts were carried out to grow rice in the Senegal River Valley but the real expansion of irrigated cropped rice was in 1964, with the setting up of SAED (Société Nationale d'Aménagement et d'Exploitation des Terres du Delta du Fleuve Sénégal). The emergence of the rice value chain was fueled by two factors.

The first one is State intervention: each level of the value chain was directly or indirectly managed through two State agencies, SAED and CPSP (Caisse de Péréquation et de Stabilisation des Prix). SAED set up hydro-agricultural equipment at the rate of 600 ha per year from 1965 to 1980 (Belières and Touré, 1999). SAED also provided producers with technical advice and subsidized inputs such as seed, crop protection products, mechanized services and credit. Nevertheless, SAED collected low rates of reimbursement and these systems were very costly. Farmers marketed without complying with the condition that their paddy should go to two rice mills managed by SAED, under obligation to buy it at a planned price. But they sometimes faced problems relating to their payments. That is why an informal value chain started to appear, the paddy being de-husked by small-scale units.

The second factor which enabled the emergence of the value chain is the link to the global market. CPSP was the state agency in charge of rice distribution. It highly taxed imports in order to subsidize paddy purchases. Once processed, the rice was sold with a loss to wholesalers. But this system was in deficit and finally collapsed.

Since coordination between stakeholders was planned, the governance of the rice value chain during this period was integrated and the driving aspect managed by the State.

Liberalization and relational governance (1987 – 2007)

State intervention is reduced and the national economy opened to global markets

The second period is the one of liberalization. Public intervention was progressively reduced and the dependency on competitive global markets increased, which gave a new dimension to the value chain. The liberalization was set up in two steps. First, production factor markets were

opened to competition in 1987, particularly for seed, pesticides, land and credit. Then, in 1994, the downstream part of the value chain was privatized, prices deregulated and the currency (Franc CFA) was devaluated.

First, public interventions decreased. (1) SAED turned over land development to the private sector from 1987 on in order to prepare for the liberalization. That led to a race for land supported by easy access to credit. Nevertheless, investments were made in hydro-agricultural equipment of poor quality, resulting in low output. From 1987 to 1991, irrigated land increased from 23,000 ha to 40,000 ha (Belières and Touré, 1999). Then, opening up to global markets led to the abandonment of these non-productive areas. Nevertheless, SAED continued its activity of production support in the SRV. (2) A national bank was created in 1987. This bank proposed various loans: production, investment and marketing. A new system was set up: the bank paid suppliers who provided inputs to farmers, who repaid the bank once the paddy was sold to rice millers. Credits grew from FCFA 150 million in 1987 to 5 billion in 1993 (Belières and Touré, 1999), which enabled an increase of cultivated areas planted and cropped, but much misappropriation of money occurred. In 1993, the bank followed a financial turnaround plan and hardened its selection criteria. The liberalization opened the Senegal River Valley (SRV) to other financial institutes but they faced the same problem of low reimbursement rates. (3) The liberalization was implemented at the same time as a decrease in the subsidy for seed, fertilizers and other inputs. Although a network of private distribution appeared, inputs prices increased.

Second, the opening to global markets hindered the modernization of the rice value chain. Indeed, the specificity of Senegal is that most of the rice for consumption is broken. Since broken rice is a byproduct in Asia, exporters sell it at a very low price. The decrease of custom duties in Senegal exposed the domestic value chain to cheap global markets (see annex), which resulted in the bankruptcy of many actors.

Development of the traditional value chain

In such a disabling institutional environment, value chain actors adapted their strategies toward low cost inputs and equipment. Rice millers owned by SAED were privatized in 1994 and the private sector was encouraged through subsidies and development projects to invest, which led to the emergence of semi-industrial rice millers. Processing capacities reached a level considerably higher than the paddy available at the scale of the SRV: between 1981 and 1996, processing capacities increased by a factor of 13 and production by a factor of only 4.5 (Belières and Touré,

1999). In 1996, the SRV was able to process 164,000 tons of paddy but actual production reached only 75,000 tons. These figures also include the strong development of small-scale processing units, managed by local actors. These units were able to meet the needs of producers and processors because of their proximity to production, low costs and flexibility. Furthermore, their informal aspect prevented CNCAS from controlling reimbursements. At first, semi-industrial rice millers got good financial results but after 1996 their activity became unprofitable because of marketing subsidies being withdrawn, bad harvests, strong competition from small-scale units and a collapse of rice prices (Belières and Touré, 1999). This led to a concentration of the midstream segment. A number of industrial processors stopped their activity; those continuing used their proximity with producers to secure their supplies. From 1994 to 1995, the share of paddy processed by industrial units decreased from 62% to 11%, small-scale units increasing their activity strongly (Belières and Touré, 1999). Wholesalers became referees between local and global rice markets.

The governance changed from State hierarchy to market with a relational tendency, stakeholders needing trust with their partners after the failures of the past. The driving of the chain was not taken over by small-scale units. The technology used only performed the function of husking and prevented the production of rice without impurity.

A favorable context supporting modernization (since 2007)

During several decades, the rice of the valley could not compete with the imported rice, because of its low quality. On the other hand, an urban bias incited policies to favor imports rather than the development of domestic food chains. Nevertheless, it was recently demonstrated by using experiments that local rice can compete if its quality is adapted to the preferences of consumers (Demont et al., 2013a, 2013b; Demont and Ndour, 2015; Demont and Rizzotto, 2012). In that case, consumers have a higher willingness to pay for local rice and extrinsic qualities of products such as packaging and labeling. Similar results were identified at the level of 11 cities in 7 countries of Africa (Demont and Ndour, 2015). Investments should therefore be carried out in order to reverse the urban bias (Demont et al., 2013b).

Since 2007, it seems that several factors are fostering the modernization of the value chain. On the one hand, public policies favor the improvement of production and processing activities. The inter-ministerial council set up in January 2008 a national program for rice self-sufficiency (PNAR), with the goal of producing 1,500,000 tons of paddy per year (Ministère de l'Agriculture du Sénégal, 2009). Its activities aim at expanding land capacities and improving credit for production

and marketing. SAED and CNCAS are implementing this program. Japanese International Cooperation (JICA) set up projects aiming at upgrading processing technologies, securing processor supplies and promoting local rice. Several organizations such as AfricaRice have been working for many years at improving the seed used by producers. The French Development Agency supports land development. USAID and SAED support producers and processors to better coordinate their activities in order to propose higher quality rice.

On the other hand, the price crisis which started in 2007/2008 on global markets decreased the competitiveness of Asian rice relative to the Senegal product. Thai rice prices (A1 grade) increased from US\$270 to US\$516 per ton between 2007 and 2012 with a peak at US\$ 850 in May 2008 (see figure in annex, data from OSIRIZ/InfoArroz). It was a strong incentive to invest in processing technologies that had been unprofitable up to that time. Nevertheless, millers faced very strong marketing difficulties when world prices decreased in 2014 to almost reach their pre-crisis level (US\$309 in January). The State intervened in March 2015 to ensure the marketing of domestic rice through the implementation of an agreement between importers and rice millers.

In that favorable context, producers and processors changed their strategies toward the production of higher quality rice. The access to improved inputs and new sources of funds increased yields and output. Volumes increased from under 200,000 tons during the 1990s to 400,000 tons with peaks of 600,000 tons between 2009 and 2013 (Baris and Gergely, 2012 ; Ministère de l'Agriculture du Sénégal, 2009). Processors invested in technologies with higher yields performing more functions (such as cleaning, sorting...), thanks to credit and previous benefits. Their capacities theoretically may reach up to 4 tons of paddy per hour, and we reckon that they processed in 2014 around 45,000 tons of paddy. These rice millers set up new coordination modes to secure their paddy supplies, sometimes with the support from SAED. It enabled them to meet the national demand, more exacting as to rice quality.

These organizational innovations brought about changes in governance. Although relational governance is still the most important in terms of volumes processed, we also describe in the next part new integrated chains driven by processors.

6.2 Modernization of the present value chain

We identified five types of value chain distinguished according to their proxies of governance: market-relational coordination; marketing contract; farmers' networks; production contracts and vertical integration. They differ according to variables close to the ones from Gereffi et al., (2005).

Transactions are simple in the case of market-relational coordination, the quality not being clearly specified. The use of modern technologies implies the use of paddy homogeneous in terms of variety, with a rate of humidity ranging between 10 and 12%. It makes transactions complex. These technologies also need high volumes of provision to get over their costs. Farmers may not be able to reach these levels of quality and quantity, especially when they do not have access to credit and proper inputs such as seeds. In that case, certain skilled processors tend to bring production in. Their ability to influence price becomes higher. Processors which are not skilled to integrate production deal with independent producers having access to bank credit. In that case, producers have better bargaining power. There does not exist standards certifying criteria of quality of paddy. Figure 3 presents the characteristics of the modes of governance between rice growers and processors.

Figure 3: Typology of modes of governance between rice growers and processors in the Senegal River Valley

	Market-relational coordination	Marketing contract	Farmer networks	Production contract	Vertical integration
Financing of crop season	Bank credit or no credit	Bank credit, repayment in paddy to processor, who repays the bank	Credit to the CNCAS or a farmers union	Rice millers provide credits and are repaid in paddy	Bank credit or no credit
Processing technologies	Small-scale millers	Industrial millers	Industrial and semi-industrial millers	Industrial and semi-industrial millers	Industrial and semi-industrial millers
Relational proximity	High	Low	High	Medium	Low
Quality of end product	Low	High	Medium	High	High
Mechanism of price-setting	Negotiation between producers and processors	An inter-professional negotiation indicates a price per season	An inter-professional negotiation indicates a price per season	Negotiation between producers and processors, with rice millers having strong negotiation power	Production costs

We identified 8 industrial and semi-industrial rice millers which processed around 45,000 tons of paddy over the 360,000 tons produced in the valley in 2014. Based on the volumes and modes of coordination declared by these rice millers, we estimate that for that year, production and marketing contracts represented 5% each of the volumes produced in the SRV, while vertical integration represents 2% and farmer networks around 1%. The traditional value chain remains the most important one, gathering 87% of the volume. Nevertheless, marketing contracts are

increasing quickly since they did not exist in 2010, and they are more and more developed by the national bank and the agricultural development agency. Production contracts followed the same trend but we forecast a decrease because of the cancelation of producers' debt by government. Vertical integration is also increasing, but faces problems of land access. On the contrary, the volumes processed by farmer networks seem to decrease since several of these organizations were in deficit and stopped their activity.

Traditional value chain: market governance with a relational tendency

We precise here the present characteristics of the traditional value chain which is the baseline situation of other forms of coordination. Most of producers grow rice as a food crop on small acreages, using seeds that are not always improved. They mainly rely on family labor and sometimes pay for mechanized services. The purchase of inputs is one of the major constraints (Le Roy, 2004). They have access to credit mainly through the national bank (Diop, Fofana and Fall, 2008). However, 20% of rice growers do not have access to credit because of previous arrears in payment (Fall, 2006).

Farmers sell to small-scale processors and collectors (Colen, Demont and Swinnen, 2013). Relational proximity is strong with their purchasers, which enables risks to be shared, and to adapt the selling process to the needs of household. Nevertheless, market price plays a pivotal role in the transaction. It can range between 80 and 170 FCFA/kg. The small-scale processors only play the function of hulling, which hinders the quality of final product. The packaging is such that the product cannot be tracked within the Senegal River Valley. There is no mutually agreed upon definition of the concept of quality among producers and processors.

The marketing contract: a modular governance

In 2014, marketing contracts were used by 98 POs growing around 4,000 ha and including around 2,000 small-scale producers (data from SAED, 2015). All of them have access to credit. Identifying the purchaser is done through the POs, which may receive advice from the national bank. The producers are located in a maximum radius of 70 km around the millers. 15,000 tons of paddy were purchased through marketing contracts in 2014. The CNCAS (*Caisse nationale de crédit agricole du Sénégal*) lets millers know the groups of producers that have taken out a loan. The paddy is then purchased, based on the price which was negotiated at the beginning of the season within the inter-professional organization (around 120 FCFA/kg). The price takes into account quality criteria, mainly measured through the rate of humidity, but also homogeneity of varieties

and level of impurities. Payment is directly made to the PO's bank account, from which is withdrawn payment of the credit reimbursement. Millers sort the rice by grade and sometimes aroma, and a brand marker enables the consumer to identify which firm did the milling.

Farmer networks: a relational governance driven by farmers

Farmer networks concern various organizations such as semi-industrial mills owned by producers or farmer association linking producers and traders. A few hundred producers are members of these networks, which sometimes also manage a credit union. Nevertheless most of them get their funding from the national bank. Purchasers are most of the time also from the network. Networks which do not own a mill subcontract de-husking. In most cases, traders pay a service provision according to volumes processed.

The coordination between producers, traders and husking service providers is set up through the network, with most of the time high levels of relational proximity. The price is negotiated taking into account the one decided by the inter-professional association, but marketing contracts are rarely signed. Various levels of rice quality may be observed since processing technologies vary, as well as the definition of quality. Furthermore, these networks propose different prices for the same kinds of rice. Their activity seems to be decreasing over the years.

The production contract: Captive governance with a relational tendency

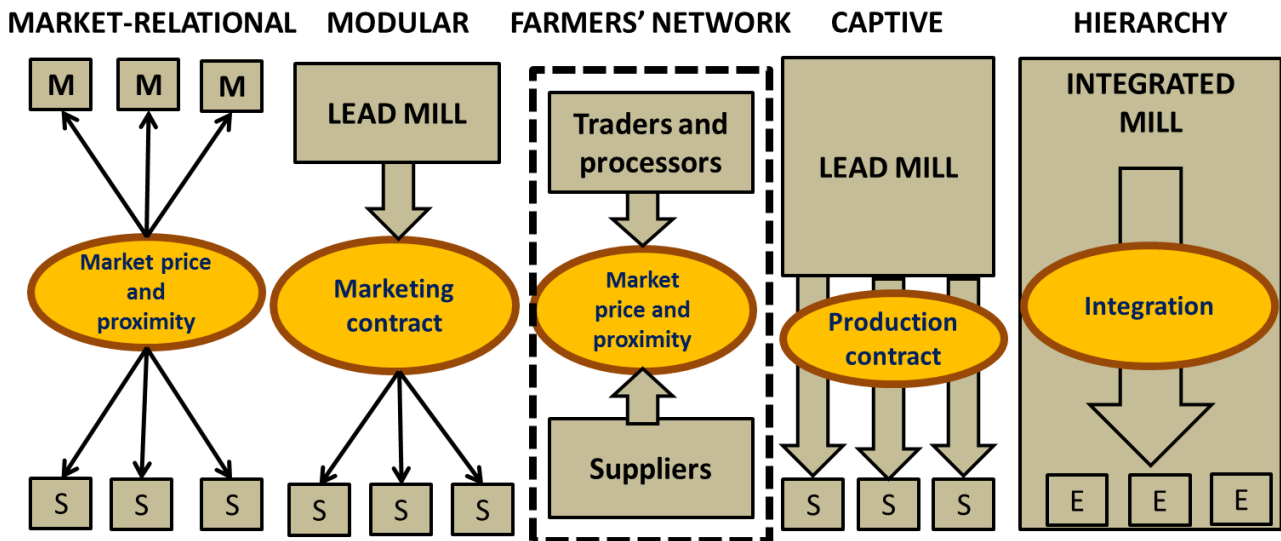
In 2014, production contracts were used by 71 POs growing around 3,500 ha and including around 1,500 producers (figure based on rice miller databases). 15,000 tons of paddy were purchased through these contracts. Producers are financed by rice millers through credit paid in cash or the provision of in-kind inputs. Most of them were rejected by the national bank credit system because they did not reimburse previous credits. When their financial resource is limited, the only remaining option to fund their season is production contracts. Five processors implement them. Their processing capacities are industrial and semi-industrial.

These processors set up production contracts to secure the quality of their supplies. A crop management technique is sometimes implemented and controllers are hired within villages to use relational proximity as an enforcement lever. The processor may do the harvesting. The purchase price is lower than that on the marketing contract, at around 100 FCFA/kg. Should repayment not be made, the land can be seized. Nevertheless, in most cases, a second credit is implemented with very strong follow-up. There is a common definition of quality. The rice is sorted by grade and sometimes aroma, and a brand marker enables the consumer to identify the rice miller.

Vertical integration: Hierarchical governance

Four processing units were vertically integrated in 2014. Rice is a cash crop managed by the processors. The production is done on irrigated areas cropped by the processing companies and covering dozens or hundreds of hectares. The managers hire seasonal workers (who receive room and board along with a salary of about 40,000 FCFA/ month) or daily workers (paid between 2,000 and 3,000 FCFA/ day). Around 8,000 tons of paddy processed by industrial units in 2014 were self-produced. The purpose of integration is to secure the supplies, but access to land seems limited. The rice is sorted, is of good quality, and a label with a brand enables the company to be identified. The following figure synthetizes the modes of governance observed within the rice value chain.

Figure 4: Governance modes within the rice value chain



Adapted from Gereffi, Humphrey et Sturgeon (2005)

6.2 Change in distribution of net margin: decrease of producer margin for the benefit of processors?

We propose an overview of the change in the distribution of the net margin between the actors of the value chain across the three historical periods of governance. We corrected prices for inflation with price index from the World Bank². For each actor, the net margin was calculated by removing all costs (including wages, depreciation and financial fees) to revenues (which includes bran, which is usually sold). We take into consideration only volumes of paddy which were sold by farmers.

² Index 100 in 2005

(1) The value chain in deficit under State regulation

Benz (1996) compares four studies of the profitability of the value chain which were realized before the devaluation (Agrer, 1990; FAO, 1994; Freud et al., 1991; Rabès, 1991), and proposes a synthesis after correcting for depreciation. These studies all find the total net margin is negative, especially due to the high deficit of the CPSP. We present the study from FAO, that we completed with an hypothesis on the cost of traders based on the survey of Ndoye, Boughton, and Crawford (1991). Since the total net margin is negative (-43.8 FCFA), the percentage of producers (-236.4%) means they get the most important part of the positive value added of the chain (103.6FCFA/KG), contrary to downstream segments.

Figure 5 : Prices, net margins and costs along the chain in 1994, industrial processing

	Price	Net margin		Production costs	
		FCFA	%	FCFA	%
Producers	242,8	103,6	-236,4%	139,2	45,3%
SAED	304,4	-18,6	42,4%	80,2	26,1%
CPSP	230,9	-131,9	301,0%	58,3	19,0%
Traders	263,6	3,0	-6,9%	29,7	9,7%
TOTAL	263,6	-43,8	100,0%	307,4	100,0%

Source: FAO (1994)

(2) The value chain becomes profitable after the liberalization

Studies conducted during the period reveal the total net margin becomes positive after the liberalization of the value chain, without any actor in deficit (Liagre, 1997; UCAD/UNEP/ISE, 2003). According to Liagre (1997), it reached 23.42% in the case of small scale processing in 1997, and 27.22% in the case of industrial processing. The use of industrial technologies increases the total net margin. These low rates of net margin are explained by the strong competition from global markets and high cost of the domestic value chain. Producers still get the most important part of the total net margin but the distribution becomes more favorable to traders, who manage processing.

Figure 6 : Prices, net margins and costs along the chain in 1997, small scale processing

	Price	Net margin		Production costs	
		FCFA	%	FCFA	%
Producers	123,4	43,6	78,3%	79,8	47,0%
Small-scale units	225,3	12,1	21,7%	89,8	53,0%
Traders	237,8	5,5	15,0%	7,0	4,1%
TOTAL	237,8	55,7	100,0%	169,6	100,0%

Source: Liagre (1997)

Figure 7: Prices, net margins and costs along the chain in 1997, industrial processing

	Price	Net margin		Production costs	
	FCFA	FCFA	%	FCFA	%
Producers	123,4	43,6	64,0%	79,8	46,0%
Industrial rice millers	241,4	24,5	36,0%	93,5	54,0%
Traders	250,3	1,9	2,8%	7,0	4,0%
TOTAL	250,3	68,1	100,0%	173,3	100,0%

Source: Liagre (1997)

(3) Modernization increases the net margin?

The study carried out by Gergely and Baris (2009) just after the peak of the first world food crisis considers traders purchasing paddy to producers and paying processors to have it hulled. We completed this study which just takes into consideration retailers' gross margin with the cost of retailing from WFP (2008). They show the total net margins followed the same trend as shown in previous survey: it reached 32.23% in the case of small-scale hullers and 38.35% in the case of rice millers.

Nevertheless, our study, which was carried out five years later, demonstrates that the traditional value chain generates higher total net margin than the modern one in the case of broken rice³. In 2014, the share in the final retail price increased to respectively 37.64% and 32.8% although the final price is higher in the second case⁴. We understand this change was provoked by the increase of price competitiveness from the global market since early 2014 coupled with difficulties in securing procurements. In the case of whole grain rice, this share of total net margin increased to 42.7%.

Figure 8 : Prices, net margins and costs along the chain in 2014, small-scale processing, broken rice

	Price	Net margin		Production costs	
	FCFA	FCFA	%	FCFA	%
Producer	180,9	55,5	56,0%	125,4	76,4%
Small-scale unit	215,8	11,3	11,4%	23,5	14,3%
Wholesaler	223,0	4,2	4,2%	3,1	1,9%
Semi-wholesalers	239,3	13,1	13,2%	3,2	2,0%
Retailers	263,2	15,0	15,1%	8,9	5,4%
TOTAL ⁵	263,2	99,1	100,0%	164,1	100,0%

³ The study carried out by François et al. (2014) analyses the net margins downstream, the sharing of cost between different products being based on the share of space these products occupy in shops. The hypothesis is that imported and local rice have same marketing cost. We are still working on data analysis, and figures could vary a little.

⁴ We used Paddy-to-rice ratio of 65% in the case of small-scale processing and 66% in the case of industrial processing.

⁵ Final price data is from ANSD

Figure 9 : Prices, net margins and costs along the chain in 2014, rice millers, broken rice

	Price	Net margin		Production costs	
	FCFA	FCFA	%	FCFA	%
Producer	174,2	53,6	58,9%	120,6	64,6%
Rice miller	227,8	23,9	26,3%	29,7	15,9%
Importer	239,3	0,0	0,0%	11,5	6,2%
Wholesaler	253,7	1,7	1,9%	12,6	6,8%
Semi-wholesaler	263,2	6,4	7,0%	3,2	1,7%
Retailers	277,6	5,4	5,9%	9,0	4,8%
TOTAL ⁶	277,6	91,0	100,0%	186,6	100,0%

Figure 10 : Prices, net margins and costs along the chain in 2014, rice millers, whole grain rice

	RIZ BRISE, Rizerie				
	Price	Net margin		Production costs	
	FCFA	FCFA	%	FCFA	%
Producer	174,2	53,6	41,0%	120,6	68,8%
Rice miller	262,3	58,4	44,7%	29,7	16,9%
Importer	269,5	5,8	4,5%	1,3	0,8%
Wholesaler	283,2	1,7	1,3%	12,1	6,9%
Semi-wholesaler	292,4	6,1	4,7%	3,1	1,8%
Retailers	306,1	5,1	3,9%	8,6	4,9%
TOTAL ⁷	306,1	130,7	100,0%	175,4	100,0%

In the case of broken rice, farmers' share keeps decreasing since the previous period but they still get the most important part of the net margin. Nevertheless, the result in the case of husking with modern technology hides large differences due to the mode of coordination between producers and millers: the value reaches 64% in the case of marketing contracts and 40% in the case of production contracts. In the case of whole grain rice, the share of the total net margin obtained by millers becomes higher than the farmers' one.

7. Discussion:

Change in governance in Asia?

The benchmark situation of the "Quiet Revolution", although given little description, concerns two kinds of value chains. The most traditional one is "geographically and intermedationally short", and located in rural areas. The second value chain is "geographically and intermedationally long", and supplies cities. Both chains use traditional technologies, provide coarse rice (transactions are

⁶ Final price data is from ANSD

⁷ Final price data is from ANSD

simple) and do not have a driver⁸. We understand the governance as market-based with some relational tendency.

The modernisation according to Reardon et al. (2012) is reflected by the reduction of the intermediaries number despite long geographical distances. We understand this phenomenon is coupled with a change in governance. First, the value chains in Asia upgraded the quality of products on final markets, with implications for farmers. The increase of households' income in Asia during last decades brought about the decrease of the share of rice in the feed ration, but also a shift toward higher quality rice. Millers became the drivers of the value chain: in addition to the increase of processing capacities to satisfy a growing population, larger mills oriented their activity towards the production of higher quality rice. For instance, the share of fine regular rice processed by large mills increased from 50% in 2004 to 80% in 2009 in PRC, and from 20% in 1999 to 29% in 2009 in Bangladesh (India showed the least change in quality). These mills also set up criteria of quality that paddy must reach. Transactions between producers and millers became more complex to meet the demand. Farmers were able to provide paddy of higher quality since varieties beforehand had been introduced by national and international agriculture centers. The share of coarse rice decreased from 37% to 15% between 1999 and 2009 in Bangladesh. Second, relationships between millers and producers changed. The function of collection was brought in by small and medium millers (Reardon et al., 2014), which respectively purchase 98% and 78% of their procurements in PRC by themselves. Furthermore, cases of contract farming appeared in the same country: it concerns 8% of volumes for medium mills and 13% for the large ones in the same country. In addition, resource providing relationships were set up: large millers in PRC, arranged farmers' access to seed for 50% of their suppliers, and provided seeds to 10% of them. Same figures were observed for fertilizers. Credit relationships were also observed between warehouses and producers (Reardon and Minten, 2011). Finally, downstream, cases of formal contracts have been reported between millers and their purchasers, as well as agents representing one or two mills on urban wholesale markets.

The "Quiet Revolution" reveals that value chains are more modern in PRC and India but the phenomenon emerge quickly in Bangladesh. The midstream segment becomes the driver of the value chain, by defining the criteria of quality and setting up new relationships with their suppliers. We understand that process as a shift from market governance (with a relational tendency) toward integration. As in Senegal, several forms of governance coexist. Nevertheless, the survey of

⁸ Authors cite (Lele, 1971)

Reardon et al. (2012) does not use the conceptual framework of governance which prevents us to clearly specify governance beyond the tendency to integration. Moustier (2009) revealed in the case of fragrant rice in Vietnam a form of modular and contractual governance driven by Producers Organizations and supermarkets, and a form of relational and modular governance driven by midstream companies and supermarkets. We wonder if we could observe in PRC, India and Bangladesh the same forms of governance.

Is the quiet revolution going on in Senegal?

The modernization in Asia and Senegal presents many similarities. In both cases, public and development policies fostered modernization by improving the economic environment, and subsidizing investments and functioning of processing and producing actors. With the increase in volumes produced, the value chains supply distant urban areas more although the number of intermediaries decreases (and have no collectors in most of cases in Senegal). Small producers provide most or products and their inclusion in modern value chains seems not to be constrained in most cases. The midstream segments carried out a technical change, although the concentration seems not to be occurring yet in Senegal. Reardon, Timmer, and Minten (2012) reported the fast growth of modern retailing in Asia, but there is not such evidence in the case of Senegal, although the share of local higher quality rice marketed increases. In both cases, the midstream segment becomes the driver of the value chain, and steers the governance towards integration by defining criteria of quality. It increases the share and amount of the total net margin in the final price, but also the share obtained by this segment.

Nevertheless, the modernization in Senegal is vulnerable to competition from global markets, and therefore dependent on State intervention. The main difference between Asia and Senegal is the percentage of consumption domestically produced, and the competitiveness with global markets. Indeed, PRC, India and Bangladesh produce around 98% of their consumption (Reardon et al., 2012a) whereas we demonstrated that Senegal produced 20% in 2014. Furthermore, broken rice is very largely consumed in Senegal, when it is a byproduct on global markets, sold at very low prices. The modernization in the African country faces lack of competitiveness against imports and is dependent from state intervention. When world prices decreased in 2013 to almost reach their pre-crisis level, the State intervened in order to ensure the marketing of domestic rice through the implementation of an agreement between importers and rice millers. The commitment of importers to buy all the production from the local VC may be questioned with the increase of

these volumes, since their margins are higher when purchasing imported rice. The following table summarizes the comparison of modernization in Asia and Senegal.

Figure 11 : comparison of modernization in Asia and Senegal

		Asia (Reardon et al. (2012))	Senegal (Our data)
Institutional environment	Policies	Support to modernization	Support to modernization
	Link to global market	Supplier or independent	Purchaser, dependency and strong competition from global markets
Organization of the chain	Number of intermediaries	Decreasing (integration of collection)	Steady, direct relationships between producers and processors
	Geographical distance	Increasing	Increasing
	Small-producers	Increase of marketing	Increase of marketing
	Processing	Technical change and concentration	Technical change and expansion
	Retailing	Increase of modern retailing	Traditional retailing dominates
	Driving	Midstream segment	Midstream segment
	Governance	From market to integration	From market to integration
Performance	Volumes	Intermediate and modern value chains dominate in PRC and India and emerge in Bangladesh	Modern value chains provide 2% of domestic consumption and growth
	Quality	Increase of high quality rice	Increase of high quality rice
	Margins	Increase of the total net margin and of the share of midstream segment	Increase of the total net margin and of the share of midstream segment

8. Conclusions and follow-up

The case studies conducted in Asia by Reardon et al. (2012) reveal the modernization of value chains, brought about by the midstream segment which implements a technical change and integrates new functions. Although some research suggest the transformation of food chains in Africa, there is still little evidence making it possible to determine if the same modernization is happening in Africa. We investigate in that paper whether the modernization happening in Asia is in progress in certain domestic food chains in Africa. We propose the in-depth analysis of the rice value chain in Senegal which presents the same modernization aspects as the Quiet Revolution. Our assumption is that policies enhance the technical change of midstream segment and the appearance of new modes of coordination with their suppliers. To address this issue, we made use of the “Global Value Chain” theoretical framework proposed by Gereffi, Humphrey et Sturgeon (2005), which highlights the influence that one actor in a steering position within the food chain

can have on the distribution of tasks and skills among the various partners, and on the achievement of greater performance levels. The dynamics of governance was analyzed from a historical point of view, based on previous research and 121 in-depth qualitative interviews. Our work also calls upon 975 quantitative interviews with farmers, rice millers and traders.

We find that the rice value chain is undergoing modernization as described by Reardon et al. (2012) with increased investments in processing and vertical integration of the chain. Public policies and links to the global markets are the main drivers of changes in actor behavior and governance. The rice value chain was set up by the government, but its progressive deregulation leads to more and more effects from global markets impacting the chain's competitiveness. In order to meet a growing demand with more quality requirements, stakeholders are setting up new modes of coordination, sometimes with the support of development agencies to propose high-quality products on the national market. The governance tends towards integration. The modernization in Senegal is vulnerable to competition from global markets, and therefore dependent on State intervention

The observation of the change in the Senegalese rice value chain governance leads us to four new questions. (1) First, we wonder if a similar modernization is observed in other African countries, and if the public policies have the same role than in Senegal. Particular attention could be given to the paradox of the State structuring and disturbing the modes of coordination, and to issues of economic sustainability. (2) Second, this change of governance raises the question of performance. The political objectives concern the food security of cities, but not much interest has so far been shown to the consequences of the modernization on the upstream part of the value chain. Our current research projects aim at estimating the impact that new contracts have on the remuneration of producers. We conducted a cross-sectional survey which will allow us to identify the factors of inclusion in the modern value chains, as well as to compare the levels of added value and food security of producers according to their types of marketing. The geographical area covers the department of Dagana, especially the Senegal River Delta, which is the core of rice production in the country, and the only place where coordination types different from the traditional one were observed. SAED provided us, in the framework of an agreement with CIRAD, the POs database from the department which cropped in 2014. Rice millers implementing production contracts did the same. We stratified the population according to their marketing strategies: market coordination, marketing contract, selling of processed rice, and production contract. We randomly selected respondents. We collected data from 607 producers, using one large

questionnaire addressing technical and economic aspects of rice production (two seasons), financing of crop growth, uses of paddy, processing, marketing, food security, household and farm characteristics and changes in these aspects that occurred during the last 10 years. We will use non-parametric econometrics (such as the model proposed by Heckman, Ichimura, and Todd, 1998), to assess without bias the impact of marketing strategies on farmer incomes and food security. (3) Third, the context which is very favorable to the investment in industrial production and processing capacities raises several questions as to the sustainability of the *modus operandi* set up by recently arrived agribusinesses, inquiring about the positive or negative influences on small local producers. The case studies and surveys we are doing should bring more information regarding the sustainability of agricultural practices, the equity of access to land and the food security of small producers. (4) Finally, our work represents one of the few applications of the theoretical framework “Value Chain” at a domestic level. We wish in the future to realize further studies to specify the adaptations necessary for this change of scale and context, with a particular interest for public policies.

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APPENDIX:

The following tables present the net margin distribution highlighted by “The Quiet Revolution”⁹

⁹ Notes following the tables in the book “The Quiet Revolution”:
Rewards are calculated as the difference between costs and margins:

Figure 12: Shares of rewards, costs, and total margins in the rice value chain from Shahjahanpur in Uttar Pradesh to Delhi

	Common Rice		Fine Rice	
Average retail price of rice in Dhaka (\$/ton)	444,23		634,6	
	Net margin	Costs	Net margin	Costs
Farmers	69	87	38	86
Rural paddy wholesalers	4	1	17	1
Millers	8	3	10	3
Urban rice wholesalers	10	1	5	1
Urban traditional retailers	9	8	30	8
Total	100 (47)	100 (53)	100 (70)	100 (30)

Reardon et al. (2012)

Figure 13: Shares of Rewards, Costs, and Total Margins in the Rice Value Chain from Heilongjiang to Beijing

	Common Rice		Fine Rice	
Average retail price of loose rice in Beijing (\$/ton)	646		866	
	Net margin	Costs	Net margin	Costs
Farmers	60	44	41	44
Millers	33	36	25	36
Urban rice wholesalers	6	11	22	11
Traditional urban rice retailers	1	7	13	7
Total	100 (58)	100 (42)	100 (69)	100 (31)

Reardon et al. (2012)

Figure 14: Shares of Rewards, Costs, and Total Margins in the Rice Value Chain from Shahjahanpur in Uttar Pradesh to Delhi

	Common Rice		Fine Rice	
Average retail price of rice in Delhi (\$/ton)	433,33		593,33	
	Net margin	Costs	Net margin	Costs
Farmers	69	63	65	61
Rural paddy wholesalers	6	2	6	4
Millers	6	7	13	9
Rural rice wholesalers ⁴	4	2	0	0
Urban rice wholesalers	3	3	7	5
Urban traditional retailers	13	22	9	22
Total	100(46)	100(54)	100(55)	100(45)

Reardon et al. (2012)

Figure 15 : Price of Thai A1 Super 100% broken rice 1990-2015

