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# Moving Up or Moving Out? Insights on Rural Development and Poverty Reduction in Senegal

Goedele VAN DEN BROECK<sup>1</sup> and Miet MAERTENS<sup>1</sup>

## Abstract

In this paper we investigate livelihood and poverty dynamics in the Senegal River Delta area in Senegal over a period of seven years. We use household survey data from two panel rounds in 2006 and 2013 and a cluster analysis to reveal which livelihood strategies and development processes have been most important in poverty reduction. We find that income growth in the region was rather modest but poverty decreased much more rapidly than in Senegal and Sub-Saharan Africa in general. We find that moving out of agriculture into wage employment in horticultural export companies and local service sectors has by far been the most successful strategy to move out of poverty for rural households. The ongoing structural transformation process in the region, that has been triggered by the development of export chains and the creation of employment in these chains, contributed importantly to rural income growth and poverty reduction. Agricultural intensification and upgrading of domestic agri-food chains are lagging behind and have not been major driving forces of income growth and poverty reduction. Our results support the view that moving out of agriculture can be a valid pro-poor rural development strategy. Moving up in agriculture remains necessary for further poverty reduction in the Senegal River Delta.

**Key Words:** rural development, poverty reduction, globalisation, foreign direct investment, export supply chains, Sub-Saharan Africa

**JEL classification:** I32, O12

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# **Moving Up or Moving Out? Insights on Rural Development and Poverty Reduction in Senegal**

## **1 Introduction**

The first Millennium Development Goal to halve by 2015 the proportion of people who are poor has been met. Worldwide progress in poverty reduction has been impressive: the global poverty headcount ratio decreased from 37.1% in 1990 to 12.7% in 2012<sup>2</sup> (World Bank, 2015). Yet, progress in poverty reduction is lagging behind in Sub-Saharan Africa (SSA), especially in rural areas. The SSA poverty headcount ratio remains high at 42.7% in 2012 and has decreased only with 14.1 percentage points from the 1990 ratio (World Bank, 2015). Strategies to further reduce poverty and stimulate, especially rural, development are still highly needed. The target of eradicating extreme poverty completely by 2030 in the new Sustainable Development Goals, will require substantial attention to development in rural areas in SSA as this is where the incidence and depth of poverty remain most problematic.

A plethora of views, paradigms and strategies for poverty reduction and rural development have been proposed. In the past two decades, most of these strategies have included elements of 1/ agricultural intensification and transformation, 2/ value chain development and market access, 3/ structural transformation, and 4/ rural infrastructure investments. These strategies have proven to be successful in realising pro-poor economic growth, but when and how these processes contribute to poverty reduction and rural development are highly context specific. Empirical evidence from regions that experienced substantial poverty reduction can give additional insights to more effectively designing pro-poor rural development policies.

In this paper we investigate livelihood and poverty dynamics in the Senegal River Delta area in Senegal over a period of seven years. During that period, the region has experienced

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<sup>2</sup> Poverty headcount ratio is based on \$1.90 a day (2011 PPP).

substantial poverty reduction and rapid rural development. Poverty incidence decreased much faster than in other parts of Senegal, or in SSA in general, which makes this a particularly relevant case to assess the factors contributing to the development of the region. We use household survey data from two panel rounds in 2006 and 2013 to estimate livelihood and poverty dynamics in the region. We apply a cluster analysis to classify households in livelihood strategy groups, to reveal which groups improved their well-being most and which income sources were most important in household income growth. We link our findings with general processes of agricultural intensification, value chain development, structural transformation and infrastructure investments.

## **2 Poverty reduction strategies in rural areas**

Four broad strategies for poverty reduction and rural development have been put forward: 1/ agricultural intensification and transformation, 2/ value chain development and market access, 3/ structural transformation, and 4/ rural infrastructure investments. We explore each strategy in turn.

First, agricultural transformation implies that smallholders move from subsistence farming to commercially-oriented farming, increase the profitability of their farming systems, and thereby improve their household income and wellbeing (Tsakok, 2011). Agricultural intensification has been a crucial element in this transformation. Already for decades, since the Green Revolution, there has been an emphasis on yield and productivity increases through increased use of inputs (e.g. mineral fertilizer, pesticides) and improved technologies (e.g. improved varieties, more efficient irrigation techniques) (Irz et al., 2001; Christiaensen et al., 2011). A more recent debate on agricultural transformation centres around paradigms for sustainable agricultural intensification, which usually involves a combination of several technologies, practices and principles (e.g. integrated soil fertility management, integrated pest management, conservation agriculture, agro-ecology) (Vanlauwe et al., 2010; Verhulst et al.,

2010; Tilman et al., 2011). While in the past agricultural intensification in SSA has mainly been associated with industrial-scale farming, in recent decades intensification of small-scale family farming became important; as witness e.g. the FAO's declaration of 2014 as the International Year of Family Farming.

Second, since the early years 2000s, value chain development received increased attention from researchers and policy makers. Apart from yield and productivity increases, also increased value-added, more efficient exchange and improved market access can contribute to increased profitability of smallholder farming systems, higher farm incomes and rural development. From a research perspective, value chain development has mostly been studied for global high-value chains, involving export-oriented production or inter- and multinational companies in the chain, and for domestic high-value chains, involving supermarkets in developing countries (Aksoy and Beghin, 2004; Dollar and Kraay, 2004; Traill, 2006; Gómez et al., 2011). It has been recognized that institutional and commercial innovations in value chains – such as quality and safety standards, product certification and differentiation, vertical coordination and contract-farming – can be an important engine for productivity and income growth but that creating inclusive value chains is a main challenge (Oya, 2012; Wang et al., 2014; Beghin et al., 2015). From a policy perspective, 'linking farmers to markets' has become an important element in rural and agricultural development strategies. If small-scale family farms are to become commercially-oriented farms, improved market access – to international as well as domestic markets – and efficient exchange is of crucial importance.

Third, structural transformation in rural areas implies that rural households shift their livelihoods away from small-scale family farming to off-farm and non-farm activities. Off-farm and non-farm activities refer to wage employment and participation in the labour market as employees as well as to self-employment and investments in non-farm businesses. Off-farm and non-farm activities do play an important role in the livelihoods of many farm-households,

either as an income-diversification and risk-reduction strategy, or as a low-season income-supplementation strategy – as has been documented by numerous studies and in different settings (e.g. Barrett et al., 2001; Rigg, 2006; Davis et al., 2010; Haggblade et al., 2010). Moreover, off- and non-farm wages frequently serve to finance agricultural input purchases, as rural credit markets are often weak (Adjognon et al., 2016). Contrary, Loison (2015) argues that growth in the rural nonfarm economy in SSA is currently neither inclusive nor redistributive, as only relatively better-off smallholders can exploit opportunities and synergies between farm and nonfarm activities. Yet, structural transformation implies a gradual or radical shift in the livelihoods of rural households from depending primarily on small-scale farming to depending on off-farm jobs and non-farm activities, which requires more lucrative off- and non-farm opportunities (Andersson Djurfeldt and Djurfeldt, 2013; Collier and Dercon, 2014). Christiaensen and Todo (2014) show that especially the rural nonfarm economy and secondary towns can contribute to more inclusive growth patterns and faster poverty reduction, while agglomeration in mega cities is associated with higher growth and increased income inequality. International organisations such as ILO, OECD and IFPRI have recently stressed the importance of off-farm employment for rural development and poverty reduction (OECD, 2006; ILO, 2008; IFPRI, 2015). In their recent Global Food Policy Report, IFPRI (2015) states that smallholder farmers should either move up in agriculture or move out the agricultural sector. In this view, only smallholders who have farm profit potential should be supported in increasing farm profitability, while others should be assisted in seeking off-farm employment.

Fourth, investments in rural infrastructure have been and remain important components in rural development (Fishbein, 2001). The poor benefit directly from the provision of essential services such as water and sanitation, energy and electricity, roads and telecommunication, and health and schooling infrastructure. Investments in rural infrastructure can stimulate economic growth; e.g. by reducing transaction costs and enabling new income-generating activities.

### **3 Research background**

#### **3.1 Research area**

Our research area is the area around the Senegal River Delta, located in the region of Saint-Louis in the northern Sahel part of Senegal, upstream of Saint-Louis town and the estuary of the Senegal River (Figure 1). It is bounded by the Senegal River and the border with Mauritania in the north-west and the N2, the national road that connects the towns of Saint-Louis, Ross-Béthio and Richard-Toll, in the east. The area stretches over two rural communities, Gandon and Diama, in two of the three departments in the region, Saint-Louis and Dagana.

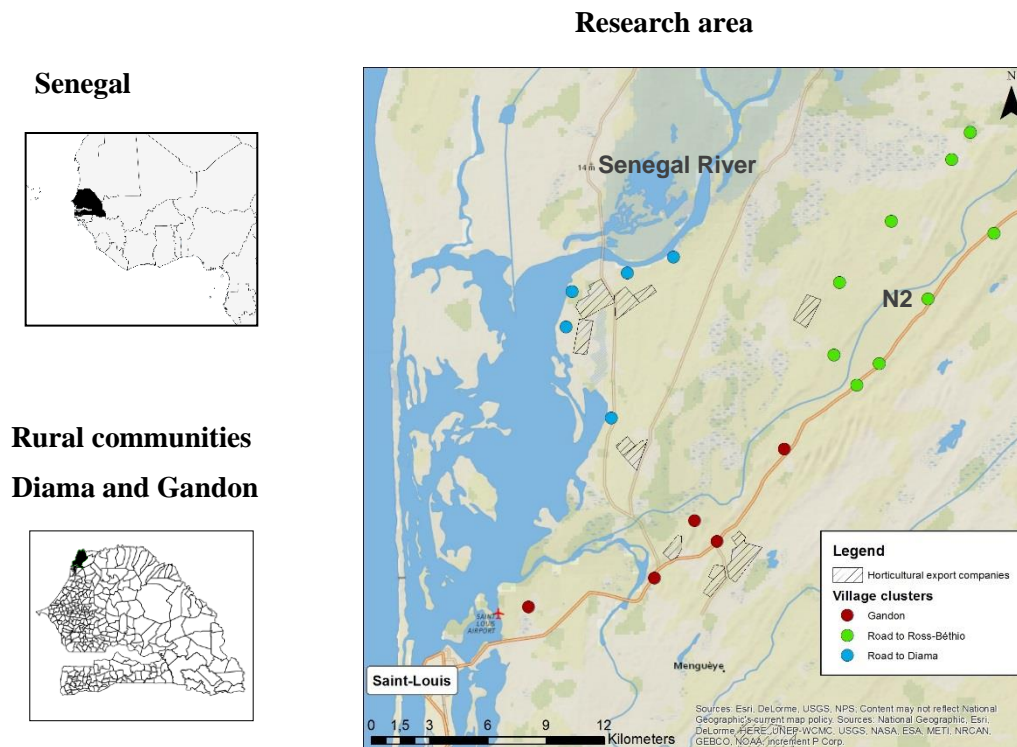
The research area is situated at the mouth of the Senegal River Valley, which is the main irrigated rice area in Senegal. The Senegal River Valley accounts for 44% of the total national rice acreage and almost 70% of national rice production (Tanaka et al., 2015). With a dry season from November to July, rice producers need to irrigate using water from the Senegal River and its tributaries. In order to increase rice production and become less dependent on imports, the Senegalese government has heavily invested in developing new irrigation perimeters or restoring neglected irrigation schemes. The entire irrigated rice area increased from 51,000 ha in 2008 to 103,000 hectares in 2011 (Sakurai, 2015).

Recently the region has become one of the two principal horticultural export areas in Senegal, besides the Niayes region north of Dakar. Since the mid 2000s five horticultural export companies established in the region, mostly through foreign direct investment, and horticultural exports from the region increased tremendously. The cultivated area is still expanding as established companies seek to expand their activities. Product variety has increased but tomatoes, beans and mangoes are the main export crops, largely destined for the European market. Production mainly occurs from October to May, when horticultural production in Europe is less competitive. The companies all use a vertical integration strategy and lease land from rural communities to establish large-scale estate farms and one or several conditioning



units. Based on interviews with the companies, we estimate that approximately 5,000 people are employed on the fields and in the conditioning units of the companies in 2013; of which 80% female workers. The employees have daily, seasonal or more permanent labour contracts with the companies.

Households in the research area belong to Wolof, Peulh and Maure ethnic groups. The majority of them are Muslim and live in large extended families within one compound. Polygamy is common in the area, with members of polygamist households living in the same compound (often referred to as polygynous extended family households). Traditionally, households in the research area are farm-households deriving the majority of their income and livelihood from cropping and livestock-rearing. Cropping is traditionally most common for Wolof households while Maure people are typically goat-keepers and Peulh cattle herders; the latter used to be (semi-)nomadic but started to become sedentary from the 1970s onwards. This traditional ethnic livelihood distinction is becoming faint and farm activities are becoming more mixed. Cropping systems currently include irrigated rice production and vegetable production with onions, tomatoes and beans as most common crops. Commercial livestock activities include selling of meat and milk from cattle, goats and sheep. Households complement their farm income with wages earned in the horticultural export companies. Small business activities, such as petty trade, hairdressing and tailoring are also common in the area.



**Figure 1: Map of research area: sampled villages in the rural communities of Gandon and Diamas. Source: ESRI (Environmental Systems Research Institute)**

### 3.2 Data collection

We conducted fieldwork in this area in the period 2006 - 2013 and collected data and information from several sources. First, we conducted semi-structured interviews with the major investors and research institutes in the area, and compiled existing reports and secondary statistics on the area. We interviewed all five horticultural export companies – the oldest ones several times throughout the period – on production activities, sourcing strategies, employment strategies and working conditions. We interviewed international and government agricultural research institutes and extension agencies to get information on investments in rice and livestock production in the area: AfricaRice, ISRA (*Institut Sénégalais de Recherches Agricoles*), and SAED (*Société d'Aménagement et d'Exploitation des terres du Delta du Fleuve Sénégal*). We also interviewed APIX (*Agence de Promotion des Investissements et Grand Travaux*), a national investment promotion agency.

Second, we conducted a two-round household survey in the area, with the first baseline round implemented in February - April 2006 and the second follow-up round in April - June 2013. The first survey round covered 284 households in 17 villages across the two rural communities Gandon and Diama. We used a two-stage stratified sampling design. In the first stage, villages were stratified according to their distance to the road and randomly selected within the strata with an oversampling of villages closer to the road. This resulted in three clusters of sampled villages: 1/ villages located along the N2 north-east of Gandon in the community of Diama, 2/ villages located along the smaller road to the Senegal River dam and the border with Mauretania, and 3/ villages in the community of Gandon (Figure 1). In the second stage, households in the sampled villages were stratified according to whether or not members of the household are employed in the horticultural export industry and randomly selected within the strata with an oversampling of households with employment. To draw population inferences from descriptive statistics, we use sampling weights to correct for the oversampling of households close to the road and employed in the horticultural export sector. The weights are calculated with census information from the rural communities and villages. We complemented the household survey with a village survey to collect information on geographical and institutional characteristics of the sampled villages.

For the second survey round, we tried to resurvey all the households from the original sample but 25 households moved out of the region, an attrition rate of 8.8%. We do not know the reasons of their resettlement, but attrition bias is deemed to be sufficiently low because the relocated households are not statistically different from other sampled households. Four observations were not retained for the analysis in this paper because of missing information. The final sample consists of a balanced panel data set of 255 households.

We used a structured quantitative questionnaire with different modules. We used the same questionnaire in both survey rounds but in the follow-up survey some less relevant modules

were dropped while some potentially relevant modules were added. The survey data include information on demographic characteristics, productive assets, living standards, and income sources from agricultural production (both crop and livestock production), off-farm wage employment and self-employment, and non-labour income (mainly remittances). Income data are collected for the 12-month period prior to the survey.

## **4 Methods**

### **4.1 Income, poverty and inequality calculations**

We calculate total household income and income per adult equivalent from the survey data for both survey rounds. We use real income data to compare income over time and inflate all income data to 2013 price levels using consumer price indices (IMF, 2015). We use the modified OECD adult-equivalence scale, which assigns a value of 1 to the household head, 0.5 to each additional adult member and 0.3 to each child. We derive incidence of poverty and extreme poverty using the national rural poverty and extreme poverty line of 2011 (République du Sénégal, 2014). A household is poor if per adult equivalent income is lower than 225,909 FCFA per year and extremely poor if it is lower than 141,521 FCFA per year<sup>3</sup>.

### **4.2 Cluster analysis**

We classify the households in our sample according to the income-generating activities or livelihood strategies (LS) they pursue in the period 2006 - 2013. We use survey data on households' labour and time allocation. We distinguish four main income-generating activities: crop production, livestock rearing, off-farm wage employment and self-employment. We use eight variables for both years in the cluster analysis. The first four variables describe households' labour allocation to the four activities and are defined as the share of the available family labour spent on each of the four main activities (i.e. the number of actual workers in an activity over the total number of workers in the household). The other four variables describe

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<sup>3</sup> The national currency FCFA stands for *Franc Communauté Financière d'Afrique* and has a fixed exchange rate to the Euro: €1 is 655.957 FCFA.

the time allocation of individual household members and are defined as the share of labour time spent by household members on each of the four main activities (i.e. the actual time spent by workers in an activity over workers' total labour time). We use proportional values rather than absolute values as these better reflect the chosen LS and are not sensitive to outliers in household sizes. We calculate the eight labour and time allocation variables for both survey years and use these 16 variables to capture households' livelihood strategy in the period 2006 - 2013.

The rationale behind our approach is that labour allocation, rather than the income portfolio, reflects households' strategies. The approach fits within the conceptual framework proposed by Ellis (2000) and is in line with a stream of studies that classify LS based on the productive assets of a household, including land and labour (e.g. Jansen et al., 2006; van den Berg, 2010). Other studies follow other approaches to distinguish LS. For example, Babulo et al. (2008) and Rahman and Akter (2014) base their classification on income sources. However, income is rather a short-term result of the actions undertaken by a household and is heavily influenced by temporal and exogenous shocks. Other studies cluster LS based on the factors that determine households' decisions to participate in activities, such as human capital and location (e.g. Petrovici and Gorton, 2005; Ansoms and McKay, 2010).

We apply a factor and cluster analysis to quantitatively classify households in LS classes. We start with a factor analysis to reduce the correlation between the 16 labour and time allocation variables. We retain four factors with an eigenvalue higher than one, and perform a varimax rotation to ease the interpretation of the factor loadings. We then use the predicted factor scores as input for the cluster analysis, which exists of two parts. We start with a hierarchical clustering method using Ward's linkage and squared Euclidean distance as similarity measure. We then apply a k-means cluster analysis to correct for possible misclassification of observations at the boundaries between clusters, using the number of

clusters and the means of each variable of the Ward's linkage clustering as starting values for the k-means analysis. We determine the number of clusters based on the dendrogram and find that heterogeneity is maximized across clusters and minimized within clusters if four clusters are retained. Hence, this analysis results in four LS classes.

### **4.3 Multinomial logit model**

To reveal which household characteristics determine households' LS, we run a multinomial logit model. As dependent variable we use the LS that a household follows. As covariates in the model we include indicators of human capital (age, gender and schooling of the household head, total number of household members and dependency ratio), physical capital (land and livestock assets), social capital (ethnicity), and location (village dummies). To avoid reverse causality, we use baseline (2006) covariate values only. We additionally include a variable that controls for a change in household head between 2006 and 2013, as the decease of a household head might cause an abrupt change in households' LS. We calculate and report average marginal effects, which are interpreted as the effect of a one unit change in an explanatory variable on the probability of a household selecting a particular LS.

## **5 Results: income, poverty and livelihood dynamics**

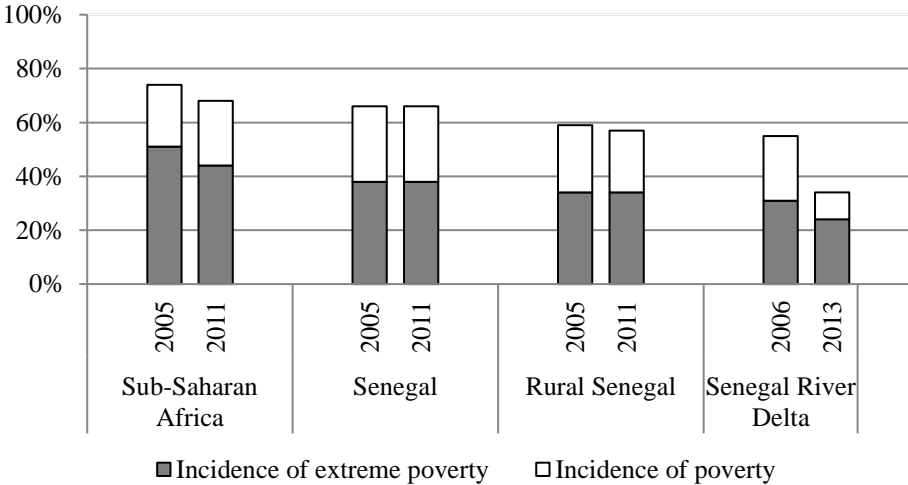
### **5.1 Income and poverty dynamics**

Between 2006 and 2013, average total household income has increased with 21.7% in the Senegal River Delta, which comes down to an annual income growth rate of 2.9%<sup>4</sup>. This is lower than the annual gross domestic product (GDP) growth rate of Senegal in general or at the regional level of SSA (3.5% and 4.6% respectively in 2013) (World Bank, 2015). However, while income growth has been moderate in the Senegal River Delta, the rate at which poverty is reduced is spectacular. The share of poor households decreased from 54.1% to 34.9% - a reduction of 19.2 percentage points - and the share of extremely poor households from 30.6%

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<sup>4</sup> We additionally calculate income inequality and find a Gini coefficient of 44.2 in 2006 and 45.1 in 2013.

to 23.9% - a reduction of 6.7 percentage points (Figure 2). In Senegal in general, the incidence of poverty and extreme poverty even increased between 2005 and 2011 (from 65.8% to 66.3% and from 37.6% to 38.0%) (World Bank, 2015)<sup>5</sup>. At regional level in SSA, poverty decreased with 5.2 percentage points from 73.5% in 2005 to 68.3% in 2011 and extreme poverty with 6.1 percentage points from 50.5% to 44.4% (World Bank, 2015). Thus, the rate at which poverty decreased in the Senegal River Delta in recent years is much higher than in other rural regions of Senegal, or in SSA in general.



**Figure 2: Headcount ratio of people living below poverty and extreme poverty lines.**  
**Source: République du Sénégal (2014), World Bank (2015) and own calculations.**  
 Poverty measures of SSA and Senegal are based on international poverty lines, and poverty measures of Rural Senegal and Senegal River Delta are based on national rural poverty lines.

**5.2 Livelihood strategies**

We performed a cluster analysis based on the labour and time allocation of household members in 2006 and 2013 (see table A1 in appendix for details on the outcome). From this cluster analysis we identify four different livelihood strategies (LS) in the Senegal River Delta (Figure 3): 1/ crop production and self-employment (LS1); 2/ livestock rearing and self-employment (LS2); 3/ transition to wage employment (LS3); and 4/ wage employment (LS4). Table 1

<sup>5</sup> Incidence of poverty / extreme poverty is measured as the percentage of the population living on less than \$3.10 a day / \$1.90 a day at 2011 international prices.

presents the importance of the different livelihood strategies in the research area and their geographical distribution across the three sub-regions (Gandon, Road to Diama and Road to Ross-Béthio). Households of LS1 use most of their family labour to work on their own farm fields and in off-farm businesses. This category represents 49% of the households in the Senegal River Delta and is by far the largest group. They live further away from Saint-Louis town, mainly along the road to Ross-Béthio and close to a tributary of the Senegal River as they need water to irrigate their rice fields. The labour and income allocation of LS2 does not change much over time and only six percent of the households belong to this relatively small cluster. LS2 is common among households of Maure ethnicity that live along the road to Diama. Households of LS3 mainly allocate their family labour to self-employment and wage employment in 2006, while wage employment is the sole main activity in 2013. They represent 29% of the households in the research area and they live closer to Saint-Louis town. Wage employment is the main source of income of LS4 both in 2006 and 2013. Sixteen percent of the households belong to this cluster and LS4 is common among large households that live close to Saint-Louis town and the horticultural export company that was established in 2003.

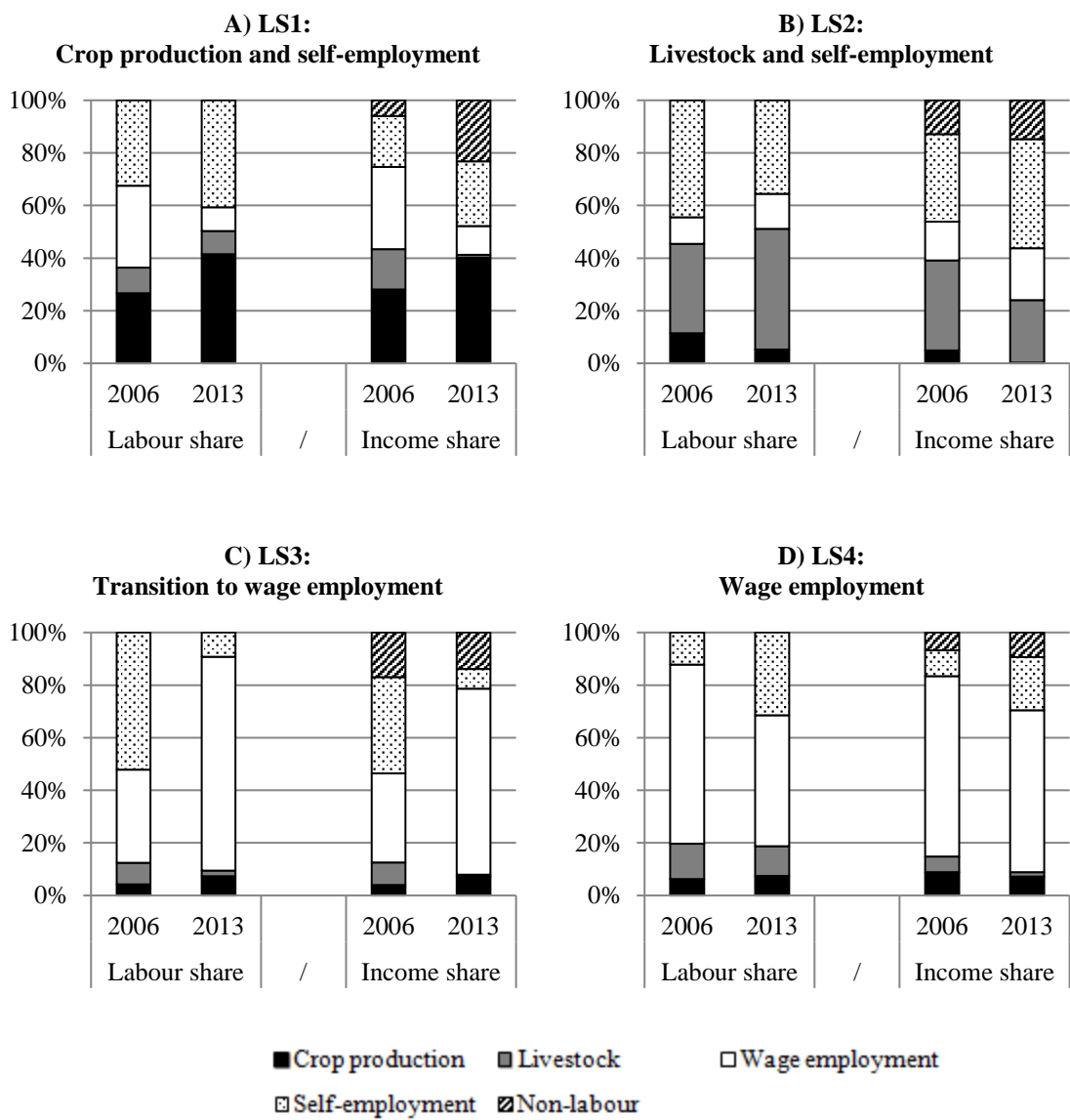
**Table 1: Location of livelihood strategies.**

Livelihood strategy (LS)	Population share in the Senegal River Delta	Sample share in the LS classes		
		Gandon	Road to Diama	Road to Ross-Béthio
LS1: Crop production and self-employment	48.95%	21.24%	17.96%	60.80%
LS2: Livestock and self-employment	6.35%	5.84%	69.01%	25.14%
LS3: Transition to wage employment	29.13%	75.09%	14.75%	10.16%
LS4: Wage employment	15.57%	88.51%	4.07%	7.42%

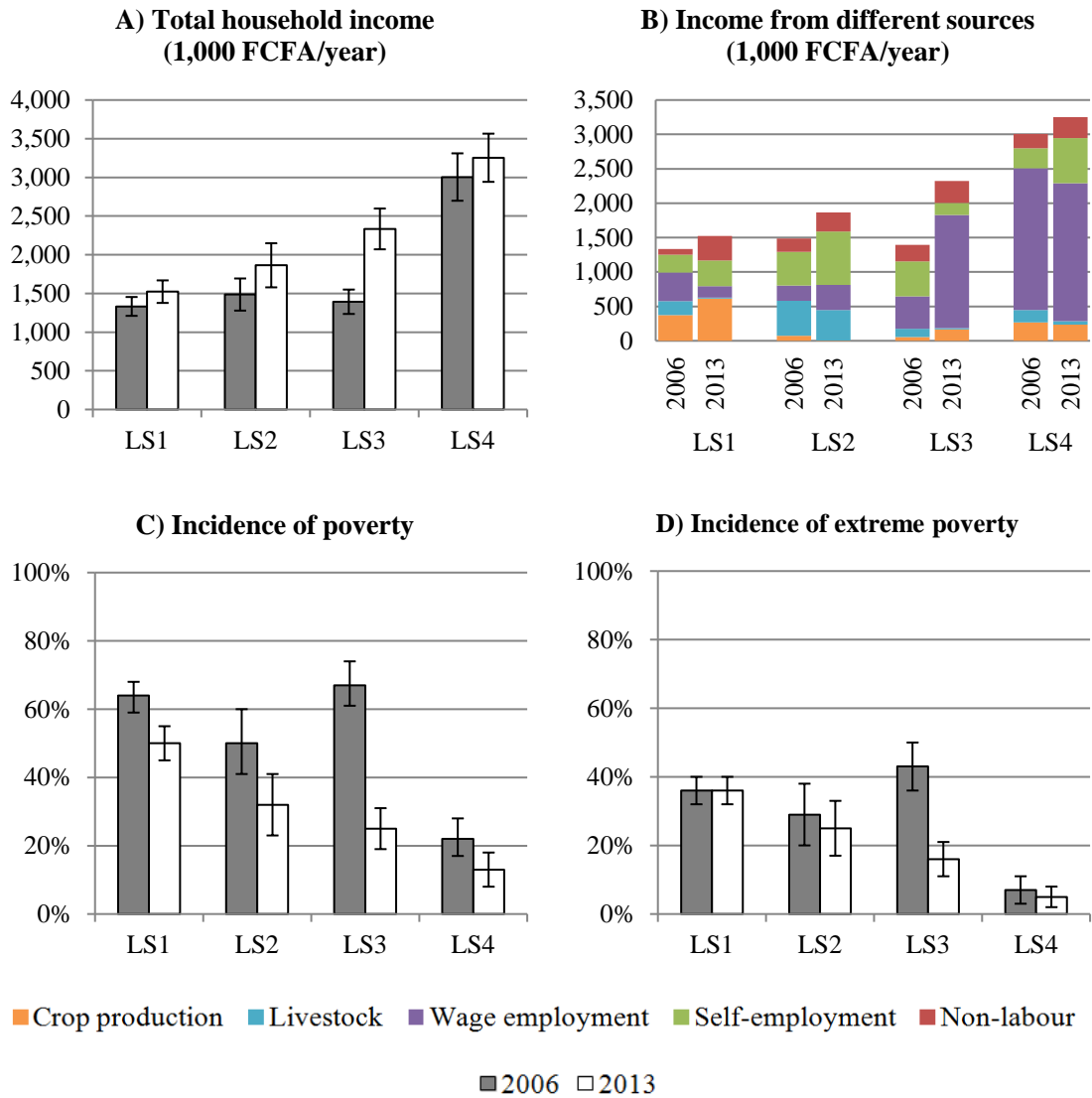
Sampling weights are taken into account. 'Gandon' represents a cluster of villages along the N2 road close to Saint-Louis town and the horticultural export company that was established in 2003. 'Road to Diama' represents a cluster of villages along the road to Diama dam where two horticultural companies started exporting in 2007. 'Road to Ross-Béthio' represents a cluster of villages along the N2 road further away from Saint-Louis town.



Figure 4 presents for each LS how income and poverty levels changed over time. We observe three main trends in these income and poverty dynamics. First, all LS were able to boost income and reduce poverty, although not all to the same extent. For example, the incidence of poverty among households of LS1 decreased with 14.9 percentage points, but the incidence of extreme poverty did not change over time. Their increase in total income is mainly driven by an increase in income from crop production and non-labour income, but is mitigated by a decrease in income from wage employment. Similarly, the incidence of poverty among households of LS2 decreased with 17.9 percentage points, but the incidence of extreme poverty did not decrease significantly over time. Especially self-employment contributed to their welfare improvement: it increased from 493,000 FCFA (33% of total household income) to 773,000 FCFA (52% of total household income). Second, households of LS3 experienced the highest income growth and poverty reduction. While households of this category were amongst the poorest in 2006, their poverty headcount ratio reduced to 25.5% in 2013. Their spectacular increase in income is mainly driven by an increase in income from wage employment; it almost quadrupled from 472,000 FCFA in 2006 (34% of total household income) to 1,646,000 FCFA in 2013 (71% of total household income). Third, households of LS4 have overall the highest income levels and lowest poverty levels. The difference in welfare with other strategies is more pronounced in 2006 than in 2013, as the income increase over time of other strategies was relatively larger. Households did not change their activities much over time, except for self-employment. While 38% of the households had their own off-farm business in 2006, this increased to 80% in 2013.



**Figure 3: Shares of average labour and income allocation of four different livelihood strategies (LS).** A) LS1: Crop production & self-employment, B) LS2: Livestock & self-employment, C) LS3: Transition to wage employment and D) LS4: Wage employment.



**Figure 4: Income and poverty levels of four livelihood strategies (LS) in 2006 and 2013.** A) Total household income (1,000 FCFA/year), B) Income from different sources (1,000 FCFA/year), C) Share of households who live below national rural poverty line and D) Share of households who live below national rural extreme poverty line. LS1: Crop production & self-employment, LS2: Livestock and self-employment, LS3: Transition to wage employment and LS4: Wage employment. Error bars represent the standard error of the means.

Table 2 presents the average marginal effects of the multinomial logit model with LS as dependent variable. LS1 is followed by smaller households with large landholdings, while the probability of following LS2 increases with 0.6% with each additional livestock unit. LS3 is followed by households who have limited productive assets (land and livestock) but who have a large family labour force. Characteristics of the household head (age, gender or education) do

not seem to influence the choice of livelihood strategy; neither does the change of a household head.

**Table 2: Average marginal effects of multinomial logit model with livelihood strategy as dependent variable.**

	LS1: Crop production and self-employment	LS2: Livestock and self-employment	LS3: Transition to wage employment	LS4: Wage employment
HH head change (dummy)	-0.069 (0.095)	-0.012 (0.078)	0.011 (0.069)	0.070 (0.069)
Age of HH head (years)	0.000 (0.003)	0.000 (0.002)	-0.001 (0.002)	0.000 (0.002)
Female HH head (dummy)	0.044 (0.142)	0.076 (0.080)	-0.031 (0.114)	-0.090 (0.110)
HH head education (dummy)	-0.025 (0.076)	0.041 (0.049)	-0.030 (0.064)	0.014 (0.054)
HH size (number)	-0.008 ** (0.004)	-0.004 (0.003)	0.009 *** (0.003)	0.004 (0.003)
Dependency ratio (%)	-0.057 (0.179)	0.027 (0.112)	-0.020 (0.161)	0.050 (0.158)
Cultivated land (ha)	0.073 ** (0.031)	-0.027 (0.026)	-0.058 * (0.035)	0.012 (0.025)
Total livestock units (TLU)	0.012 (0.008)	0.006 *** (0.002)	-0.026 * (0.014)	0.007 (0.006)
Ethnicity dummies	Included	Included	Included	Included
Village dummies	Included	Included	Included	Included

Covariate values are for 2006. Standard errors are reported between parentheses. HH means household. Significant effects are indicated with \*  $p < 0.1$ , \*\*  $p < 0.05$  or \*\*\*  $p < 0.01$ .

## 6 Discussion: Factors contributing to income growth and poverty reduction

In this section we describe and discuss the main factors behind the income and poverty dynamics in the Senegal River Delta and the observed differences across households with different LS. We structure this discussion based on the rural development strategies discussed in section 2 and discuss factors related to structural transformation, agricultural intensification and transformation, value chain development and rural infrastructure investments.

### 6.1 Structural transformation

#### 6.1.1 Rural employment creation by horticultural export companies

The horticultural export companies have created many off-farm employment opportunities, allowing households to participate in the labour market. Especially households of LS3 and LS4

are employed in the export companies and their wages contribute importantly to their high income level. Maertens et al. (2011) previously showed that the wages these employees earn, add importantly to total household income and that household income is substantially larger in the households of these employees. Table 3 describes some characteristics of employment in the horticultural export companies. In general, the share of employed households increased over time from 30.3% in 2006 to 42.0% in 2013. This is explained by the fact that after 2006 new horticultural export companies invested in the Senegal River Delta and created more jobs in the region. The employment duration per year increased over time as well; workers are hired on average 136 days in 2006 and 163 in 2013, but employment in the horticultural export companies remains mainly seasonal. Average daily wages did not change over time, but wages are 66.7% higher than the national minimum wage of 1,500 FCFA per day. Another striking characteristic of employment in the horticultural export companies is the high share of female labour. More than half of the labour-days in the companies are on the account of women in the household. Previous research has shown that the creation of off-farm employment opportunities for women in the area lead to increased female empowerment, increased child schooling and reduced fertility rates (Maertens and Swinnen, 2012; Maertens and Verhofstadt, 2013; Van den Broeck and Maertens, 2015).

**Table 3: Characteristics of employment in horticultural export companies and in the service sector.**

	Employment in horticultural export companies		Employment in service sector	
	2006	2013	2006	2013
Share of employed households <sup>1</sup> (%)	30.28	41.98	10.46	25.24
		***		***
Number of workers per employed household <sup>2</sup>	3.15 (0.22)	2.12 (0.14)	1.15 (0.09)	1.51 (0.11)
		***		**
Daily wage (FCFA/day)	2,537 (88.00)	2,550 (91.00)	3,002 (409.00)	4,982 (556.00)
		***		**
Number of days employed per worker <sup>2</sup>	135.99 (7.39)	163.22 (6.75)	215.35 (19.25)	244.98 (13.00)
		***		
Share of female labour <sup>3</sup> (%)	56.19 (2.91)	52.02 (3.69)	21.79 (8.05)	33.47 (6.18)

<sup>1</sup>Population statistics are derived using sampling weights.

<sup>2</sup>Conditional on being employed.

<sup>3</sup>Calculated as number of female man-days employed over total number of man-days employed per household.

Significant differences are indicated with \*  $p < 0.1$ , \*\*  $p < 0.05$  or \*\*\*  $p < 0.01$ .

Standard errors are reported between parentheses for continuous variables.

### 6.1.2 Development of a rural service sector

Not only horticultural export companies created employment opportunities in the region, the labour market in general has evolved. The demand for jobs in the service sector has grown as income of rural households increased. The jobs in this sector are highly heterogeneous, as they comprise both low-skilled professions, such as domestic workers, hairdressers and garment-workers, and high-skilled professions, such as teachers and civil servants. The jobs are partially performed in Saint-Louis town and the more urbanised villages that are closely located to Saint-Louis town, mainly by households of LS3 and LS4. Table 3 describes some characteristics of employment in this sector. On average, the share of employed households as well as the number of workers per household increased, illustrating the growing importance of the service sector in the Senegal River Delta. Wages earned in this sector are quite high and increased from 3,000 FCFA per day on average in 2006 to almost 5,000 FCFA in 2013, but they vary substantially across professions, as indicated by the high standard error. A large difference with employment in the horticultural export sector is that workers are nearly year-round employed. The share of

female labour in the service sector is lower – likely because of the need for more skills and women’s lower level of education - but has increased substantially over the seven year period.

Also employment in own off-farm businesses increased among rural households in the Senegal River Delta. The share of households involved in self-employment did not change over time in the area (53% in 2006 and 51% in 2013), but the income from self-employment increased modestly in all LS categories, except for LS3. This self-employment includes a variety of businesses, mainly services, that are done by men as well as women, such as petty trading, construction works and taxi services. These businesses are mainly located within the villages or along the roads. Some of these businesses are directly linked to the horticultural companies and associated employment, such as food and drink stalls serving employees at the company gates, and transport services from and to the companies. The income from self-employment in category LS4 increased most substantially and the number of households with own businesses in this category increased from 38% to 80%. This suggests some spill-over effects whereby wages earned in off-farm employment are invested in own businesses with a relatively high return. Contrary, the income from self-employment for households in category LS3 decreased substantially, and the share of households involved in self-employment decreased from 61% to 27%. These households likely traded less remunerative off-farm businesses for wage employment.

### **6.1.3 Migration and remittances**

Migration is also part of households’ livelihood strategies in the research area. Non-labour income consists mainly of remittances (53% in 2006 and 74% in 2013) and has increased over time for all LS while average household size decreased (from 15.3 in 2006 to 11.1 in 2013). The share of remittances in total household income is largest for LS1, which is the category with the lowest income growth and poverty reduction. Migration is related to structural transformation as members likely migrate out of their rural villages in search of non-farm jobs

in urban and peri-urban areas or abroad. Unfortunately our data are not detailed enough to describe migration destinations and reasons, and to establish a better link between members leaving the household and households receiving remittances.

The findings in section 6.1 imply that the ongoing structural transformation process in the Senegal River Delta contributed importantly to rural income growth and poverty reduction. Moving out of agriculture into wage employment in horticultural export companies and local service sectors has by far been the most successful strategy to move out of poverty for rural households.

## **6.2 Agricultural transformation and intensification**

### **6.2.1 Crop production**

Crop production remains important in households' livelihoods in the Senegal River Delta, especially for households in the category LS1, which includes about half of the population. Their increase in income is mainly driven by an increase in income from crop production, indicating that cultivation became more profitable over time. In Table 4, we present some statistics related to crop production for the whole area and for sampled households in LS1. Rice is the main cultivated crop, grown by 36% of household in the area, but farmers increasingly produce other crops as well, such as tomatoes, beans and onions. Increases in crop income mainly follow from rice area expansion and rice price increases, and not from yield increases. Average rice yields decreased over time, from an average of 4.72 ton/ha in 2006 to 3.26 in 2013. These yields are comparable to the average of 3.62 ton/ha in irrigated rice cultivation in SSA (Rodenburg and Johnson, 2009), but far below potential yields that can mount up to 9-12 ton/ha (Diagne et al., 2013). The use of inputs, such as fertilizer and pesticides, did not change over time either, as nearly all farmers applied already these inputs in 2006. Our data are not detailed enough to estimate changes in the quantity of fertilizer or pesticides applied. On the other hand, farmers in LS1 were able to expand their landholdings; the average area cultivated



with rice increased from 1.56 ha to 3.40 ha. All rice plots are irrigated and nearly all plots are owned by the households who cultivate them; only very few plots (3% in 2013) are rented. In addition, the farm-gate price of rice increased substantially over the seven-year period; it more than doubled from 126 FCFA/kg in 2006 to 281 FCFA/kg in 2013 (we explain this further in section 6.3). This price increase contributed substantially to the incomes of rice producers.

**Table 4: Characteristics of crop production**

	Senegal River Delta <sup>1</sup>		LS1: Crop production and self-employment	
	2006	2013	2006	2013
Share of households involved in crop production (%)	48.64	44.58	75.21	71.90
Share of households involved in rice production (%)	39.35	35.85	70.25	57.85 **
Share of households involved in horticultural production (%)	3.70	11.30	13.22	8.26
Number of crops <sup>2</sup>	1.54	1.87	1.42	1.63
	(0.15)	(0.15)	(0.08)	(0.10)
Rice yield (kg/ha)	4,720	3,261	3,668	2,804 ***
	(771)	(510)	(206)	(265)
Rice area <sup>2</sup> (ha)	1.46	1.08	1.56	3.4 *
	(0.24)	(0.16)	(0.18)	(1.32)
Rice selling price (FCFA/kg)	126.59	281.05 ***	124.5	261.93 ***
	(8.83)	(32.18)	(4.86)	(21.33)
Share of rice sold (%)	13.93	39.47 ***	27.44	43.28 ***
	(2.69)	(6.71)	(2.94)	(0.04)

<sup>1</sup> Population statistics are derived using sampling weights.

<sup>2</sup> Conditional on having crop production.

Significant differences are indicated with \*  $p < 0.1$ , \*\*  $p < 0.05$  or \*\*\*  $p < 0.01$ .

Standard errors are reported between parentheses for continuous variables.

### 6.2.2 Livestock rearing

Although livestock is kept by more than half of the households in the Senegal River Delta, it plays a small role as income generating activity, except for households following LS2 (Table 5). The share of households that own cattle or small ruminants (i.e. goats and sheep) in the Senegal River Delta decreased over time, but the average herd size of livestock owners remained the same. Households in category LS2 increased the number of small ruminants and cattle. Compared to other LS, they also provide more inputs for livestock; e.g. 73% gave

industrial feed to their cattle in 2013 (especially in the dry season), while this is only 34% for all other cattle holders in the sample. Despite herd expansion and some intensification, the average livestock income for households in LS2 did not increase over time. This suggests that livestock is not commercially managed but rather used as savings mechanism, and that meat and milk production are mainly consumed by the households.

**Table 5: Characteristics of livestock rearing**

	Senegal River Delta <sup>1</sup>		LS2: Livestock and self-employment	
	2006	2013	2006	2013
Share of households who own livestock (%)	59.95	49.68	92.86	100.00
Share of households who own cattle (%)	25.79	13.20 *	64.29	78.57
Share of households who own small ruminants <sup>2</sup> (%)	52.65	38.04 *	85.71	89.29
Total herd size <sup>3</sup> (TLU)	8.58	5.43	16.75	20.62
	(1.81)	(1.12)	(5.05)	(3.86)
Number of cattle <sup>3</sup>	6.04	3.60	13.08	15.50
	(1.51)	(0.99)	(4.35)	(3.08)
Number of small ruminants <sup>3</sup>	9.59	7.05	11.62	24.54 *
	(0.02)	(0.01)	(2.39)	(5.97)

<sup>1</sup> Population statistics are derived using sampling weights.

<sup>2</sup> Small ruminants are goats and sheep.

<sup>3</sup> Conditional on livestock ownership.

Significant differences are indicated with \*  $p < 0.1$ , \*\*  $p < 0.05$  or \*\*\*  $p < 0.01$ .

Standard errors are reported between parentheses for continuous variables.

Our findings in section 6.2 indicate that agricultural intensification has not been a major driving force of income growth and poverty reduction in the Senegal River Delta. There were no important productivity increases in agriculture, neither in rice production nor in livestock-rearing. Farm incomes increased due to rice area expansion, price increases and expansion of cattle herds. Income growth has been much less substantial and poverty reduction much slower for households who remained in agriculture (LS1 & 2) than for households moving out to wage employment (LS3 & 4). Our findings document the government policy of stimulating rice area expansion by developing new irrigation perimeters. This policy was heavily criticized: studies

by de Mey et al. (2012), Demont and Rizzotto (2012) and Diagne et al. (2013) stress the need to increase rice productivity by tackling the various institutional and biological constraints that smallholder rice farmers in the Senegal River Delta face. As a response to these concerns, the government modified the program in 2012 towards subsidizing fertilizer, providing agricultural equipment and attracting private investors in addition to area expansion (République du Sénégal, 2012). The effects of these investments are not yet visible in our data.

### **6.3 Value chain development and market access**

#### **6.3.1 Local rice value chain**

As already indicated (Table 4), the farm-gate price of rice more than doubled over the seven-year period. This price increase is not driven by supply chain upgrading, quality upgrading or higher local demand, but is associated with fluctuations in international market prices and the price shocks of 2008-2009. The international rice price was on average about \$300 per ton in the 2005-2006 season and about \$570 per ton in the 2012-2013 season, which corresponds to 150 and 285 FCFA/kg respectively (World Bank, 2015). Despite the efforts of the government to render Senegal self-sufficient in rice production, the country remains a net rice importer. While the international price increase lowers purchasing power of net rice consumers, it boosts the income of rice producers. With a sharp price increase and a substantially expanded rice area, farmers are selling an increased proportion of total rice production (14% in 2006 and 40% in 2013). Yet, if prices start to fall down again and revenues are not invested in improving rice production or upgrading the rice supply chain, farmers remain vulnerable to downward price shocks.

#### **6.3.2 Horticultural export chain**

Employment in horticultural export companies and the development of a horticultural export supply chain have been major drivers of poverty reduction in the research region. Horticultural exports from Senegal increased tremendously over the past years – from 5.8 billion US\$ in

2003 to 57.7 billion US\$ in 2014 (Comtrade, 2015). The sharp boom in horticulture exports fits within Senegal's strategy of agricultural export diversification towards higher-value commodities, which was adopted since the devaluation of the FCFA in 1994 and after decades of dependency on groundnuts as the main agricultural export commodity throughout the 1960s, 1970s and 1980s. The development of the horticultural export chain is the result of private investments by the export companies, mainly foreign direct investment, and public investments. The government has played an active role in attracting foreign investors in the sector – through the investment promotion agency APIX that was established in 2000; in establishing cold storage facilities at the airport and the main harbour in Dakar, laboratory testing of food quality and safety aspects; and the establishment of the label *Origine Senegal* in 2010 as a tool to promote fruit and vegetable exports from Senegal. The sector also received some donor support, e.g. assistance from the ColeACP-PIP program financed by the EU.

In the value chain literature, the horticultural export chain in the Senegal River Delta would be called an 'exclusive chain' because it is completely vertically integrated and thereby completely excludes local smallholder farmers as suppliers in the chain (Reardon et al., 2009; Maertens et al., 2012). Yet, the chain includes a large number of local households as employees and our findings document that this employment has been a main source of income growth and poverty reduction. It is often argued that globalisation and export chain development leads to upward mobility but that only households who are better-off in terms of assets are able to profit from globalised trade (Winters et al., 2004). This does not hold for the case of horticultural export chain development in the Senegal River Delta. The results from the multinomial logit model (Table 2) show that especially larger households with less land and livestock move out of agriculture and shift to wage employment. The development of the horticultural export supply chains has been very pro-poor despite developing into a vertically integrated (or 'exclusive') chain.

Our findings in section 6.3 indicate that the development of the horticultural export chain, and particularly wage employment in the chain, has been a major driver of income growth and poverty reduction in the Senegal River Delta, but that upgrading of domestic chains, especially the rice supply chain, remains necessary for boosting farm incomes.

#### **6.4 Rural infrastructure investments**

In the Senegal River Delta, both public and private investments have been carried out to improve rural infrastructure. The Senegalese Poverty Reduction Strategy focuses on increasing access to water, electricity and telecommunication (République du Sénégal, 2006). Additionally, the horticultural export companies have invested in infrastructure, including the construction of a concrete road in 2007 to improve company access, and the building of schools and health posts as part of companies' commitment in rural development projects.

Table 6 presents how infrastructure in the Senegal River Delta improved during the seven-year period. Access to electricity increased with 30 percentage points and access to clean drinking water with 46 percentage points. While less than half of the households had access to clean water or owned a telephone in 2006, nearly all households do so in 2013. The government target to increase rural access to water to 82% and electricity to 30% by 2015, have been exceeded in the Senegal River Delta. These infrastructure improvements benefited all households by directly improving their living conditions. Because of the road construction to the Diama dam, more households live closer to a concrete road in 2013 than in 2006. This has benefitted many households in the region through increasing the access to employment in the horticultural companies and reducing transaction costs for exchange with Saint-Louis town. The road might have played a role in stimulating the rural service sector and off-farm businesses; e.g. for households from category LS2 the new road has been beneficial because it facilitated selling handcrafts (e.g. woven tapestries) to tourists in Saint-Louis town.

**Table 6: Rural infrastructure indicators**

	2006	2013	
Access to electricity (%)	45.09	75.26	***
Access to clean drinking water (%)	48.39	94.62	***
Telephone ownership (%)	47.58	99.05	***
Distance to nearest concrete road (km)	3.65	1.59	***
	(0.59)	(0.29)	

Population statistics are derived using sampling weights.

Significant differences are indicated with \*  $p < 0.1$ , \*\*  $p < 0.05$  or \*\*\*  $p < 0.01$ .

Standard errors are reported between parentheses for continuous variables.

## 7 Conclusion

We find that over the period 2006-2013, average household income in the Senegal River Delta grew with 21.7 percent, poverty reduced with 19.2 percentage points and extreme poverty with 6.7 percentage points. While average income growth has been rather modest, we can conclude that economic growth in the area has been pro-poor. Poverty decreased much more rapidly in the region than in Senegal and Sub-Saharan Africa in general.

Our findings imply that the ongoing structural transformation process in the Senegal River Delta, that has been triggered by the development of export chains and the creation of employment in these chains, contributed importantly to rural income growth and poverty reduction. Moving out of agriculture into wage employment in horticultural export companies and local service sectors has by far been the most successful strategy to move out of poverty for rural households. This is in sharp contrast with the view that globalisation increases inequality and with the view that food export supply chains need to be smallholder-based (or 'inclusive') in order to be pro-poor. Our results support the view that moving out of agriculture can be a valid pro-poor rural development strategy, and call for rural development policies with attention for attracting private investments to rural areas, for employment creation and rural labour market development, and for development of a rural service sector.

Our findings indicate that agricultural intensification and productivity increases in agriculture have not been major driving forces of income growth and poverty reduction in the

Senegal River Delta. More than half of the population in the region remains primarily dependent on agriculture – cropping and livestock rearing – for their livelihoods. Upward price shocks in the international rice market have benefitted these households but these increased revenues might only be very temporarily and farmers remain vulnerable to downward price shocks. Moving up in farming through productivity increases and upgrading of domestic agri-food chains, especially the rice supply chain, remains necessary for further poverty reduction in the Senegal River Delta.

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## Annex

**Table A1. Cluster analysis of different livelihood strategies**

Livelihood strategy	1		2		3		4	
	Crop production and self-employment		Livestock and self-employment		Transition to Wage employment		Wage employment	
Number of observations	121	47%	28	11%	51	20%	55	22%
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
2006								
Share of workers involved in crop production	0.59	0.04	0.29	0.07	0.17	0.04	0.27	0.05
Share of workers involved in livestock	0.12	0.02	0.31	0.05	0.08	0.03	0.16	0.03
Share of workers involved in self-employment	0.17	0.02	0.40	0.06	0.40	0.06	0.36	0.06
Share of workers involved in wage employment	0.32	0.03	0.14	0.05	0.19	0.03	0.62	0.04
Share of time involved in crop production	0.12	0.02	0.18	0.04	0.03	0.01	0.08	0.02
Share of time involved in livestock	0.12	0.03	0.70	0.08	0.13	0.05	0.29	0.06
Share of time involved in self-employment	0.28	0.04	0.70	0.07	0.44	0.06	0.36	0.06
Share of time involved in wage employment	0.27	0.03	0.14	0.05	0.32	0.05	0.83	0.03
2013								
Share of workers involved in crop production	0.40	0.03	0.17	0.06	0.07	0.02	0.19	0.04
Share of workers involved in livestock	0.07	0.01	0.67	0.05	0.02	0.01	0.11	0.02
Share of workers involved in self-employment	0.24	0.03	0.33	0.05	0.06	0.01	0.24	0.02
Share of workers involved in wage employment	0.10	0.02	0.20	0.04	0.48	0.04	0.49	0.03
Share of time involved in crop production	0.37	0.03	0.09	0.03	0.09	0.02	0.16	0.03
Share of time involved in livestock	0.16	0.03	0.75	0.04	0.05	0.02	0.38	0.05
Share of time involved in self-employment	0.49	0.04	0.73	0.08	0.16	0.04	0.72	0.05
Share of time involved in wage employment	0.15	0.02	0.38	0.08	0.78	0.04	0.79	0.03

Source: own elaboration

**Table A2. Socio-economic variables of different livelihood strategies for 2006 and 2013**

Livelihood strategy	Crop production and self-employment		Livestock and self-employment		Transition to wage employment		Wage employment	
	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
Wolof ethnicity	61%		14%		59%		35%	
Peulh ethnicity	19%		21%		18%		55%	
Maure ethnicity	12%		54%		16%		4%	
2006								
Age of HH head	56.89	12.41	55.89	12.58	58.10	11.52	57.91	12.20
Female HH head	4%		4%		4%		4%	
HH head education	16%		14%		25%		33%	
2013								
Change of HH head	9%		7%		14%		13%	
Age of HH head	58.65	13.92	55.00	14.95	58.57	14.01	61.04	12.62
Female HH head	9%		14%		8%		13%	
HH head education	16%		21%		39%		42%	

Source: own elaboration