

Trade, Standards, and Poverty:

Evidence from Senegal

Miet Maertens and Johan F.M. Swinnen

LICOS Centre for Institutions and Economic Performance
& Department of Economics,
University of Leuven,

Version : 20 November 2006

Abstract

An emerging literature on standards, global supply chains, and development argues that enhanced quality and safety standards are major trade barriers for developing country exports and cause the marginalization of small businesses and poor households in developing countries. This paper is the first to quantify income and poverty effects of such high-standards trade and to integrate labor market effects, by using company and household survey data from the vegetable export chain in Senegal. First, horticultural exports from Senegal to the EU have grown sharply over the past decade, despite strongly increasing food standards in the EU. Second, these exports have strong positive effects on poor households' income. We estimate that these exports reduced regional poverty by around 12 percentage points and reduced extreme poverty by half. Third, tightening food standards induced structural changes in the supply chain including a shift from smallholder contract-based farming to large-scale integrated estate production. However, these changes mainly altered the mechanism through which poor households benefit: through labor markets instead of product markets. Moreover, the impact on poverty reduction is stronger as the poorest benefit relatively more from working on large-scale farms than from contract farming. These findings challenge several basic arguments in this research field.

Contacting author: Miet.Maertens@econ.kuleuven.be

1. Introduction

Trade liberalization and the integration of developing countries in global trade is generally believed to benefit economic growth and is advocated as a major potential engine for global poverty reduction (Aksoy and Beghin, 2005; Anderson and Martin, 2005). The recent debate on standards however casts doubt on the beneficial effect of trade liberalization. The first critique is that the proliferation and tightening of quality and safety standards in high-income markets is causing new (non-tariff) barriers for developing country exports (Augier et al., 2005; Brenton and Manchin, 2002; Unnevehr, 2000).

The second critique is that increasing standards result in the marginalization of small businesses and poor households in developing countries as they are excluded from high-standards supply chains while the rents in the chain are extracted by large (often multinational) companies and developing country elites (Dolan and Humphrey, 2000; Farina and Reardon, 2000; Reardon et al., 1999). However, there is considerable debate and uncertainty on the validity of these arguments, and more generally on the welfare implications of high-standards trade (Swinnen, 2006). Empirical studies have often focused on the question of small farmers' participation in modern supply chains and have presented a mixed picture. Several studies indicate that small farmers are increasingly excluded because of increasing standards (Reardon et al., 2003; Key and Runsten, 1999; Gibbon, 2003; Weatherspoon and Reardon, 2003; Kherralah, 2000). For example, evidence from Kenya, Zimbabwe and Cote d'Ivoire suggests that FFV for exports are increasingly grown on large industrial estate farms, thereby excluding smallholder suppliers in the export supply chain (Dolan and Humphrey, 2000; Minot and Ngigi, 2004). But others find very different effects. For example, Minten et al. (2006) show that in Madagascar most high-

standards FFV production is on very small farms, often on a contract-basis with the agro-food industry, and that this contract-based FFV export production has important positive effects on farmers' productivity. Similar results are found by studies in Asia (Gulati et al. 2006) and in Eastern Europe (Dries and Swinnen, 2004). In summary, various studies come to different conclusions on the participation of the poor in high-standards food supply chains.

However, there is a more fundamental problem with the literature on high-standards trade and poverty. None of these studies actually measures full welfare and poverty effects. This is especially problematic for those studies identifying exclusion of small producers since they generally ignore labor market effects of employment on large estates, which can be very important.

The aim of this study is to assess the welfare and poverty implications of increasing standards and fruit and vegetable (FFV) exports in Senegal. We analyze how the structure of the FFV export supply chain in Senegal has changed in response to tightening food standards and changing coordination in global food supply chains and investigate the welfare impact for local households. High-standards fruit and vegetable (FFV) exports from Senegal is a particularly relevant case for a number of reasons. First, Sub Sahara Africa is the region generally considered most lagging in global market integration and poverty reduction. Second, FFV is one of the most dynamic export sectors, especially for developing countries where they have grown importantly in recent years – from 14% of total food exports to 22% (Aksoy, 2005). Given the intensity of land and unskilled labor in this sector, the longer cultivation periods in tropical countries, and export incentives such as preferential trade agreements, developing countries have been able to capture a significantly increased share of world FFV trade (Diop and Jaffee, 2005). Third, FFV exports are

increasingly confronted with tightening food standards – arising from EU legislation as well as from private food companies who increasingly dominate world agricultural trade (Maertens and Swinnen, 2006; Reardon and Berdegúé, 2002).

To measure the poverty and welfare impacts of high-standards horticulture exports in Senegal, we collected data at three different levels. First, we collected statistics on horticulture production and exports from existing data sources and conducted a series of qualitative expert interviews. Second, in April 2005, we conducted quantitative and structured interviews with nine of the 20 horticulture exporting companies in the Dakar region. Third, in the period August-September 2005, we organized a large survey among smallholder farm-households in the main horticulture zone *Les Niayes* from where over 90% of exported French beans originate.

Our study yields several important findings. First, we find that FFV exports from Senegal to the EU have increased sharply over the past decade, despite increasing food standards in the EU. Second, these FFV exports have positively affected poor household incomes in the FFV producing regions. Third, tightening food standards induced structural changes in the supply chains including a shift from smallholder contract-based farming to large-scale integrated estate production. Fourth, despite these changes, the welfare effects of high-standards FFV export production for rural households are found to remain strongly positive. Supply chain restructuring has altered the mechanism through which local households benefit – increasingly through labor markets instead of through product markets. Fifth, as a consequence of this induced change in the mechanism of income gains the equity distribution of gains within rural communities has improved as the poorest benefit relatively more from working on large-scale farms than from contract farming.

The structure of the paper is as follows. In the next section we describe horticulture exports from Senegal and the increasing EU standards. Section three deals with standards-induced structural changes in the FFV export supply chain. We look at household participation in the chain and overall welfare implications of this participation – in terms of income and poverty – in section four. A comprehensive econometric analysis of the income and poverty effects is presented in section five and six. In a final section, we present the main conclusions and implications from our study.

2. Horticulture exports from Senegal

2.1. Increasing exports

The horticulture sector plays a central role in Senegal's recent strategy of export diversification towards high-value commodities. FFV exports increased sharply over the past 15 years: from 2,700 ton in 1991 to 16,000 ton in 2005 (figure 1). The period of the sharpest growth was after 1997. During this period the export of the main export crop, French beans, alone increased from 3,000 ton to almost 7,000 ton. French beans represent almost half (42%) of the total FFV export volume aside from other major crops including cherry tomatoes (23%) and mangoes (16%).

Apart from some small volumes exported to neighboring countries, FFV are exported to the EU; in particular to France (40%), the Netherlands (35%) and Belgium (16%). Senegal ranks fourth as external supplier of beans to the EU, after Morocco, Egypt en Kenya.

2.2. Increasing standards

The FFV sector in Senegal experienced accelerated growth during a period when standards on food imports increased substantially. FFV exports to the EU now have to satisfy a series of stringent public and private quality and safety standards. EU legislation imposes (1) common marketing standards for FFV¹; (2) sanitary and phytosanitary (SPS) measures; (3) general hygiene rules based on HACCP control mechanisms; and (4) traceability standards. The latter two requirements came into force with the General Food Law of 2002. Traceability standards imply that EU agro-food companies – including importers – have to document from/to whom they are buying/selling produce such that products can be traced back to their origin in case of food safety problems. SPS measures have also become much more stringent; e.g. decreasing tolerance for chemical residue levels², treatment of wooden packaging material (since 2005) and maximum levels of contamination by heavy metals (since 2002).

Moreover, in addition to increasing public standards, many large trading and retailing companies have engaged in establishing private food standards that are even stricter. For example, the Euro-Retailer Produce Working Group (Eurep) has engaged in adapting food quality and safety standards into the EurepGAP certification protocol. On top of public traceability regulations that apply within the EU, they require complete traceability throughout the chain up to the level of overseas producers. Agri-food businesses in the EU increasingly require such private certification from their suppliers.

¹ Commission Regulation (EC) No 912/2001, an amendment of EC No 2000/96, specifies a classification for French beans based on quality and size, and stipulates provisions concerning the presentation and marketing of the beans.

² Since 2000 there have been 29 new EU notifications of maximum residue levels (MRL) to the WTO (World Trade Organization, 2006).

Despite these increasing standards, Senegal has been able to increase horticulture export earnings – as was also the case for e.g. Kenyan FFV exports (Jaffee, 2003). This proves that tightening standards do not necessarily undermine the competitive position of developing countries in international agricultural markets. The World Bank (2004) argues that the development of a certification scheme and validation of the label *Origine Sénégal* has played an essential role in raising the quality and standards of Senegalese FFV, and thereby realizing export growth.

3. Structural changes in the export supply chain

Changes in EU standards put pressure on FFV exporters in Senegal to stay up to date with the changing legislation and demands and to make additional investments for compliance. The growing demands also increase the need for tighter coordination and have led to important structural changes in the FFV export supply chain in Senegal, with major implications for Senegalese farmers. Key structural changes are (1) increased consolidation at the level of the agro-exporting industry as well as at the level of the primary producers; and (2) increased vertical coordination with downstream buyers in the EU as well as with upstream suppliers. This translates into a decreasing volume of French beans that is procured from small farmers and an increase in vertically integrated FFV estate production.

These structural changes can be analyzed in more detail with information from quantitative and structured interviews with nine of the 20 horticulture exporting companies in the Dakar region. Our company sample constitutes a mixture of firms recently entering the market and older firms, a mixture of smaller and larger exporter, and a mixture of domestic and foreign companies, jointly representing 44% of the exported volume French beans – the major export crop (table 1).

3.1. Increased consolidation

Because of financial constraints, only larger firms are able to comply with increasingly stringent food standards. Since 1994, most exporters are member of the organization SEPAS³ which coordinates transport, provides market information – including information on food standards – and assists its members in the contact with overseas buyers. However, following the increasing EU standards, the seven largest FFV exporters founded the organization ONAPES⁴ in 1999. One of their specific aims was to comply with traceability standards and become EurepGAP certified. Four ONAPES companies are in our sample (table 2). Among these firms one – *Sepam* – is EurepGAP and HACCP certified (since 2004). Two other ONAPES firms – *Soleil Vert* and *Baniang* – and one SEPAS firm – *Agriconcept* – are in the process of certification and made substantial investments for this in the past couple of years. The remaining exporting companies, mainly smaller ones, are not certified and not undertaking particular investments in the scope of certification.

As a result, since 2000, the export sector is consolidating with some of the smaller exporters dropping out. In 2002, 27 companies were exporting French beans. Three years later, in 2005, only 20 firms remained. Moreover, while the three largest companies' market share was less than half in 2002, their share had increased to two-thirds of the total export volume by 2005.

3.2. Increased vertical coordination

Vertical coordination increased, both downstream and upstream. First, the FFV exporting companies – especially larger firms – increasingly engage in tighter

³ *Syndicat des Exportateurs des Produits Agricoles*

⁴ *Organisation National des Producteurs Exportateurs de Fruits et Légumes de Sénégal*

coordination with downstream importers and wholesalers in the EU market. Smaller exporters deal with importers through indicative agreements on the supplied quantity, which are not binding for either party. Larger exporters have recently changed from such indicative agreements to more binding contracts with overseas buyers, which specify a fixed (minimum) price, the quantity to be delivered, the time of delivery and sometimes also include pre-financing to the suppliers. Exporting companies mention the volatility of prices in the EU market and the incidence of produce refusal by importers to be the main reasons to engage in tighter coordination.

Second, to guarantee food quality and safety throughout the supply chain and to assure accurate timing of production and harvesting exporting firms – especially larger firms – increasingly rely on tighter vertical coordination with upstream suppliers of primary produce. Especially increased traceability requirements by EU importers have induced this increased vertical coordination. This occurs in two ways. The first is through more elaborate production contracts and tighter coordination within those contracts. Contracts signed with small family farms are typically specified for one season – lasting from November till April – and indicate the area to be planted – usually 0.5 or 1 ha – all technical requirements and the price. As part of the contract, the firms provide technical assistance and inputs to the farmers; especially seeds and chemicals, sometimes also cash credit. Some firms go as far in contract-coordination as the complete management of fertilizer and pesticide application and daily or weekly inspection of the farmers' fields. Also field preparation, planting and/or harvesting can be coordinated and financed completely by the exporting firm. Especially larger exporters provide pre-financing and apply tighter contract-coordination while smaller exporters leave management decisions to

the farmers. The most extreme case of contract-coordination is *Sepam*, who manages the whole production on farmers' land except for irrigation and harvesting.

A second, and even more radical, change towards vertical coordination is the shift from contract farming with smallholders to large-scale estate production on agro-industrial farms. Larger exporters are increasingly engaging in fully integrated estate production. In fact, the ONAPES exporting companies have agreed among themselves that each member should seek to process every season a volume of at least 200 ton and that at least 50% of the volume should originate from the companies own estate production – a measure that is having a profound impact on the structure of the export supply chain. Three firms in our sample have already substantially reduced procurement through contract farming with smallholders: from 100% in their first year of operation to respectively 60% and 20% in the last season (table 2), in favor of integrated estate production. The companies cited quality rather than quantity to be the reason for this change. Even firms that currently completely rely on contract farming mentioned fully integrated production to be an important strategy for compliance with food standards in the future and hence for the survival and growth of the firm.

Similar observations of standards-induced consolidations and vertical coordination – including a shift towards large-scale estate farming – have been noticed in the FFV export sector of other African countries; e.g. in Kenya, Zimbabwe and Cote d'Ivoire (Dolan and Humphrey, 2000; Minot and Ngigi, 2004). It is generally argued that this leads to the marginalization of small farmers and poor households. In the next sections we will provide evidence that this has not been the case in Senegal.

4. Household participation and welfare in export production

4.1. Survey and data

To measure the impact on households, we organized a large household survey in the main horticulture zone *Les Niayes* – from where over 90% of exported French beans originate – in the period August-September 2005. The survey covered 300 households in 25 randomly selected villages in three rural communities – Sangalkam, Diender and Noto – in the region Dakar and Thiès (figure 2). The majority of households in this area are smallholder horticulture farmers producing – next to French beans for exports – a large variety of vegetables and basic food crops for the local market and for direct consumption. To study the household-level effects of horticulture export production, farmers producing French beans on contract with an exporting firm were over-sampled and constitute 59 of the 300 selected households. To draw correct inferences from this sample we use sampling weights that are calculated with information on the number of households and the share of contracted households at the level of the villages and the rural communities.

The sample represents small household farms in the area. Among the sampled households, agriculture constitutes on average more than 80% of total household income and the average farm size is 5 ha. Eighty-eight percent of the sampled households cultivate less than 10 ha – which is in the region considered as the threshold to be classified as smallholder – and 66% less than 5 ha.

4.2. Total household participation

Along with increasing export volumes also the participation of rural Senegalese households in high-standards horticulture export markets increased

dramatically over the past 15 years; from less than 10% in 1991 to 40% in 2005 (figure 3). However, as a result of standards-induced structural changes in the supply chain the nature of increased household participation differed strongly in the 1990s from more recent years. During the second half of the 1990s, households increasingly involved in export production through contract farming. In 2000, an estimated 23% of households in the research area were contracted to produce French beans for export. However, from 2000 onwards, while household participation grew further, this was increasingly through wage employment on integrated estate farms, while the incidence of contract farming was decreasing. Employment on estate farms increased from less than 10% of households in 2000 to 34% in 2005 while at the same time, the share of contract farmers decreased from 23% to 10%. As a result of the supply chain restructuring 72% of households who produced vegetables under contract lost their contract in the period 2000-2005, and almost half of these (43%) started to work on vegetable estate farms. The change occurred because the firms who were earlier contracting these farmers either exited the market or started their own estate production.

Still, on aggregate participation of rural households in high-standards FFV production continues to increase with their role shifting from contracted farmers to estate farm workers. Based on company level data for the 2005 season, we estimate that almost 1,000 farmers produce French beans on contract and that FFV exporting companies employ almost 12,000 workers (mostly temporarily).⁵

⁵ Notice that some of the data in this paper are in “household” terms and others in “individual” terms, and that not all of the workers and households employed or contracted by the companies are from the region in the survey; these considerations should be taken into account when comparing with the data in the tables and figures.

The shift from contract farming to estate farming (and associated employment) has important implications for the distribution of rural incomes, which we analyze in detail in the next sections.

Before moving to this analysis, it is important to note that the shifting role of households in the export supply chain should not be perceived as an absolute change in household status from independent farmers to subordinate workers. Contract farmers are already ‘quasi-farmers’ or ‘semi-farm workers’ as their activities are highly coordinated and monitored by traders and processors to ensure quality and safety. Hence, the dichotomy in the literature between independent smallholders and estate farm workers is much less clear than suggested. Moreover, French bean export activities are concentrated in one season (from November till April – which does not coincide with the main ‘rainy’ agricultural season) and households generally allocate only a share of their land and/or labor to these activities – either as contract farmer or as estate farm worker – thereby continuing to primarily be independent smallholders. Moreover, the expansion of the estate sector does not come at the expense of the smallholder farming operations. Companies seeking to expand their own integrated estate production either buy or rent land from large commercial farms (usually over 100 ha), integrate with these farms or expand by investing in uncultivated land belonging to the government⁶.

4.3. Characteristics of FFV producers

The distributional implications of high-standards FFV exports critically depend on the participation of poorer households in the supply chain. The figures in table 3 indicate that participants in contract farming are larger households with more

⁶ One of the larger FFV exporting companies – which is not included in our sample – cultivates French beans and other exports crops on the land (600 ha) of a former state-owned company.

labor endowments while participants in estate farm employment are larger, slightly older and lower educated households. Contract farmers have on average larger farms – 6.8 ha compared to 4.9 ha for non-participating households – and more livestock – 4.1 units compared to 2.9 units. These comparatively larger contracted farms are in per capita terms, however, still relatively small. Per capita landholdings for these contracted farmers are 1 ha on average – compared to 0.83 ha for non-participating households. Estate wage workers tend to be households with less land (0.78 ha per capita), less livestock (1.8 units) and less non-land assets – 176 thousand FCFA compared to 320 thousand FCFA for other households. In conclusion, both relatively larger farms and poorer households are included in high-standards vegetable production but the former rather as contracted farmers and the latter as estate farm workers.

Looking at changes in landholdings (figure 4) reveals that currently contracted farmers already had slightly larger landholdings in 1995 – before the FFV export sector started to boom and they obtained contracts. Moreover, the distribution of land between contracted and non-contracted farmers was more equal in 2000 – before farmers lost contracts as a result of supply chain restructuring – than in 2005 (figure 5). Hence, contract farming has become increasingly biased towards relatively larger (albeit still small) farmers. Nevertheless, overall participation in vegetable export production became more equitable with poorer households involved as farm workers. In the next section we analyze whether this equitable participation translates into a more equitable distribution of the gains from high-standards export production.

4.4 Income

The increase in high-standards horticulture exports and the participation of rural households in the export supply chain has had major positive welfare effects. A simple comparison of means reveals that there are large differences in household income: 1.8 million FCFA for non-participating households compared to 4.5 million and 6.4 million for FFV estate workers and FFV contract farmers respectively (figure 6). These differences in income remain large in per capita terms: the average per capita income for estate wage workers is twice as high as for non-participating households and for contract farmers it is more than three times higher (figure 7).

On average, agriculture is the main source of income in the area and two thirds of household income is derived from own farming (figure 6). Yet, estate farm workers derive more than one third of their income from agricultural wages – mainly (more than 80 %) earned at vegetable estate farms – while still having farm incomes that are higher than non-participating households.

4.5 Poverty⁷

Furthermore, the incidence of poverty in the research area is estimated to be 46% – which is lower than the national rural poverty rate of 58 %. Poverty is much higher among households who do not participate in export production (51%) than among households employed in FFV estates (42%) and FFV contract farmers (13%) (figure 8). The incidence of extreme poverty is 25 % and follows a similar pattern across participants and non-participants.

⁷ We use the national rural poverty lines that were constructed using data from the ESAM I and ESAM II surveys conducted in 1994 and 2002 (République du Sénégal, 2004) and adapt them for changes in consumer price indices (African Development Bank, 2006). The poverty lines that are used are 181,770 F CFA/year for poverty and 106,245 F CFA/year for extreme poverty.

4.6 Summary

The data and descriptive analysis presented in this section suggest that there are substantial differences in income across contract farmers, estate workers and non-participating households. However, based on a simple comparison of means it is impossible to identify causality and to satisfactorily attribute these differences in income to the impact of high-standards vegetable export production. There might be observable and unobservable factors that simultaneously enhance household income and increase the likelihood of a household to have a contract with or to be employed by the FFV export industry. Therefore, in the next section we develop a set of more elaborate econometric techniques to take into account unobserved heterogeneity and the potential bias due to self-selection into contract farming and estate employment, and to assess how much of the differences in income and poverty can be attributed to the impact of participation in high-standards vegetable export production.

5. Econometric estimation of income effects

5.1 Correction for selection and treatment bias

We apply econometric techniques from the literature on average treatment effects⁸ (Wooldridge, 2005; Wooldridge, 2004; Wooldridge, 2002; Heckman and Robb, 1985; Rosenbaum and Rubin, 1983) to correct for potential selection bias in estimating the impact of participation in FFV estate wage employment (W_1) and in FFV contract farming (W_2) on household income (Y). We hypothesize that high-standards export production has positive welfare implications and hence expect the effects of both participation dummies (W) to be significantly positive. We first specify

⁸ An average treatment effect is a special case of an average partial effect for binary explanatory variables (Wooldridge, 2002) – such as participation in vegetable contract farming and estate farm employment.

a basic model and then use several alternatives to test the robustness of the main econometric results.

In a first regression model (MODEL 1) we attempt to control for potential selection bias by including a vector of observable covariates (X) as control functions⁹.

$$Y_i = \theta + \alpha W_i + \beta X_i + \varepsilon_i \quad (\text{MODEL 1})$$

We include the following additional covariates in the model: *LAND* (landholdings in ha); *ASSETS* (value of non-land assets in FCFA); *LABOR* (number of laborers); *AGE* (age of the household head), and *EDUCATION* (a dummy variable for household heads with formal education). These are variables generally believed to determine rural incomes (Deaton, 1997; Udry, 1997) and might also affect households' participation decision. We expect all these variables – apart from *AGE* – to have a positive effect on income as these measures of physical and human capital increase the income generating capacity of a household. In an alternative specification, we additionally include dummy variables for the 25 sampled villages to control for location specific aspects that simultaneously affect income and participation decisions – such as land characteristics and distance to exporting industries.

The second regression model includes, in addition to the vector of covariates X , the interaction terms between the participation variables and the demeaned covariates¹⁰:

$$Y_i = \theta + \alpha W_i + \beta X_i + \delta W_i (X_i - \mu_X) + \varepsilon_i \quad (\text{MODEL 2})$$

⁹ The assumption underlying this approach '*selection on observables*' – put forward by Heckman and Robb (1985) – allows treatment (or in this case participation in export production) to depend on observable covariates and unobservable characteristics in a restricted fashion such that unobservables are not arbitrarily correlated with the main dependent variable and implies that the effect of the treatment variables can be consistently estimated by OLS. (Wooldridge, 2002).

¹⁰ Under the *selection on observables* assumption this specification consistently estimates treatment effects (Wooldridge, 2002).

This specification allows for heterogeneous effects such that the effect of participation can vary with elements of X (Wooldridge, 2002).

In a third model, we use propensity scores as control functions in case the participation variables interact with unobserved heterogeneity (Wooldridge, 2005) – a method pioneered by Rosenbaum and Rubin (1983):

$$Y_i = \theta + \alpha W_i + \phi PS_i + \varepsilon_i \quad (\text{MODEL 3})$$

$$\text{with } PS_i = \hat{p}(W_i = 1 | X)$$

The propensity score (PS) is the conditional probability of participation given observed covariates X and can be estimated by a probit model. The estimated propensity scores are used in the structural equation as a control function for selection bias¹¹.

In a fourth model we further include interaction terms between the participation variables and the demeaned propensity scores (Wooldridge, 2002):

$$Y_i = \theta + \alpha W_i + \phi PS_i + \varphi W_i (PS_i - \mu_{PS}) + \varepsilon_i \quad (\text{MODEL 4})$$

$$\text{with } PS_i = \hat{p}(W_i = 1 | X)$$

This is a more general version of correction on propensity scores – proposed by Rosenbaum and Rubin (1983).

In a fifth and final model the propensity scores are used in a matching estimators approach (Wooldridge, 2002; Rosenbaum and Rubin, 1983). Rosenbaum and Rubin (1983) have shown that pair matching, stratification and covariance adjustment on the propensity score can produce unbiased estimates of the treatment

¹¹ A key assumption underlying this method is *ignorability of treatment*, which implies that the potential outcomes are independent of participation conditional on the set covariates (Wooldridge, 2004; Rosenbaum and Rubin, 1983).

effect. We use a stratification matching method in which observations are grouped in blocks with similar estimated propensity scores and the average treatment effect is calculated as the averaged response difference for treated and non-treated observations¹².

5.2 Results and discussion

The results of the different econometric models (table 4) confirm our hypotheses and show that participation in high standards FFV export production, whether as farm worker on estate farms or as contract farmer, has a significant positive effect on household income. The estimated coefficients on both participation dummies are similar and significantly positive throughout the different econometric models, which is an indication of the robustness of the estimates. After correction for potential selectivity bias, we find that estate farm workers have incomes that are between 1.5 and 2.3 million FCFA higher than for non-participating households while that of contracted farmers is between 2.4 and 4.1 million FCFA higher¹³. So, participants in horticulture export production have incomes that are 50% to 130% higher than the average income in the research area – indicating very strong positive income effects.

Furthermore, the results of the first stage probit models that estimate the probability of participation in estate employment and in contract farming confirm that vegetable contract farming is biased towards households with more land and labor

¹² This method requires, next to the *ignorability of treatment* assumption, that balancing properties are satisfied (Rosenbaum and Rubin, 1983) – an issue dealt with in appendix.

¹³ The impact on household income is found to be higher for contract farming than for estate wage employment. There are several possible explanations for this that could be explored in a more detailed analysis, which is beyond the scope of the analysis presented here.

while this is not the case for estate wage employment. The latter is more likely for households with fewer assets but with more labor (table 5).

The coefficients of the covariates X in the model have the expected sign and are statistically significant, except for the variable *EDUCATION* (table 4). So, households with more land, more non-land assets, more labor endowments and a younger household head have higher incomes. Moreover, the interaction term between *estate worker* and *LABOR* is significantly positive, indicating that the income effect of participation in estate wage employment is larger the more laborers a household has.

In summary, the findings from the econometric analyses imply that (a) high-standards agricultural trade significantly adds to rural incomes; (b) the income effect for contract farmers is larger than for estate farm workers; (c) participation in contract farming is biased towards larger farms; and (d) wage employment on vegetable estates has no bias towards better endowed households and benefits also the poorest. In the next section we will use these findings to estimate what the overall effects are in terms of poverty reduction.

6. Simulation of poverty and inequality effects

To assess the poverty effects, we simulate household income for two alternative scenarios and compare the outcomes with the actual income situation. For the first scenario (“*No Exports*”) both participation variables W_1 and W_2 are set to zero for all households in the sample, which simulates a situation in which there would be no exports of French beans at all. The second scenario (“*Contract*”) corresponds to the case where French bean exports would have been mainly realized through contract farming – as was the case till 2000. For this scenario participation in contract farming

W_2 is set as if none of the farmers who had a contract in 2000 lost their contract in the period 2000-2005.

For these two scenarios we simulate household income based on the estimated coefficients in the above described models, take the average estimated income across the six models, calculate per capita incomes, and derive poverty indicators.

The results (figures 9 and 10) are striking. First, high-standards vegetable exports reduced poverty by 12% in the research area. Without the possibility for rural households to participate in high-standards export production, the incidence of poverty in the region would have been 58% – similar to the average rural poverty rate for Senegal – while the actual poverty rate is only 46%. Moreover, the incidence of extreme poverty falls by almost half: from an estimated 44% in the *No Export* scenario to 25% in the actual situation. These are very large and important effects.

Second, we find that per capita incomes and poverty rates are not significantly different in the actual situation compared to the scenario *Contract*, while the incidence of extreme poverty is lower in the actual situation – 25% compared to 30% (figure 10). Recall that scenario *Contract* represents the case where export growth would have taken place without the shift from smallholder contract farming to large-scale estate farming. Hence the results imply that the change to vertically integrated production by exporters' shifting to estate farming – as a strategic response to increasing standards – has not only not worsened poverty, but has in fact had beneficial effects by reducing extreme poverty. By creating employment opportunities that are relatively more accessible for the poorest households, FFV estate farming has contributed to the reduction of poverty.

These findings demonstrate that high-standards agricultural production and trade can directly reduce poverty and improve welfare even if it is realized through large-scale agro-industrial production. This challenges the general view in the literature of increasing food standards and agro-industrialization leading to a concentration of the gains from trade with large food companies and to the marginalization of the smallest farmers and the poorest households.

7. Conclusion

FFV exports from Senegal to the EU grew sharply over the past decade despite increasing standards in EU markets. The response of FFV exporting companies to these increased standards has resulted in consolidation and increased vertical coordination at different levels of the supply chain. Part of the institutional response has been a shift away from smallholder contract-based farming towards large-scale agro-industrial production. Based on conventional arguments in the literature, one could expect these developments to be particularly bad for the smallest farmers and the poorest households.

However, our analysis in this paper shows that this is not the case. We find that more and more poorer households participate in and share in the gains from high-standards FFV export production. Supply chain restructuring has altered the mechanism through which local households benefit – increasingly through labor markets rather than through product markets – and thereby improved the distribution of gains within rural communities.

We find highly significant and large effects on income, which demonstrate that rural households involved in high-standards export supply chains, either through

contract farming or as workers on estates, do share importantly in the gains from export. This is a key empirical finding as it has repeatedly been argued in the literature that the gains from international trade and the rents in high-standards supply chains are captured by foreign investors and large agro-food companies while small farmers and poor households are marginalized. Especially contract farming and have often been criticized as a tool for agro-industrial firms and food multinationals to exploit unequal power relationships vis-à-vis farmers and extract rents from the supply chain.

Furthermore, our results demonstrate that high-standards agricultural trade benefits rural incomes even if the export industry is consolidating and even if export production is realized on industrial estate farms. In fact, we find that this model has the strongest positive effects on poverty reduction. The findings challenge the implicit assumption underlying many empirical studies that high-standards food production and trade needs to integrate farm households as primary producers in the supply chain if it is to benefit rural incomes. We show that also households involved as wage workers reap significant benefits from high-standards trade.

The insight from this study that poorer households benefit from agricultural export development through the labor market rather than through product markets – has so far been neglected in the empirical literature on trade, standards and modern supply chains. We could draw the analogy with insights from the Green Revolution of the 1960s – that triggered major productivity growth and rural income rises in South-East Asian countries. The Green Revolution was at first believed to benefit richer farmers while marginalizing poorer farmers because of the specific constraints they face in accessing and using Green Revolution inputs. However, David and Otsuka (1994) were the first to document that poorer households did benefit from this

technology-driven agricultural development because of labor market effects. The same might hold for standards-driven (or supply chain-driven) agricultural development.

Another important finding from this study is that high-standards agricultural export development in poor African countries is possible, despite the many constraints. This case-study on Senegalese FFV exports could add to the existing evidence of high-standards export development in Sub Sahara Africa (e.g. in Kenya, South-Africa, etc) and thereby shift the balance from viewing standards as barriers to trade to the standards-as-catalysts view – put forward by Jaffee and Henson (2005). In analogy with the technology-driven developments in South East Asia in the 1960s, there might be scope for standards-driven agricultural development – in which Sub Sahara Africa and its poor are not left behind.

References

- African Development Bank, 2006. Selected Statistics on African Countries Volume XXV, Statistics Division, Development Research Department, African Development Bank, Tunis, Tunisia
- Aksoy M.A., 2005. The evolution of agricultural trade flows. In. (eds) Aksoy M.A. and J. C. Beghin, *Global Agricultural Trade and Developing Countries*, The World Bank, Washington D.C.
- Aksoy M.A. and J. C. Beghin, 2005 *Global Agricultural Trade and Developing Countries*, The World Bank, Washington D.C.
- Anderson K. and W. Martin, 2005. Agricultural Trade Reform and the Doha Development Agenda. *World Economy* 28(9), pp. 1301-27
- Augier, P., Gasiorok, M. and C. Lai Tong, 2005. The Impact of Rules of Origin on Trade Flows, *Economic Policy* 20(43), 567-623.
- Brenton, P. and M. Manchin, 2002. Making the EU Trade Agreements Work. The Role of Rules of Origin, CEPS working document 183, Centre for European Policy Studies, Brussels.
- David C. and K. Otsuka, 1994. *Modern Rice Technologies and Income Distribution in Asia*. Lynne Rienner Publisher, Boulder and London; International Rice Research Institute, Manila.
- Deaton A., 1997. The Analysis of Household Surveys: A Microeconomic Approach to Development Policy, John Hopkins University Press, Baltimore and London.
- Diop, N. and S.M. Jaffee, 2005. Fruits and Vegetables: Global Trade and Competition in Fresh and Processed Product Markets. In: Aksoy, M.A and Beghin, J.C. (ed.) *Global Agricultural Trade and Developing Countries*. World Bank, pp. 237-257.
- Dolan, C. and J. Humphrey, 2000. Governance and Trade in Fresh Vegetables: The Impact of UK Supermarkets on the African Horticulture Industry. *Journal of Development Studies* 37(2), pp. 147-176.

- Dries, L. and J.F.M. Swinnen, 2004. Foreign Direct Investment, Vertical Integration and Local Suppliers: Evidence from the Polish Dairy Sector. *World Development*, 32(9), pp. 1525-1544
- Farina, E.M.M.Q. and T. Reardon, 2000. Agrifood Grades and Standards in the Extended Mercosur: Their Role in the Changing Agrifood System, *American Journal of Agricultural Economics* 82(5), pp. 1170-1176.
- Gibbon, P, 2003. Value-Chain Governance, Public Regulation and Entry Barriers in the Global Fresh Fruit and Vegetable Chain into the EU. *Development Policy Review* 21(5-6), pp.615-25.
- Gulati, A., Minot, N. Delgado, C. and S. Bora, 2006. Growth in high-value agriculture in Asia and the emergence of vertical links with farmers. In: Swinnen, J.F.M (ed) *Global Supply Chains, Standards and the Poor*, CABI publishing.
- Heckman J. and R. Robb , 1985. Alternative Methods for Evaluating the Impact of Interventions. In: Heckman, J. and B. Singer (eds) *Longitudinal Analysis of Labor Market Data*, New York: Wiley, pp. 156-245.
- Jaffee S., 2003. From Challenge to Opportunity: Transforming Kenya's Fresh Vegetable Trade in the Context of Emerging Food Safety and Other Standards in Europe. Agricultural and Rural Development Discussion Paper, The World Bank, Washington D.C.
- Jaffee S. and S. Henson, 2005. Agro-food Exports from Developing Countries: the Challenges Posed by Standards. In. (eds) Aksoy M.A. and J.C. Beghin *Global Agricultural Trade and Developing Countries*, The World Bank, Washington D.C.
- Key, N. and D. Runsten, 1999. Contract farming, smallholders, and rural development in Latin America: the organization of agroprocessing firms and the scale of outgrower production. *World Development* 27(2), pp. 381-401.
- Kherralah, M., 2000. Access of smallholder farmers to the fruits and vegetables market in Kenya, IFPRI, mimeo.
- Maertens, M. and J.F.M. Swinnen, 2006. Globalization, Privatization and Vertical Coordination in Food Value Chains in Developing and Transition Countries.

Plenary paper presented at the IAAE 26th Conference of the International Agricultural Economists Association, Gold Coast, Australia

- Minot, N. and M. Ngigi, 2004. Are Horticultural Exports a Replicable Success Story? Evidence from Kenya and Côte d'Ivoire. EPTD/MTID discussion paper, IFPRI, Washington, DC.
- Minten, B., Randrianarison, L. and J.F.M. Swinnen, 2006. Global Retail Chains and Poor Farmers: Evidence from Madagascar. LICOS Discussion Papers 164/2006, Leuven, Belgium (<http://www.econ.kuleuven.be/LICOS/DP/dp.htm>)
- Reardon, T. and J. Berdegue, 2002. The Rapid Rise of Supermarkets in Latin America: Challenges and Opportunities for Development. *Development Policy Review* 20(4), pp.371-88.
- Reardon, T., Codron, J. M., Busch, L., Bingen, J., and C. Harris, 1999. Global change in agrifood grades and standards: agribusiness strategic responses in developing countries. *International Food and Agribusiness Management Review* 2(3). pp. 421-435.
- Reardon, T., Timmer, C.P., Barrett, C. and J. Berdegue, 2003. The Rise of Supermarkets in Africa, Asia, and Latin America. *American Journal Agricultural Economics* 85(5), pp. 1140-1146.
- République du Sénégal, 2004. La Pauvreté au Sénégal : de la Dévaluation de 1994 à 2001 – 2002. Report, Ministère de l'Economie et des Finances, Direction de la Prévision et de la Statistique and World Bank.
- Rosenbaum P.R., and D.B. Rubin, 1983. The central role of the propensity score in observational studies for causal effects, *Biometrika* 70, pp. 41-55.
- Swinnen, J.F.M, 2006. *Global Supply Chains, Standards and the Poor*, CABI publishing.
- Udry C., 1997. Recent Advances in Microeconomic Research in Poor Countries: An Annotated Bibliography. *Journal of Economic Education* 28, pp. 58-75.
- Unnevehr, L.J., 2000. Food Safety Issues and Fresh Food Product Exports from LDCs. *Agricultural Economics* 23(3), pp. 231-240.

- Weatherspoon, D.D. and T. Reardon, 2003. The Rise of Supermarkets in Africa: Implications for Agrifood Systems and the Rural poor. *Development Policy Review* 21(3), pp. 333-356.
- Wooldridge J.M, 2002. *Econometric Analysis of Cross Section and Panel Data*. The MIT Press, Cambridge, Massachusetts; London, England.
- Wooldridge J.M, 2004. Estimating Average Partial Effects under Conditional Moment Independence Assumptions. Department of Economics, Michigan State University.
- Wooldridge J.M, 2005. Instrumental Estimation of the Average Treatment Effect in the Correlated Random Coefficient Model. Department of Economics, Michigan State University.
- World Bank, 2004. Implementation Completion Report PPF1-Q0640 IDA-30170 for the Senegal Agricultural Export Promotion Project. Report, The World Bank, Washington D.C.
- World Trade Organization, 2006. Actual SPS notifications.
<http://www.wto.org/english/tratope/spse/spse.htm>. Accessed on May 2006.

Tables

Table 1: Characteristics of selected horticulture exporting companies

Company name	Exported volume (ton), 2004		Year entering FB export	Foreign ownership
	FB ¹	other FFV ²		
Soleil Vert	800	1,100	2000	80%
Sepam	883	1,410	1992	0
Master	68	0	1989	0
Baniang	80	150	1999	51%
Agriconcept	100	80	2002	0
ANS Interexport	64	0	2001	0
Pasen	30	0	2000	0
Agral Export	180	0	1992	0
PDG	173	239	1993	0

¹ FB: French beans; ² FFV: fresh fruits and vegetables

Source: Authors' calculation from company level interviews

Table 2: Changing procurement of selected horticulture exporting companies

Company name	Organisation membership	% of supply from smallholder contract-farming	
		1 st year of operation	last season
Soleil Vert	ONAPES ¹	100	20
Sepam	ONAPES	100	60
Master	ONAPES	50	40
Baniang	ONAPES	85	85
Agriconcept	SEPAS ²	30	30
ANS Interexport	SEPAS	100	100
Pasen	SEPAS	100	60
Agral Export	SEPAS	100	100
PDG	SEPAS	100	100

¹ ONAPES – Organisation National des Producteurs Exportateurs de Fruits et Légumes de Sénégal

² SEPAS – Syndicat des Exportateurs des produits

Source: Authors' calculation from company level interviews

Table 3: Ownership of human and physical capital across households

	total sample	non-participants	estate farm workers	contract farmers
HUMAN CAPITAL				
Average age of the household head	54	53	56	53
Share of household heads without education	18.5%	17%	21%	19%
Average number of laborers	6.9	6.4	7.7	7.7
PHYSICAL CAPITAL				
Average farm size (ha)	5.03	4.92	5.05	6.82
Average per capita ¹ landholdings (ha)	0.83	0.84	0.78	1.03
Average units ² of livestock	2.64	2.87	1.84	4.14
Average value of non-land assets (1,000 FCFA)	270.7	320.9	176.9	308.8

¹ Per capita landholdings are calculated using the modified OECD adult equivalence scales

² One livestock unit equals 1 cow, 0.8 donkey and 0.2 sheep/goat

Source: Authors' calculation from household survey data

Table 4: Regression results

Variables	model 1a	model 1b	model 2	model 3 ¹	model 4 ¹	model 5 ¹
PARTICIPATION DUMMIES						
W ₁ estate worker	2.32*	2.16**	2.39**	2.28***	2.29***	1.51*
W ₂ contract farmer	2.44*	2.68**	3.78***	2.39***	2.67***	4.10***
COVARIATES						
X ₁ land	0.30**	0.24*	0.21**	-	-	-
X ₂ assets	0.82	0.5	0.66**	-	-	-
X ₃ labor	0.39***	0.39***	0.21*	-	-	-
X ₄ age	-0.12**	-0.13**	-0.07*	-	-	-
X ₅ education	-1.13	-0.77	-1.01	-	-	-
X ₆₋₃₀ village dummies	-	not reported	not reported	-	-	-
INTERACTION TERMS						
W ₁ (X ₁ -μ _{X1})	-	-	0.12	-	-	-
W ₁ (X ₂ -μ _{X2})	-	-	2.13	-	-	-
W ₁ (X ₃ -μ _{X3})	-	-	0.66**	-	-	-
W ₁ (X ₄ -μ _{X4})	-	-	-0.18*	-	-	-
W ₂ (X ₁ -μ _{X1})	-	-	-0.25	-	-	-
W ₂ (X ₂ -μ _{X2})	-	-	-4.14	-	-	-
W ₂ (X ₃ -μ _{X3})	-	-	-0.48	-	-	-
W ₂ (X ₄ -μ _{X4})	-	-	0.04	-	-	-
PROPENSITY SCORES						
PS_W ₁	-	-	-	-7.72***	-7.30***	-
PS_W ₂	-	-	-	31.59***	33.27***	-
W ₁ * PS_W ₁	-	-	-	-	-10**	-
W ₂ * PS_W ₂	-	-	-	-	-1.57	-
Constant	4.29*	3.98*	2.68	1.58***	1.31***	-
R ²	0.18	0.33	0.37	0.13	0.13	-

Significance levels: * 10%, ** 5%, *** 1%

¹ Standard errors are bootstrapped to account for the two step nature of the model

Source: Authors' estimations using household survey data

Table 5: Results of first stage probit regressions

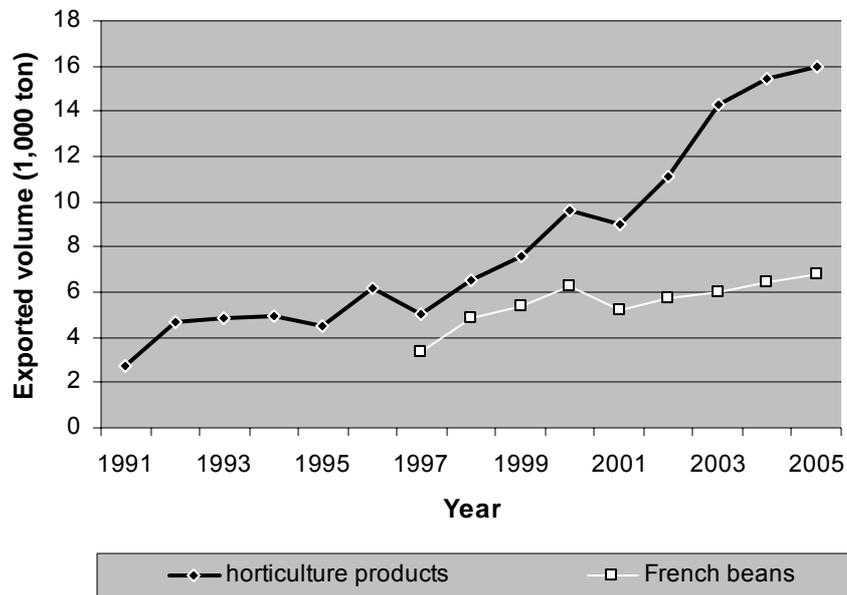
	P(W ₁ estate worker)	P(W ₂ contract farmer)
X ₁ land	0.0072	0.0476***
X ₂ assets	-0.4705**	-0.0308
X ₃ labor	0.1142***	0.0565**
X ₄ age	0.0055	-0.0095
X ₅ education	0.1987	-0.1142
X ₆ region dummy	0.4053**	0.6207***
Constant	-1.6893***	-1.7757***
Prob Chi ² >	0.000	0.002
Pseudo R ²	0.080	0.072

Significance levels: * 10%, ** 5%, *** 1%

Source: Authors' estimations using household survey data

Figures

Figure 1: Exported volume of horticulture products from Senegal, 1991 - 2005

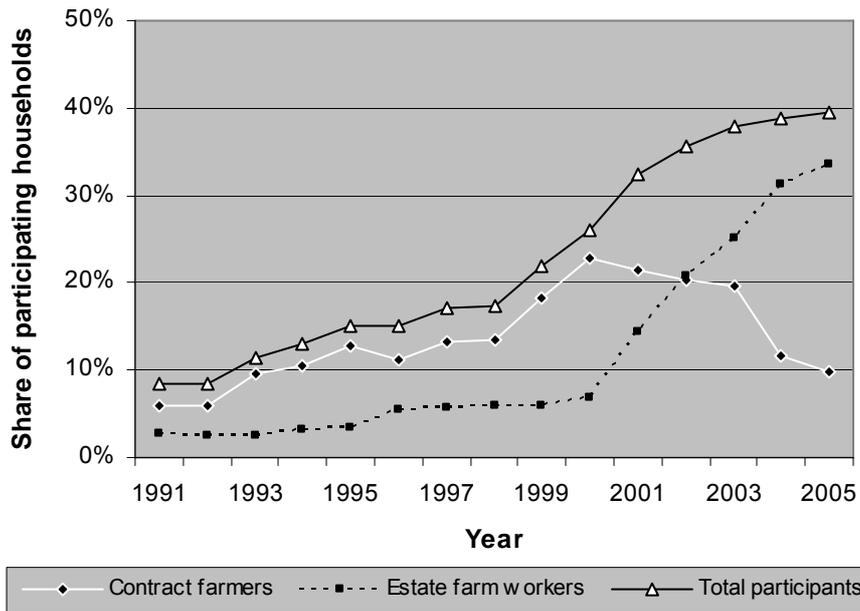


Source: Authors calculation from DH – Direction de l’Horticulture (2005)

Figure 2: Map of the research area



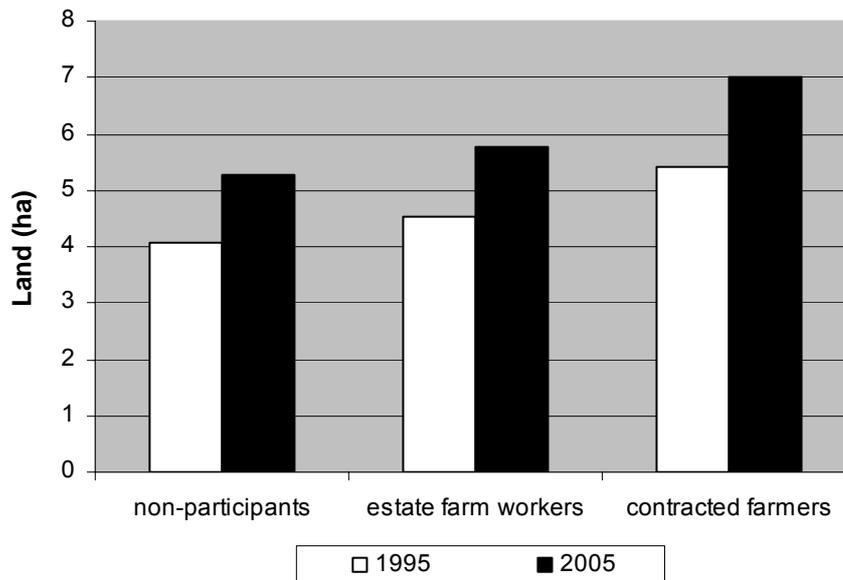
Figure 3: Household participation in French bean export production



The figure is based on recall data collected in 2005. To account for demographic effects, households for which the household head did not reach the age of 25 in a particular year and households who migrated to the area after a particular year are not taken into account for the figures of that year.

Source: Authors' calculation from household survey data

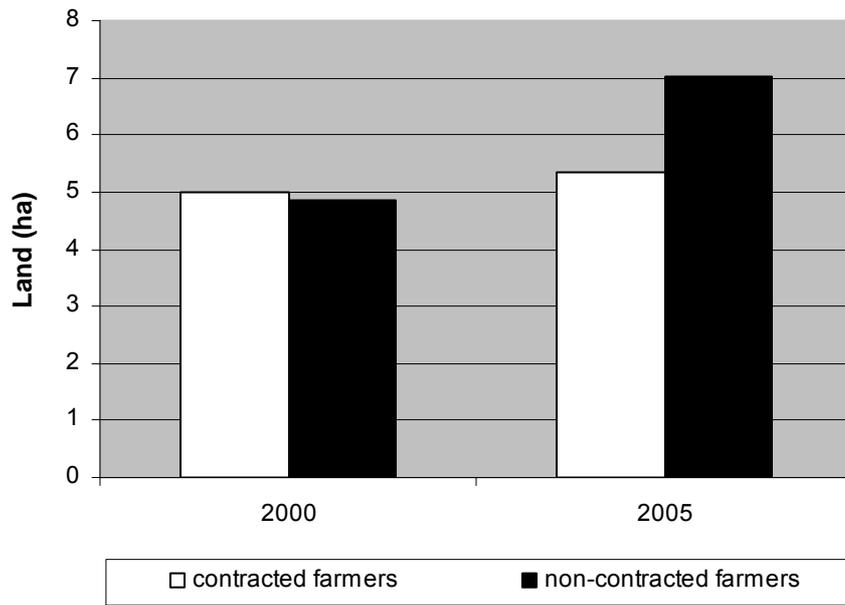
Figure 4: Changes in landholdings across households



Estate farm workers are households employed on FFV estates in 2005; Contracted farmers are households having a contract for FFV production in 2005.

Source: Authors' calculation from household survey data

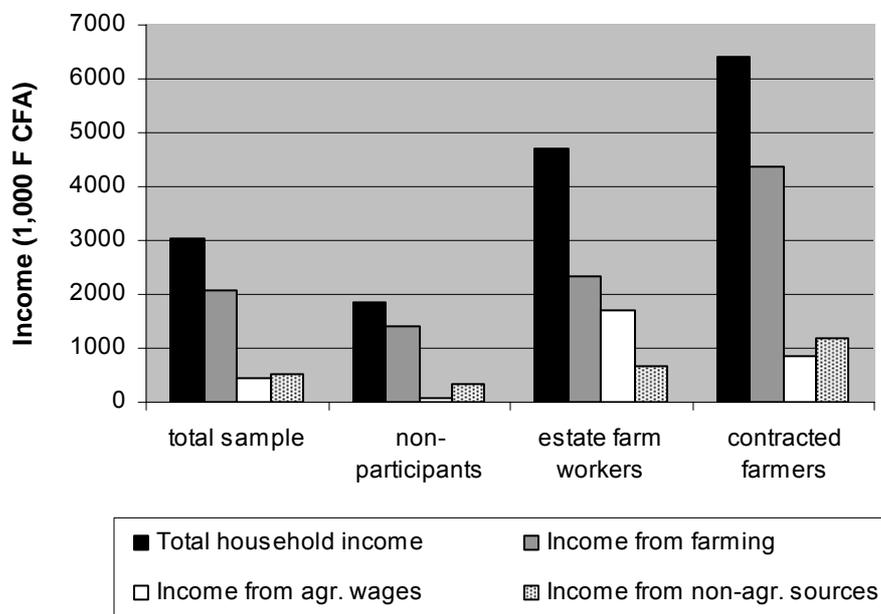
Figure 5: Changes in the distribution of land across households



Contracted farmers are households having a contract for FFV production in 2000 for the figures of 2000 and in 2005 for the figures of 2005.

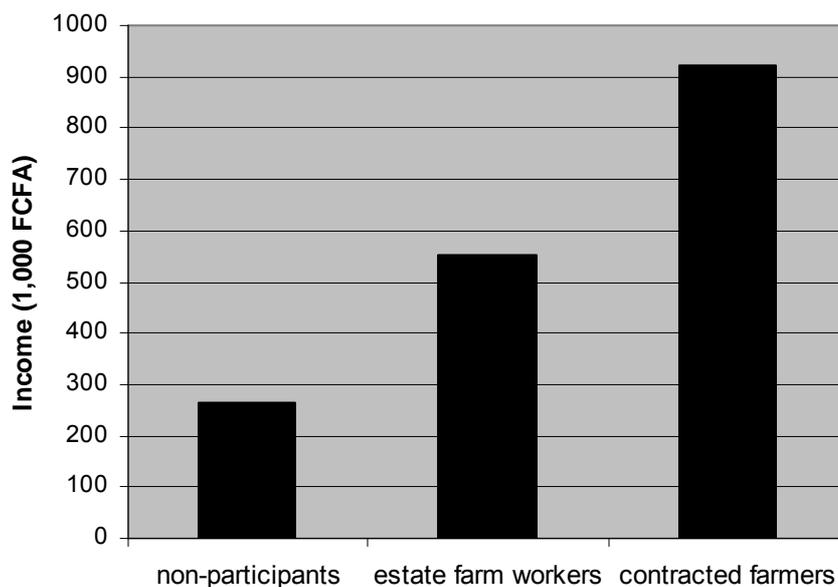
Source: Authors' calculation from household survey data

Figure 6: Household income from different sources



Source: Authors' calculation from household survey data

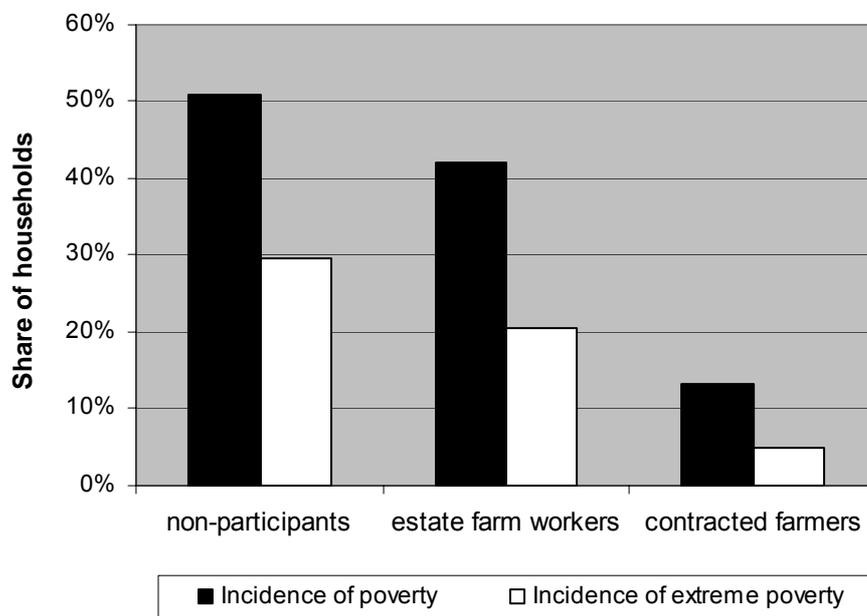
Figure 7: Per capita income across households



Per capita incomes are calculated using the modified OECD adult equivalence scales.

Source: Authors' calculation from household survey data

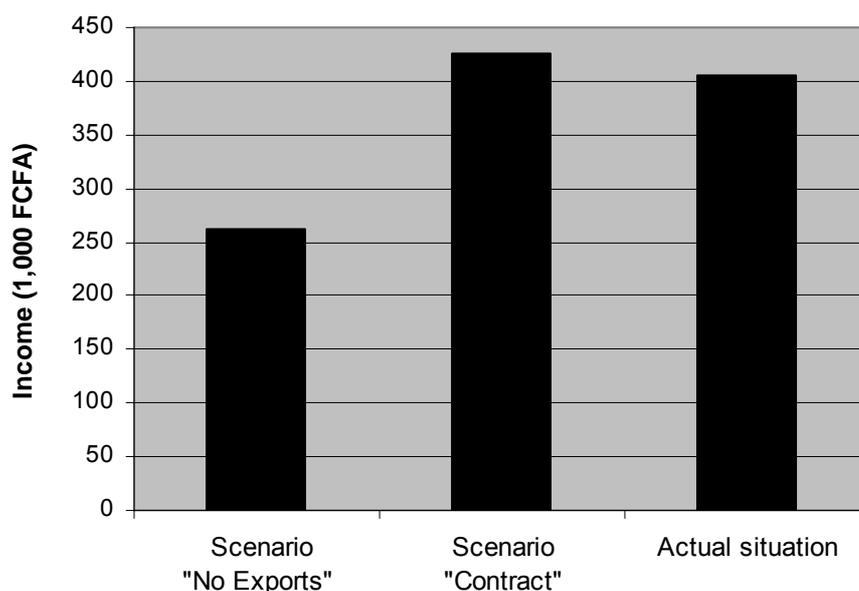
Figure 8: The incidence of poverty and extreme poverty across households



National rural poverty lines are used – constructed using data from the ESAM I and ESAM II surveys conducted in 1994 and 2002 (République du Sénégal, 2004) and adapted for changes in consumer price indices (African Development Bank, 2006). The poverty line is 181,770 F CFA/year and for extreme poverty (or food poverty) it is 106,245 F CFA/year.

Source: Authors' calculation from household survey data

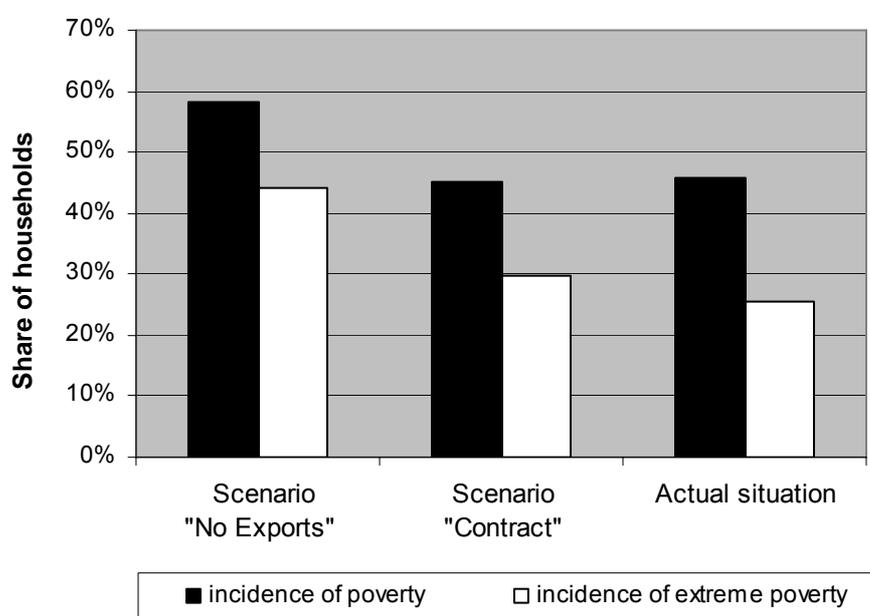
Figure 9: Per capita income for three alternative scenarios



Per capita incomes are calculated using the modified OECD adult equivalence scales.

Source: Authors' simulations from household survey data

Figure 10: The incidence of poverty and extreme poverty for three alternative scenarios



National rural poverty lines are used – constructed using data from the ESAM I and ESAM II surveys conducted in 1994 and 2002 (République du Sénégal, 2004) and adapted for changes in consumer price indices (African Development Bank, 2006). The poverty line is 181,770 F CFA/year and for extreme poverty (or food poverty) it is 106,245 F CFA/year.

Source: Authors' simulations from household survey data