GENDER, RESOURCE ALLOCATION AND PRODUCTIVITY
Evidence in Senegalese Rural households

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Abstract

The debate about intra-household resource allocation is a field of interest because of the policy implications in terms of poverty alleviation and food security issue. Most studies were mainly focused on aggregated productivity at the level of the household, thus ignoring thus gender differences and differences across activities. The study comprises data from 300 rural households and shows evidence that women and children are productive factors of farming's income. This paper provides empirical results of intra-family distribution of incomes and brought out important determinants of productivity in crops and livestock in rural household in Senegal through assets and human capital endowments. For instance, it shows that income from livestock and crops are gender-differentiated and well explained by individual and community's characteristics. Regarding individual's characteristics, labor force participation in terms of time allocation to agricultural activities and household tasks and also education are important determinants. Other determinants of individual farm's income with respect to community's factors are the type of land, the ethnicity, the distance to the market and the no-labor income (cash transfers from migrants).

Key words: Income, crops, livestock, productivity, assets, gender, land, resources allocation, Senegal.

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1 Introduction

The debate about the efficiency of agricultural activities in the household concerns especially the resource allocation, in particularly labor time and human capital allocation (Kandler, 1988, Lado, 1992; O'Neill and O'Neill, 2005). The traditional gender division of labour within the New Economics Household framework was viewed as a rational economic response to market valuations of people's time which reflects their productivity in the market. Becker stated in 1976 that "*Members who are relatively more efficient at market activities would use less of their time at household activities than would other members"*. Assuming that households make choices about the allocation of time to maximize their joint utility, Becker's explanation of gender division of labor was based on the specialization of men in market production and women in household activities. Moreover, with the specialization of human capital within market and home, it has been argued that women spend less energy on markets jobs (Becker, 1985) and thus receive a lower return in terms of wages.

Furthermore, New Home Economics underlines human capital theory as an important component of gender differences in earnings. Indeed, the allocation of labour and time to agricultural activities is directly linked to the allocation of productive resources and then to the productivity of agricultural activities. In the context of developing countries, studies have investigated the allocation of labor and time especially for female and children to explain the effect of human capital in earnings. Some evidence (Brown and Haddad, 1995) underlined the special role of women in work activities at farm level. The contribution of males and females in farm activities appeared to be guided by a specialization of the different agents (Fafchamps and Quisumbing, 1998; World Bank, 1999) and by seasonality (Alderman and Chishti, 1991; Kumar and Hotchkiss, 1988). Even if time and labor allocation have been associated with higher income, it has been argued that men earn more that women in market work. Moreover, attempts have been carried out to provide more insights on whether women's time allocation is subject by economic constraints as suggested by economic theory of the household (Becher, 1965; England and Farkas, 1986; England and Kilbourne, 1990; Haddad et *al*, 1997) or is also affected by local norms or "patriarchy" (Cain et *al*., 1979). Nowadays, there is a growing literature in about time use particularly in developing countries because of growing poverty and declining earnings. Since time use is a variable factor in the household, it might explain the variability of resources and earnings in the household among members and across different areas. In fact time allocation as a resource of the farm can vary among people and across other resources of the household (assets, fixed inputs, human capital). A better understanding of time allocation of household members would probably assist in implementing suitable projects or extension programs, with respect to productivity and income.

In the context of developing countries, the imperfection of markets has a great influence on productivity of different household members. Hence, our first hypothesis is that productivity of households depends on individual, household and community's characteristics that are gender-differentiated. For example, the lack of information related to the market and constraints related to physical inputs (land, livestock composition) or socio-cultural factors could disfavor farmers in earnings. Also, we expect that livestock and crops activities are interdependent with a gender specialization within activities regarding time allocation. Our second hypothesis is that women spend more time on farm activities but receive less income from market farm work than men and that male' earnings in farm activities do not depend to their time spent in farm work activities. On the other hand, education as a human capital factor with a positive effect on productivity, has attracted a lot of attention in empirical work

(Lucas, 1993, Stokey, 1991, Jamison and Lau, 1980). However, in context of developing countries, results vary according to communities and geographic region (Philips, 1987). This research also seeks to provide more insights on this issue.

Since agricultural activities are all linked at the household level (growing cash or food crops, keeping livestock), this study will investigate not only how intra-household allocation of human capital and time affects productivity, but also how households owning different types of resources allocate time to different activities (livestock activities, crop growing activities and non-agricultural activities). In doing so, one relevant issue will be the gender allocation of labour and time within the household work and the effects on productivity of agricultural activities. Finally, the objective of this chapter is to assess the impact of resource allocation (human capital, time, land) on production and income.

2. Method

2.1 The study area

This study takes place in Senegal, one of the ten poorest countries in the world (PNUD, 1998). Poverty concerns 38% of the population and is mostly visible in the rural area (67%) (DAPS, 1995). The reforms proposed within the framework of the Poverty Reduction Strategic Paper (PRSP) in 2002 (IMF, 2006) amongst others prioritize promoting agriculture and gender equality and women's independency by aiming at improving their economic status (access to credit, better education, funding women's development projects). The study concerns 300 dual-headed households (husband and wife) from two contrasting rural areas in Senegal whose principal earnings are from agricultural activities and secondary earnings from non-agricultural activities or transfers. The research area is characterized as a dry Saharan tropical climate and receives between 400mm and 800mm rainfall per year from north (sylvopastoral area) to south (agropastoral area). The principal characteristic of the climate is the shift from a long dry season (8 months) to an irregular rainy season (3–4 months). During the dry season (October to June), temperature can reach 47^0C with a *harmattan* wind, which makes human and animal respiration very difficult. Between a latitude of 10 to 20 degrees north, most of the rainfall occurs between June and end of September. Ecologically, the area can be defined as semi-arid. Conditional on the availability of rainfall, natural vegetation also varies from desert flora to rain savannah flora. The research work was conducted in two different areas: the sylvo-pastoral (SP) area and the agropastoral (AP) area. In the SP zone, 50% of a farmer's income comes from livestock. In the AP area, livestock is combined with cash crops and food crops and provides only 10 to 50% of a farmer's income. While the SP area is characterized by a wealth of land pasture land that is not suitable for growing crops, the AP area is less suitable for land pasture and livestock growing mostly takes place on agricultural crop residues. Different ethnic groups are spread in these areas comprising Wolofs and Sereers (mostly farmers) and Peulh or Fulani (mostly herders and some farmers).

2.2. Method

The sample includes 300 rural households whose husbands and wives are married couples and earn income principally through agricultural activities, and secondly, through non- agricultural activities or transfers. Since we assume that productivity is strongly linked to income, we report all activities both within and outside the household and try during the year of survey, to assess income generation per activity. Couples have been interviewed separately

using questionnaires and income has been reported for each farm activity including livestock, cash crops, food crops, vegetables, transfers and off-farm activities. Since time and labour are production factors, analyses will concern resources of all household members (wife, husband, other active member in the household and active children). The analysis aims to depict the effects of labour time and human capital, associated with different activities and among farmers with different land-owning status on gender participation in market production and home production. We assume that productivity of farming activities (growing crops, milk production, and livestock) and housework depends on a number of variables including labor, human capital, skills, status, variable and fixed inputs, and other characteristics of the household. The following general equation will be specified:

$Y_{xi} = G_{xi}(L_{xi}, C_{xi}, V_{xi}, F_{xi}, H_{xi}, Z)$,

where Y_{xi} denotes income of activity x (crops, milk, livestock) of individual i (husband and wife), G_{xi} is a production function associated with activity x of individual I (husband and wife), L_{xi}, an individual's labor time devoted to x, Cxi, time devoted to homework for the wife in the household, V_{xi}, variable input, F_{xi} fixed input (land) associated with activity x of individual i, H_{xi} denotes human capital of the individual (skills, education) and Z is a vector of household characteristics. The desegregation of variables by gender allows us to specify models that determine the effects of individual, household and community's characteristics on husband and wife's income respectively in crops and livestock.

Cobb Douglas functions have been specified for these models, based on several factors that potentially affect household's output in farming like household labor endowment, land use, time allocation, home work 's involvement, human capital variables and other nonessential inputs. The estimation of different regressions from Heckman model considering female and male heads consider total outcome as the dependent variable for crops and livestock separately. Considering individual level, we expect following variables to have direct effect on their productivity for each x activity: (1) time spent in farming (T_{xi}), which can be decomposed into time spent in crops' activities and time spent in livestock's activities, (2) involvement in homework (H_{xi}) which can be decomposed into several variables (fetching water and wood, cooking/cleaning, caring children or ill persons and kitchen garden involvement), (3) land availability for different crops (L_{dxi}), (4) owning cattle, sheep and goats ($\square_{xi}$) and other characteristics of the household (female household goods considering as assets, area, zone, distance from the market, credit access). Education and ethnicity has been considered like dummies. The equation model can be specified as:

$$Y_{xi} = \alpha_{w0}\, T_{xi}^{\alpha 1}\, H_{xi}^{\alpha 2}\, L_{dxi}^{\alpha 3}\, \square_{vi}^{\alpha 4}\, e^{\alpha 5 Z} \qquad (1)$$

This can be written considering logarithm as:

$$Log\,(1+Y_{xi}) = log\alpha_{w0} + \alpha_1 log\,(1+T_{xi}) + \alpha_2 log(1+H_{xi}) + \alpha_3 log(1+L_{dxi}) + \alpha_4 log\square_{vxi} + \alpha_5 Z + \epsilon \qquad (2)$$

Individual outcome (equation 2) is a censored variable since 12% of the male in the sample have 0 observations in livestock and 42% have 0 in crops. For female, the censored observations are noticed for livestock (38%) and also for crops (91%). For this reason, we use Heckman models two steps (Heckman, 1976; Heckman, 1979) in order to consider all

observations and to allow for participation in farming to be determined by different variables from those that determine the value taken by the positive observations. Also variables are allowed to be different in two equations and to take also different coefficients. The test for the joint null hypothesis that the coefficients on the variables that are common to both decisions are equal in the two equations is rejected at 0.01 in the male's crop equation, at $p<0.00$ in livestock's male equation, at 0.1% in wife's livestock equation and at $p<0.05$ in wife's crops equation underlying the robustness of the model. This approach uses Heckman selection model two steps which estimates total outputs in all equation as censored variables. Heckman selection model uses two equations:
In the first equation, consider that equations (2) can be summarized into a general equation which is called outcome equation:

$$Y_1 = Y_1(\alpha' X + U_1) \quad (3)$$

Where $\alpha' X = \alpha_1 X_1 + \alpha_2 X_2 + \ldots \alpha_n X_n$

And where Y_1 is observed and U_1 represents the error term

In the second equation, Heckman's sample selection models a selection equation:

$$Y_2 = g' Z + U_2 \quad (4)$$

Where $g'Z = g_1 Z_1 + g_2 Z_2 + \ldots . g_n Zn$

$Y_2 = 0$ *if* $Y_2^* \leq 0$

$Y_2 = 1$ *if* $Y_2^* > 0$

$Y_1 = Yi^*$ *if* $Y_2 = 1$
Y_1 not observable if $Y_2=0$

X is a k-vector of regressors, Z is an m-vector of regressors, and the error terms U_1 and U_2 are jointly normally distributed, independently of X and Z, with zero expectations.

The first model is the model we are interested in. However, the latent variable Y_1 is only observed if $Y_2 > 0$. Thus, the actual dependent variable is:

$Y = Y_1$ if $Y_2 > 0$, Y is a missing value if $Y_2 = 0$.

Also, Y_2 is not observed. We know that Y_1 is observed only when $Y_2 > 0$, e.g.,

when $g'Z > u2$.

The estimates probability, $prob\ (Y_2=1) = F(g_i'Z)$ provides estimates of $F(gi'Z)$ for each observation.

2.3. Results

2.3.1. Household productivity statistics

This section describes the source of income earned in economic activity or not in the household by husband, wife and other adult members in rural households in the year of survey and estimates the variation of this income according to zone, land availability, time used and other socio-economic factors. In rural households, economic activities are mainly related to agricultural activities. According to the Unites Nations, economically active persons are "all *the persons of either sex who furnish the supply of labor for the production of goods and services during the time-reference period chosen for the investigation*" (Blacker, 1978:78). Following this definition, we investigate time used related for each household's member, especially in agricultural activities. For non-agricultural activities (off-farm work), the estimation of time use was quite difficult and impossible to evaluate because of the seasonality and irregularities of these activities. In addition, we add other no-economic income mostly related to transfers from migrants.

Activities managed and time use

In general, rural Senegalese households show a specialization of household's members in daily activities. Women and children tend to manage specific agricultural activities in the household. The poor infrastructure for the provision of water and energy forces women and children more than men to allocate their time to acquire these goods. Other female activities are milking and marketing milk in the market. Concerning livestock, males are more specialized in marketing, feeding and guarding ruminants.

The main source of income for the majority of the rural households is rain-fed farming. Almost all households reported that farm work was their main activity. A detailed report concerning hours per day spent on farm activities shows that male households heads and active boys spent more time in crops activities than wives and actives girls. On average male heads spend 10 hours/day on livestock (water collection for the animal, feeding, guarding, etc) and eight hours on crops (shelling, cleaning, harvesting, marketing, etc), compared to wives that spend on average six hours/day and four hours/day respectively on crops and livestock (time spent by wives also comprise polygamous households). For crops, the time reported is related to the rainy season from July to October and we can see that males and female show almost the same performance (Table 1). This result is in line with other studies that suggest that women are as productive as men in cash crops (Saito, Makonnen and Spurling 1994). Male heads also spend time (on average three hours/day) in marketing ruminants in the market; this activity is not as a concern of wives. In general, active boys spend more time on livestock and on crops which averages respectively 12 hours/day and seven hours/day. The activities handled by boys are especially guarding ruminants (on average five hours/day) and cleaning fields and harvesting crops (Table 2). Other dependent members like helpers and relatives average less time: three to four hours per day respectively on livestock and crops.

Farming household income

To study income procurement, gross income has been considered and evaluated for crop-growing activities (food crops, cash crops, and garden vegetables), livestock (selling goats, sheep and cattle, fattening and marketing milk), trade (all goods), off-farm income during the dry season and other money transfers. In fact the crop-growing activities are managed during the rainy season which starts generally in July and ends in September or

October. Fattening livestock is mainly practiced during the dry season from March to June in order to generate earnings to meet household needs. This analysis is limited to the heads of the households and dependent or subordinate members. In polygamous households (which represent 38% of the sample), the average over all wives was considered.

A first analysis concerning only the income from livestock and crops appears to show that the husband's income from farming is the most important part of the household income. Women achieved lower crop and livestock output than men **(Table 3**). Husbands' income from farming represents almost 81 percent of the total household income from farming, while wives' income from crops and livestock amounted on average to 15.45 percent of the total household earnings from farm activities. Concerning children, adult boys earned more than adult girls in farm activities, 3.12 percent and 0.39 percent of household income, respectively. On average, other household members (like dependent helpers) have contributed 0.71 percent of total household income from farm activities. A comparison by zones showed that for male heads, herding is more important in the sylvo-pastoral area than in the agro-pastoral area. In contrast, earnings related to crops in the AP area total almost ten times those in the SP area. Regarding females, the same result has been noticed: females in the SP earn more from livestock, and those in the AP area earn more from crop growing. Apart from their own earnings from farm and off-farm activities, women also received compensation from their husbands for their work in cash crops production and from selling livestock. This monetary compensation is more visible in the AP area (Table 3). However, the monetary compensation from husband to wife represents only 7.90 percent of women's earnings and cannot explain entirely the economic contribution of women in agricultural activities. The largest part of women's earnings is determined from livestock production (milk production and livestock assets).

An independent sample T-test between both areas (estimated only for the shaded items in Table 3), for total household earnings related to farm activities (including crops and livestock), shows a significant difference between the AP area and the SP area ($p<.05$). However, the difference between the two areas in earnings for male heads is not significant. In contrast, wives earn significantly more farm income in the SP area than in the AP area ($p<.01$). These results suggest that total farm income is variable across areas and that women in the SP area seemed to be wealthier, economically speaking, than females in the AP area.

Table 1 : Management of activities by gender in time used (average of hours/day)

		Crops	
	Livestock	Food crops	cash crops
Male heads	10.40	3.32	3.28
	(0.66)	(.20)	(.21)
Wives	4.11	2.70	3.50
	(0.35)	(.32)	(.28)
Hours boys	12.30	3.75	3.68
	(0.72)	(.25)	(.25)
Hours girls	1.40	1.24	1.5351
	0.16)	(.11)	(.14)

Other dependent	3	.22	.26
	(0.36)	(.08)	(.08)
hours husband in marketing ruminants	3.17 (0.18)		
Time used for hired labor	3.22	1.46	1.75
	(0.82)	(.22)	(.32)

Std/mean is in parenthesis
1$ =475 Fcfa during the year of surveys

Table 2: Hours spent per day on agricultural activities by children

Activities	Mean	Std
Boy guarding cattle	4.50	5.85
Boy guarding small ruminants	6.00	6.70
Boy watering	1.00	1.50
Boy cleaning fields and harvesting	2.80	2.90
Boy shelling	0.80	2.10
Girls cleaning fields	1.20	1.90
Girls shelling	0.24	1.10
Girls milking	0.25	0.70
Girls watering	0.12	0.48

Table 3: Average income in CFA of household members for crops and livestock in the survey year

	Total (N=300)		SPA (N=149)		APA (N=151)	
	Mean	Std	Mean	Std	Mean	Std
Husbands' income from crops	266,867	32,625	43,309	10,921	487,463	58,702
Wives' income from crops	7,730	1,638	2,631	16,591	12,761	29,382
Husbands' income from livestock	1,079,200	87,862	1,404,200	135,596	764,934	106,955
Wives' income from livestock	255,738	31,102	437,285	57,465	76,596	13,609
Wives' compensation from husbands	26,218	66,237	24,201	83,652	28,194	43,130
Total husbands' income from trade	378,635	58,482	478,165	106,942	283,059	50,182
Total husbands' income from crops and livestock	1,724,400	178,970	1,925,674	274,647	1,535,456	215,838
Total wives' income in trade	41,907	10,480	39,054	20,185	44,677	7,454
Total wives income' from crops and livestock	331,593	43,220	503,171	94,241	162,328**	23,975
Adult Boys' income from crops	5,266	1,910	2,584	1,833	7,914	3,329
Adult Boys' income from Livestock	61,775	10,879	102,231	18,928	21,854	9,926
Adult Girls' income from crops	50	866	-	-	99	99
Adult girls' income from livestock	8,416	2417	16,946	4,775	-	-
Total Other members' income	15,416	5,818	17,718	9,308	13,146	7,046

Total household income from crops and livestock	2,146,916	182,324	2,568,324	304,105	1,740,797*	192,321

T- test (difference between areas): *p<.05, **p<.01, ***p<.001
1$ = 475 Fcfa during the year of the survey

Further analysis shows that male heads of the household are more productive in crop production than females; they earn 247.00 Fcfa per hour (if we consider 6 months of working hours in all crop activities), while women earn 7.15 Fcfa per hour for almost the same spent on crops (six hours per day for both genders). This result suggests that males gain 35 times more than females for the same number of hours spent on crops. This might be explained by the fact that men sell all household crop produced and keep the revenues for themselves, especially from cash crops (see also Rowling, 2008). In livestock production males gain 300 Fcfa per hour compared to 175 Fcfa for females; even though statistically significant, the difference is far less than for crop income, suggesting that in livestock production, women are less disfavoured than men. This result is explained by the fact that women are responsible for selling milk at the market and retain their earnings. In line with our results, findings from the Peruvian Sierra (Jacoby, 1991) also suggested that female labour is less productive in crop than in livestock activities. Analysis across areas shows that male heads are more productive in the AP area than in the SP area for both crop and livestock activities (375 Fcfa per hour in the AP area compared to 40 Fcfa in the SP area for crops, and 420 Fcfa per hour in the AP area compared to 242 Fcfa in the SP area for livestock). In fact, farmers in the AP area benefit from the advantages of mixed farming systems (where agriculture and livestock are complementary and mutually beneficial) and better prices because of the proximity to big cities. For females, productivity (earnings over time allocation to crop and livestock separately) does not show much difference between the two areas.

Off-farm household income base

In the entire sample, total off-farm activities accounted for 5.14 percent of the total household income and the largest share was earned by male heads of households (on average 38.94%). Wives and other dependents achieved respectively 27.47 percent, 30.33 percent (adult boys), 2.21 percent (adult girls) and 1.03 percent (other). Data showed large differences between zones (Table 4), especially regarding husbands' and wives' off-farm wages. However, differences in earnings were only significant for wives' earnings (p<.001) as in our previous analysis concerning farm activities; off-farm wages were much higher in the SP area than in the AP area. Cash transfers to the households (especially from relatives abroad) accounted for 37.30 percent of total off-farm income and 3.06 percent of total household earnings.

The results in Tables 3and 4 regarding earnings in farming activities and off-farm activities show that there is a significant difference between women's earnings across zones. Women in the SP area earn more than in the AP area from farming and off-farm activities. The difference is large and may suggest that women in the SP area are not constrained in keeping earnings for themselves and engaging in activities outside the household. The difference in earnings between males and females is greater in the SP area than in the AP area. However, such difference may derive from the fact that farmers in the SP area are wealthier and gain more income from livestock.

Table 4: Average off-farm income by household members in the year of the survey (average)

	Global		SPA		APA	
	Mean	Std	Mean	Std	Mean	Std
Total male heads	46,869	33,822	70,777	67,580	23,280	8,770
Total wives	33,064	6,188	59,863	10,857	7,152**	5,421
Total boys	36,505	9,320	34,831	14,989	38,146	11,218
Total girls	2,667	1,365	1,812	1,109	3,510	2,486
Others	1,246	726	822	821	1,656	1,190
Total	120,351	61,908	168,105	120,089	73,744	18,500
Other transfers	71,581	17,200	64,336	27,487	78,444	21,147
Total households' non-agricultural income	191,932	401,410	232,441	483,247	152,188	310,551

T- test (difference between areas): *p<.05, **p<.01, ***p<.001

Off-farm household's income base

Over the entire sample, total off-farm activities accounted for 3.8% of the total household income and the largest share (53%) was accrued by male heads of households. Wives and other dependants achieved respectively 33%, 41% (adult boys), 3% (adult girls) and 1.4 % (other). Data showed large difference between zones (Table 4), especially regarding husband and wives' off-farm wages. However difference in earnings were only significant for wives earnings (p<.001) like in our previous analysis concerning farm activities; off-farm wages are much higher in the SP area than in the AP area. Other transfers in the households (especially from relatives abroad) accounted for 44% of total off-farm income and 3% of total households earnings.

3.3.3 Individual income determinants

In the estimation of the Heckman regressions, total income as the dependent variable for crops and livestock is considered separately for female and male household heads. Considering the individual level[1], we expect the following variables to have direct effects on their total earnings for each activity, *x*. i): time spent on farming (T_{xi}), which can be divided into time spent on crop activities and time spent on livestock activities, ii) involvement in homework (H_{xi}) which can be divided into several variables (caring for ill members and children and other chores), iii) land availability for different crops (L_{dxi}), iv) owning cattle, sheep and goats (L_{xi}) and other characteristics of the household (females' household goods considered as assets, wife's savings, wife's access to credit, area, distance from the market

[1] In our analysis we consider that there is a relationship between dependent and independent variables, although we neither assume not test for causality of the relationship. Only for the sale of convenience we speak of independent variables 'affecting'or 'having an impact'on the dependent variable, where technically speaking we mean no more than 'association' or 'correlation'.

and health status). Education and ethnicity have been considered as dummy variables. The equation model can be specified as:

$$Y_{xi} = \alpha_0 T_{xi}^{\alpha_1} H_{xi}^{\alpha_2} L_{dxi}^{\alpha_3} L_{vxi}^{\alpha_4} e^{\alpha_5 z} e^{u} \quad (5)$$

After taking the logarithm, this can be written as:

$$Log\ (1+Y_{xi}) = log\ \alpha_0 + \alpha_1 log\ (1^2+T_{xi}) + \alpha_2 log(1+H_{xi}) + \alpha_3 log(1+L_{dxi}) + \alpha_4 log(1+L_{vxi}) + \alpha_5 Z + u \quad (6)$$

Individual income (equation 5) is a censored variable since 14.16 percent of the male heads in the sample have no income from livestock and 40.16 percent have no income from crops. For female heads, censored observations are noticed for livestock (39.66 %) and also for crops (91%). For this reason, we use Heckman's two-step model in order to consider all observations and to allow for participation in farming to be determined by variables different from those that determine the value taken by the positive observations. Variables are also allowed to differ in the two equations, and to take different coefficients. The test for the joint null hypothesis that the coefficients of the variables common to both decisions are equal in the two equations, is rejected at p<.01 in the male crop equation, at p<.01 in the male livestock equation, at p<.10 in the wife's livestock equation and at p<.05 in the wife's crop equation, showing the robustness of the model.

Determinants of wife's income from farming

Determinants of wives' participation in crop activities are their savings and the number of cattle (Table 5). This number decreases their probability to participate in crops activities (p<.01), because of the competition between the activities in terms of time allocation. Wife's savings also are negatively associated with the participation in crops (p<.05), suggesting that savings enable women to get involved in other activities (trade and small entrepreneurship). In the outcome equation, results show that household size positively affects wife's income from crops. The same is noticed for off-farm activities which positively affect earnings from crops (p<.05). The effect of off-farm earnings may be related to the use of better seeds and inputs in plots and also to the access to new technologies (machinery). An important positive factor is also women's time spent on livestock which is negatively correlated with their earnings from crops (p<.01). Wives' education has a positive correlation with their earnings while with a higher level of males' education, women earn less from crops, probably through decreased males' participation in farming and thus less earnings from crops. Also, better- educated wives are more likely to be involved in other, such as off-farm, activities. Table 6 shows that with higher education, women earn more from off-farm activities. The significant effect of schooling on crop activities is in line with the work of Quisumbing (2007) that argued that return to schooling for both men and women are significant in agriculture, and contrast with other studies (Ilahi, 2000) which underline that better-educated women are less involved in farming. However, even if wives' education leads to higher individual earnings from crops, results regarding the household income show that a better-educated wife is less probably interested in growing crops (AP area). Moreover, the male's education significantly decreases (p<.05) the female's participation in livestock activities. Other results from Pakistan (Kandker, 1988) found husbands' education among the significant determinants of women's time allocation (in off-farm employment) in Bangladesh. The distance from the market is negatively associated with earnings from crops (p<.001): one

[2] We add 1 to the explanatory variables in order to avoid computational problems when taking the logarithm.

percent increase in distance leads to 0.70 percent decrease in earnings. This result may be explained by the fact that cash crops are mostly sold in the big cities (Dakar, Kaolack) that are remote from most villages and transportation costs cause lower earnings and benefits. Regarding housework, the time that girls spent cleaning, fetching wood and water, and caring, positively predict wife's earnings ($p<.05$).

Regarding livestock (Table 7), women's time allocation and land access predicts their income from livestock quite well ($p<.001$). Women's time use in feeding, milking, and water collection, and boys' marketing milk are good predictors of women's income from livestock, highlighting that women's time allocated to livestock tasks are productive factors of livestock income. In fact, for females this time includes almost all activities related to livestock. Land access for women allows the productivity of livestock activities through better access to feeds and other related residues. Evidence from peasant households in the Peruvian Sierra suggests a gender division of labour with females spending more time on livestock than men do (Jacoby, 1991)**.** Regarding household tasks, negative effects on livestock outcome are found for women's involvement in chores ($p<.01$).

Important determinant factors in the probability of wives' participation in livestock activities are females' savings and cash transfers from migrants (positive effect). These increase the probability of their participation in livestock activities but the cash transfers decrease their participation in keeping livestock) (both at $p<.01$). These results reinforce our previous findings in the SP area where cash transfers have a negative effect on livestock activities, suggesting that such alternative earnings push women to involvement in other activities. Wife's savings also have a positive effect on females' income from livestock ($p<.05$). For the wife's savings, the positive effect (in both the outcome and the selection equations) can be explained by the fact that savings can mitigate risks and reinforce the investment of income from keeping livestock, which is an important form of savings for women in West African countries. For example, domestic dairy production is an activity mainly managed by women. They are responsible for marketing and the traditional processing of milk that results in yoghurt and butter. Wife's savings are thus an important determinant of livestock assets and milk production. Research has shown that livestock production, especially smallholder dairy farming, contributes to income generation of smallholder farmers (Delgado *et al*, 1999). It contributes to the capital accumulation of households that are poor in resources. According to Staal (2002), the income partially accrues to women and has a significant effect on the family's welfare (child welfare and nutrition). Ethnicity and area also are correlated with women's earnings. In the AP area, earnings from livestock are 0.82 percent lower than in the SP area.

Table 5: Heckman's two step selection model; dependent variable: wife's income from crops (in log).

	Coeff.	Std. Err.	t
Outcome Equation			
Husband's education [c]	-0.3948	0.1854	-2.13*
Wife's education [c]	0.4423	0.2125	2.08*
Wife's access to land [d]	-0.0406	0.4079	-0.10
Household size (log)	0.9600	0.3526	2.72**
Time in livestock in log (W)	-1.1401	0.1947	-5.86***
Time spent in crops in log (W)	0.6670	0.4804	1.39
Zone [j]	0.7391	1.0195	0.72
Time spent in crops by other members (in log)	-0.0689	0.6358	-0.11

Wife's off-farm earnings	0.2195	0.0991	2.21*
Wife's access to credit [e]	-0.2071	0.1741	-1.19
Land cultivated (in log)	-0.2819	0.2398	-1.18
Housework (H) [f]	0.0493	0.0905	0.54
Housework (B)[f]	-0.0586	0.1056	-0.55
Housework (W)[f]	0.0843	0.0634	1.33
Housework (G)[f]	0.1311	0.0636	2.06*
Housework (O)[f]	0.0448	0.0313	1.43
Distance from markets (in log)	-0.7013	0.1478	-4.74***
Health status (W) [g]	0.0552	0.3251	0.17
_Constant	5.1822	2.2800	2.27
Selection equation			
Husband's education	0.0979	0.1139	0.86
Wife's education	-0.3491	0.2186	-1.60
Wife's access to land	-0.4015	0.4033	-1.00
Cattle (number in log)	-0.4637	0.1943	-2.39**
Sheep (number in log)	0.1327	0.1472	0.90
Land cultivated (log)	0.2656	0.1284	2.07*
Off-farm earnings	0.0590	0.0364	1.62
Wife's access to credit	0.0694	0.3127	0.22
Wife's savings (log)	-0.0558	0.0277	-2.02**
_Constant	-0.8053	0.6221	-1.29
Lambda	0.0169	0.3933	0.04
Rho	0.1066		
Sigma	0.1583		
N=264			
Censored observations=240			
Uncensored=2wals chi2(18)=267.29			
Prob chi2 < .0001			

*p<.05, **p<.01, ***p<0.001

Legend

H = husband, W = wife, B = boy, G = girl, O = other dependent members

[c] Education dummy: 0= lowest, 1 = highest education

[d] Dummy wife access to land: 1 = yes

[e] Dummy wife's access to credit: 1= yes

[f] Due to difficulties in reporting hours in house work by farmers and their children, we prefer using their involvement and take housework as dummy: 1 = yes

[g] Dummy: 0 = illness problem, 1 = good health

[j] Dummy: SP=0, Agro-pastoral area = 1

[k] Dummy Wolof (Wolof=1, Sereer =0)

[l] Dummy Peulh (Peulh=1, Sereer=0)

Table 7: Heckman selection model, two model; dependent variable: wife's income from livestock.

	Coeff.	Std. Err.	t
Outcome Equation			
Husband's education[c]	-0.1239	0.0962	-1.29
Wife's education[c]	0.0559	0.1220	0.46
Wife's access to land[d]	0.5421	0.2634	2.06*
Household size (log)	0.3877	0.2265	1.71
Number of goat (log)	-0.0730	0.0806	-0.91
Number of sheep (log)	0.0127	0.0785	0.16
Number of cattle (log)	0.0894	0.0981	0.91

Time in livestock in log (W)	0.7435	0.1304	5.7***
Time spent in crops (W)	-0.1153	0.0809	-1.43
Zone[j]	-0.8285	0.4259	-1.95*
Wife's access to credit[e]	-0.1798	0.2084	-0.86
Land cultivated	0.0507	0.0578	0.88
Time marketing animals (H)	0.0142	0.1620	0.09
Time marketing animals (B)	0.3734	0.1505	2.48**
Time in livestock in log (H)	-0.0497	0.0764	-0.65
Time in livestock in log (B)	-0.1397	0.0875	-1.60
Time in livestock in log (G)	-0.0196	0.1108	-0.18
Time in livestock in log (Helpers)	-0.1016	0.0907	-1.12
Housework (H)[f]	-0.0292	0.0699	-0.42
Housework (W) [f]	-0.2796	0.0982	-2.85**
Housework (G) [f]	-0.0536	0.0539	-0.99
Cash transfers	0.0463	0.0506	0.92
Off-farm earnings	-0.0277	0.0207	-1.34
Wife's savings (log)	0.0541	0.0252	2.15*
Distance to market (log)	-0.2324	0.0763	-3.04**
Housework (B) [f]	0.0777	0.0912	0.85
Housework (O) [f]	0.0435	0.0879	0.49
Heath status (W)[g]	-0.5701	0.4477	-1.27
_Constant	13.2988	1.7269	7.70
Selection Equation			
Wolof group[k]	0.6061	0.2770	2.19*
Peulh[l]	0.7515	0.3259	2.31*
Husband's education	-0.1584	0.0810	-1.96*
Wife's education	-0.0619	0.1168	-0.53
Wife's access to land	0.3937	0.2431	1.62
Zone[j]	-0.0679	0.2707	-0.25
Cash transfers from migrants (log)	-0.0565	0.0195	-2.89**
Off-farm wages	0.0320	0.0289	1.11
Wife access to credit	0.1877	0.2275	0.82
Wife's savings (log)	0.0537	0.0180	2.99**
_Constant	-1.9340	1.2284	-1.57
Lambda	0.5907	0.6550	0.90
Rho	0.6576		
Sigma	0.8983		
N=250			
Censored observations=99			
Uncensored observations=151			
Wald chi2(31)=169.22			
Prob chi2 < .0001			

*p<.05, **p<.01, ***p<.001 Legend: same table 3.13

Table 6: Comparison between off-farm earnings (CFA) and level of wives' education in the year of the survey

Level of Education	Off-farm earnings (CFA)	
	Mean	Std error
Illiterate and basic level	41,377	10,030
Primary school level	54,166	44,944
Secondary school level	103,750	98,804

Distance from the market also is a negative predictor of female earnings in livestock. One percent increase in distance leads to 0.23 percent decrease in women's income from livestock ($p<.01$). In fact, distance from the market is important in marketing milk and this activity provides the largest share of female income (33% of the wife's income in our study). Female earnings highly depend on milk sold in the market; hence long distance to the market has a decreasing effect on income, more so because dairy products do not keep as long as cereals and cash crops (peanut, millet and water melon). Because of its important effect on income generation, employment and welfare for all categories of producers (especially the women and landless), governments in many developing countries (Kenya, India, China) have developed special policies to improve milk supply. These policies relate to technical, but also to institutional aspects (infrastructure) and organizational aspects, like the New Hope Dairy Group in China (World Bank, 2004). In fact, infrastructure is an important factor in the development process. In the case of Senegal, the lack of daily markets in rural areas (most villages have only weekly markets) cause a substantial loss of milk (products), especially during the rainy season. These aspects disfavour especially wife's earnings in livestock.

Determinants of husbands' earnings from farming

Off-farm earnings of women have a positive effect on husband's participation in growing crops, thus strengthening the findings that other complementary income allows farmers to secure their crop activities (Table 8): every additional franc from off-farm activities (on the logarithmic scale) increases the probability of the husband's participation in crop activities ($p<.01$). Household size also is a good predictor of such probability. Distance to the market significantly decreases income: one percent increase in distance leads to 0.31 percent decrease of income ($p<.001$). This effect reflects the role of infrastructure in agricultural productivity . In fact, earnings from crops depend highly on timely marketing. Since the collapse of West-African cooperatives in the 1980s after structural adjustment, most farmers resorted to informal channels for marketing their crops. In the research area, the markets of Kaolack in the AP area and Touba and Dahra in the SP area, are very dynamic in the improved marketing of cash crops and food crops. The proximity of markets also allows for better information about the prices of products. Moreover, transportation costs remain an important determinant of profits. Higher transportation costs reduce farmers' profits and cause losses due to transportation constraints and delays in the delivery of perishable products.

Time allocated by other helpers to household tasks is a negative factor in crop income because of the need for household labour to participate in crop activities (boys and other helpers). In the income equation, time spent by boys on crop activities is a negative factor because as we already noticed, boys are more productive in other activities (livestock). Also, as expected, off-farm activities are good predictors of the probability of growing crops. In the outcome equation, husbands' good health induces 0.80 percent more earnings ($p<.05$): than in bad health.

Turning to men's participation in livestock (Table 9), positive factors are ethnicity (Peulh are more involved in livestock than other ethnic groups) and millet cultivation ($p<.01$). In fact, cultivated millet does not compete with livestock activities in terms of time allocation, like, for example, cash crops that need more care. Land cultivated with peanut is negatively correlated with the probability of participation in livestock activities. In addition, millet is used for consumption by both animals and humans. The AP area is negatively associated with participation in livestock activities. Because of the scarcity of available land in this area, keeping livestock remains a real problem. Cash transfers are also negatively associated with male participation in livestock. This strengthens our previous findings for the wife: cash

transfers negatively contribute to keeping livestock ($p<.01$). Cash transfers reduce the probability of participation in keeping livestock. In the livestock outcome equation, positive predictors for men are ethnicity and the number of cattle ($p<.001$). Again, an important negative predictor is the distance to the market ($p< .001$). This variable reduces the husband's income in livestock by 0.23 percent for each one percent greater distance. This result strengthens the importance of market proximity in earning farm income. In the domain of livestock, men are especially involved in the marketing of animals. Likewise, the husband's involvement in housework (fetching wood and water) negatively affects his earnings in livestock. Regarding education, the results show that better-educated males earn more from livestock ($p<.001$), thus strengthening our previous findings.

We also computed beta coefficients to test for economic significance of the variables; it appears that women's time allocated to livestock is an important factor of women's earnings since it is economically meaningful: it affects negatively earnings from crop ($\beta = 0.87$) and impacts positively on livestock earnings ($\beta= 0.65$). A change of one standard deviation of time allocated will results in 0.87 and 0.65 standard deviation change in women's earnings respectively for crop and livestock. Other significant determinants that are economically meaningful are wife's education, women's earnings from off-farm activities and household size: a change of one standard deviation of these variables lead to a 0.31, 0.33 and 0.28 standard deviation change in women's earnings from crops. An economic significant effect is also noticed for wife's savings and distance from the market: a change of one standard deviation in savings and in distance from the market will results in 0.22 and 0.21 standard deviation change in women's earnings from livestock. Involvement of women and other dependent members in housework do not seem to be economically significant because the estimates of the beta coefficients are very small ($\beta=0.09$ and 0.04 respectively for women and for girl).

In conclusion, estimations of determinant factors of individual incomes brought out differences across activities and gender. Moreover, women's and men's earnings from farming are especially associated with time allocated by females and boys to livestock activities, and that of girls and other dependent members to household tasks. These results confirm our expectations that women's time allocation is a productive factor in farming, and strengthens the finding that housework has an effect on female's earnings. Girls are the complement of their mothers in doing most household chores and this allows mothers to be more efficient in agricultural activities. Looking into the beta coefficients allows us to say that most of variables are economically significant in determining individual earnings; except the involvement of women and other dependent members in housework, all variables show meaningful beta coefficients (larger than 0.20 in most cases).

Cash transfers from migrants have a negative correlation with the participation in farming both for husband and wife, while off-farm activities and wife's savings have positive correlations with husband's and wife's participation in farming. Distance to the market has a negative impact on all types of income procurement, both for husband and wife in their different activities. These results also suggest that male heads and wives secure farm activities, especially crops, through off-farm earnings and wives' savings. In fact, for rural households in Senegal, nowadays farming is a risky business because of decreasing rainfall and repetitive droughts. Consequently, the diversification of household activities through off-farm work allows for more participation in growing crops. Individual earnings also depend on area. Men gain more in growing crops in the AP area, where they participate less in livestock activities, while women earn less in growing crops there. While husbands' education has a significant effect on livestock earnings, better-educated wives earn more in crops. The latter results suggest that their better education may increase earnings. Also, participation of women

in livestock activities seems to be influenced by males' education. Finally, health status is a good predictor of total earnings especially for men in crop production.

Table 8: Heckman selection model, two step; dependent variable: husband's income from crops (in log).

	Coeff.	Std. Error	t
Outcome Equation			
Age square (H)	-0.0007	0.0005	-1.28
Husband's age (log)	0.0743	0.0528	1.41
Husband's education[c]	-0.1101	0.0653	-1.69
Wife's education[c]	0.0319	0.1180	0.27
Wife's access to land [d]	-0.1774	0.1762	-1.01
Wife's access to credit [e]	-0.2734	0.1507	-1.81
Household size (log)	0.1480	0.2353	0.63
Water melon (yield in log)	0.0633	0.1355	0.47
Peanut (yield in log)	0.4632	0.1381	3.35**
Millet (yield in log)	-0.1812	0.1415	-1.28
Beans (yield in log)	-0.0002	0.2369	0.00
Number of goat/sheep log)	0.0118	0.0735	0.16
Number of cattle (log)	-0.0174	0.0705	-0.25
Time in crops in log (H)	-0.0028	0.0992	-0.03
time spent in crops in log (W)	0.0020	0.0687	0.03
Time in crop in log (B)	-0.4709	0.0986	-4.77***
Time in crop in log (G)	0.0452	0.0858	0.53
Time in crops in log (O)	0.0585	0.0614	0.95
distance to market (log)	-0.3147	0.0718	-4.38***
Housework (H) [f]	-0.0470	0.0736	-0.64
Housework (W) [f]	-0.1266	0.0734	-1.73
Housework (B) [f]	-0.1794	0.0900	-1.99*
Housework (G) [f]	0.0702	0.0469	1.50
Housework (O) [f]	-0.1153	0.0445	-2.59**
Health status[g]	0.8002	0.4000	2.23*
_Constant	10.1395	1.5415	6.58
Selection equation			
Husband's education	-0.0149	0.1020	-0.15
Wife's education	-0.2771	0.1360	-2.04*
Off-farm earnings (log)	0.0470	0.0196	2.39**
Cash transfers from migrants (log)	0.0255	0.0361	0.71
Household size (log)	0.8932	0.3230	2.77**
Number of goat/sheep (log)	-0.2516	0.0936	-2.69**
Number of cattle (log)	0.0765	0.1123	0.68
Housework (H)	-0.0180	0.1052	-0.17
Housework (W)	0.1278	0.1083	1.18
Housework (B)	0.3117	0.1388	2.25
Housework (G)	-0.0229	0.0761	-0.30
Housework (O)	0.5085	0.1974	2.58**
Health status	0.0680	0.5410	0.13
_Constant	-2.2385	1.4281	-1.57
Rho	-0.9217		
Sigma	0.8020		
Lambda	-0.7392	0.2434	
N=249			
Censored observations==100			
Uncensored observations=149			
Wald chi2(31)=201			
Prob chi2 < .0001			

*p<.05, **p<.01, ***p<.001 legend: same Table 3.13

Table 9: Heckman selection model, two step : dependent variable: husband's income from livestock

	Coeff.	Std. Err	t
Outcome Equation			
Wolof [k]	0.5917	0.2332	2.54**
Peulh [l]	1.0042	0.2594	3.87***
Husband's education [c]	0.2014	0.0541	3.73***
Wife's education [c]	-0.0505	0.0803	-0.63
Household size (log)	0.0162	0.1784	0.09
Number of cattle (log)	0.3580	0.0701	5.1***
Number of goats (log)	0.0434	0.0614	0.71
Number of sheep (log)	0.1073	0.0605	1.77
Number of horses & donkeys (log)	0.0524	0.0794	0.66
Time marketing animals in log (H)	-0.0191	0.1291	-0.15
Time marketing animals in (B)	0.0860	0.1363	0.63
Time in livestock in log (H)	-0.0333	0.0565	-0.59
Time in livestock in log (W)	0.0289	0.0953	0.30
Time in livestock in log (B)	-0.0886	0.0635	-1.40
Time in livestock in log (G)	-0.1498	0.0951	-1.58
Time in livestock in log (Helpers)	0.0213	0.0729	0.29
Distance to market (log)	-0.2399	0.0615	-3.9***
Housework (H)[f]	-0.1175	0.0593	-1.98*
Housework (W)[f]	0.0220	0.0603	0.36
Housework (B)[f]	-0.0564	0.0736	-0.77
Housework (G)[f]	0.0733	0.0422	1.74
Housework (O)[f]	-0.0339	0.0508	-0.67
Off-farm earnings (log)	0.0149	0.0104	1.43
Cash transfers from migrants (log)	-0.0267	0.0171	-1.56
Health (H)[g]	-0.2898	0.2802	-1.03
Zone [j]	-0.4119	0.3026	-1.36
_Constant	12.7590	1.2599	10.13
Outcome Equation			
Selection Equation			
Wolof [k]	0.1578	0.3513	0.45
Peulh[l]	0.9995	0.5085	1.97*
Husband's education	-0.1247	0.1171	-1.06
Wife's education	0.1054	0.1821	0.58
Wife's access to land	0.7569	0.4350	1.74
Peanut (yield in log)	-0.7923	0.3324	-2.38**
Millet (yield in log)	1.2410	0.3654	3.4**
Household size (log)	-0.3135	0.3930	-0.80
Zone	-1.5187	0.6264	-2.42**
Off-farm earnings (log)	-0.0269	0.0276	-0.97
Cash transfers from migrants (log)	-0.0799	0.0257	-3.11**
Husband's health status	-0.0287	0.8119	-0.04
_Constant	3.3979	2.2627	1.50
Lambda	0.2161	0.3373	0.64
Rho	0.2744		
Sigma	0.7876		
N =240			
Censored observations = 34			

Uncensored observations = 206
Wals chi2(32) = 205
Prob chi2 < .0001

*p<.05, **p<.01, ***p<.001 Legend : same Table 3.13

CONCLUSION AND POLICY IMPLICATIONS

In this paper, we have investigated the structure of productivity in rural Senegalese households. Men, women and children (especially young boys) constitute important labor in all farming activities in term of time allocation and income generating. Moreover, women and girls present a determinant role in homework. We showed also that young boys and male heads are really involved in homework. Results suggest that income generated in farming is not owned by one household member i.e the male head but each household member earn separately its income in the different areas considered. Male heads earn 12% from crops of total farming's income, 41% from livestock and 15% from trade. On other hands, wives earn 11, 46% from livestock, 2% from trade and very few from crops: 0.34%. Even if male heads earning are predominant, both husbands and wives are market oriented. In some activities, wives are more performing, for example in milk production where their earnings attain 4.5% of total farming income compared to 1% for male. Moreover females are very dynamic in off-farm activities which constitute 37% of non-agricultural activities' income. These activities represent 53% of off-farm's income for male heads.

In term of labor supply, results show that time of wives is more productive than time use of male heads in crops and livestock with large and significant estimates. For children, boy marketing ruminant predict well livestock's income wile for girls, time is more devoted to homework and that time in this activity has depressive effect on productions. As we expected, cash transfers from migrants are negatively associated to farming especially livestock's income. Indeed, cash transfers constitute important alternative in mitigation risks in productions systems; it has been showed that pastoralist tend to be more involved in crops' activities when cash transfers are available. Results show that while land access for women allows more income from livestock, better education wives tend to be less interested in farming; wives' education depress strongly crop outcome. This means that better educated females tend to abandon fields for off-farm activities that allows them to earn more and hence, to diversify revenues and mitigate risks from farming. From our results, it exists an active labor market for females outside household (especially domestic helpers in important cities or teachers), which could permit a reallocation of their labor supply from crops. In fact, these last years, drought, climate and environmental change (scarcity of the rainfall, prices of inputs, lack of subsidies etc) are induced less competitiveness of crops and more rural exodus to big cities. Growing crops became highly risky for most farmers; hence alternative activities like off-farms employment provide more strategies to secure households. Also, the distance of most rural areas from peri-urban markets disfavor wife and husband's incomes both in livestock and crops. Also, in the context of our research area where rural labor market present a very low supply of educated people (53% of illiterate male heads and 75% of illiterate wives), off-farms earnings could provide more incentives to farmers to invest more in girls' education.

Finally, this work has generally highlighted that productivity is gendered and farm and off-farm household's earnings are affected by a number of exogenous and endogenous factors

that also affect differently husband and wives. These earnings contribute in household consumption and daily food provisions.

In term of policy implications, results suggest that understanding intra-household gender allocation of resources (capital, time, responsibilities) is essential in policy analysis in order to avoid policy failures. Most of failures due to no-adoption of technologies reflect the misunderstanding intra-household resource allocation. For example in the formulation and implementation of suitable policies in developing countries aiming at poverty alleviation and at improving the well-being of the household, one important issue would be related to the understanding of productive activities in a gender perspective. In fact, the consideration of individual and community's factors that determine the productivity of male and female is important for the successful of government policies. Project aiming at improving productivity in our area of research should not be addressed to the head of household but should consider that women and boys are productive factors of farming both in livestock and crops and take consideration of these important determinants in the allocation of capital and inputs. Also, the existence of a labor market outside the household is a productive input of women's earnings in term of diversification and projects should enhance more incentives for women by improving their education. For example, modernization programs and projects leading to development and intensification of production process (processing, collecting and marketing) may increase market opportunities and better involve women in these off-farm activities. Moreover, better educated wives tend to more involve in off-farm activities and less interest in crop's activities, thus development of a labor market upstream and downstream of production system would more secure farming productions. In the two areas, females education has lead to dynamic women's organization tending to improve livestock production especially milk production (for example the Women directory board in livestock in AP area (DIRFEL) and the Hinger Project in the SP area). These perspectives are in line with other findings that conclude that adult women are more involved in intensified dairying than adult men (Tangka et *al*, 1999; Muriuki et *al*, 1997; Mullins et *al*, 1996). Also, since young girls are almost the substitute of their mother in household works, project aiming a better education of girls should offer more opportunities to women to face cost related to childcare or household tasks. In fact, the most burdened task in the household seems to be related to caring children and ill persons and wood collections which are determinant in all productivity's estimations. In the SP area, programs or project aiming to improve cash earnings for herders will probably decrease the mobility of pastoralist by favoring their better involvement in growing crops.

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