Welfare Impacts of Urban Expansion: Micro Perspective from Peri-urban Northern Ethiopia

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Abstract

Urban areas, in many developing countries, expand by engulfing the nearby rural villages which causes a complete shift of policies and livelihoods in the villages. This study examines the ex post impacts of urban expansion on welfare of subsistence farm households included to urban locality. The study utilizes panel data of 457 households, collected in 2011 and 2012, from peri-urban Ethiopia. The descriptive statistics shows that physical asset (land and livestock) holdings of farm households included to urban have reduced. Using the difference-in-difference with matching, the results show that consumption expenditure of the farm households included to urban has significantly reduced over a year. The negative effects on asset holdings and consumption expenditure is consistent with the perceived view of difficulties in livelihood transitions and to accustom new institutions. This study supports broader investments in rural nonfarm sector and institutions to address the vital challenges of rural-urban livelihood transitions, and to manage the process and embrace benefits of urbanization.

Keywords*: difference-in-difference, farm households, matching, livelihood transition, peri-urbanization, peri-urban, welfare, Northern Ethiopia*

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1. Introduction

Urban areas of many developing countries, particularly in Africa, are expanding rapidly by incorporating the surrounding rural villages (Chen, Gu, & Wu, 2006; Gregory & Mattingly, 2009). But the urban areas are surrounded by subsistence farming communities where rural-urban divisions are vital. Urbanization in sub-Saharan Africa (SSA) continues unabated (World Bank, 2013) and is land intensive. For instance, about 20% of the African population live in urban and is expected to reach 50% by 2040 (World Bank, 2013). This shows that urbanization in SSA is at its early stage and possible to make it right if lessons from the past are considered.

Urban expansion in the SSA is structurally different from that of the East Asian or the developed countries. This is because food production has remained low (Jedwab, 2012) and the manufacturing and service sectors are small and inefficient (Henderson et al, 2013; Jedwab, 2012). It is also documented that urban areas of some SSA countries were expanding against the backdrop of economic growth (Fay & Opal, 2000; Henderson, 2003).

What causes the rapid urban expansion (or urbanization) in SSA is ambiguous and needs considerable debate. But at the early stages of development, economic growth and urbanization are accompanied by raising income inequality (Kuznets, 1955). This signals the poor gain little from the early stages of urbanization and becomes worse in cases where urbanization outpaces economic development. Similarly, Henderson (2002) points out that the rapid urbanization in developing countries has little space for the rural societies and institutions to acclimatize themselves to the urban ones. These issues have vital implications to subsistence farm households inhabited in the peri-urban areas (PUAs).

In fact some studies indicate that poor farm households likely to be vulnerable and marginalized in the course of rura-urban livelihood transition (Gregory & Mattingly, 2009; Mattingly, 2009). Additionally, in Ethiopia, moving out of poverty is more difficult to urban poor than the rural (Bigsten & Shimeles, 2008). These issues suggest that urban expansion induced poverty is likely to evolve in the peri-urban areas (PUA). Hence, it merits justifying empirically the effects of urban expansion in Africa at micro level to guide policy for possible interventions. But the knowledge on effects of urban expansion on welfare of the farm households' in peri-urban villages is very thin. Hence, this paper partly addresses the

knowledge gaps using panel dataset of farm households from PUA of Tigray, Northern Ethiopia.

This paper has three main contributions. First, it provides further evidence on the effect of urbanization on welfare of subsistence farm households in the pre-existing villages. It mainly examines the effect of urban expansion on consumption expenditure and asset holdings of the farm households. Assessing asset holdings has the advantage to capture other aspect of household welfare rather than food deprivation. Second, it provides a case in a context where land is owned by the state and expropriated for investments. Third, to the best of my knowledge, this is the first study to apply ex post impact evaluation methods to examine the effect of urbanization on the peri-urban villages at a micro level using panel dataset in the context of SSA.

Benefiting from nature of the data, *difference-in-difference* matching methods (Heckman et al., 1997) is applied to evaluate welfare effects of urban expansion at micro level. The results show that the physical asset (land and livestock) holding of the farm households in urban becomes lower and their consumption expenditure has significantly reduced over a year. The analysis is organized as follows. The second part provides background information regarding urban expansion process in Ethiopia while section three presents the econometric framework applied to evaluate the effect of urban expansion. Section four discusses the data and terms used for the analysis. Section five discusses estimation results of the empirical model while section six presents conclusions and recommendations.

2. Urban Expansion and Peri-urbanization Processes in Ethiopia

Ethiopia is among the poorest and least urbanized countries in sub-Saharan Africa. But since mid of 2000s, Ethiopia is achieving remarkable economic growth and urban population is growing rapidly as well. For instance, average annual urban population growth was about 4% in 2007 (Bane and Alemu, 2012) – which is twice of the growth rate of urban Africa (Montgomery, 2008). This growth rate, if not larger, is expected to continue for some time because urban Ethiopia is still home to less than 20% of its people.

Urban and rural divisions are still vital in Ethiopia with defined boundaries where the local policies are focused within their boundaries with little room for coordination of activities. To meet the growing demand of urban land use, urban areas usually redraw their boundaries by incorporating rural sub-villages in the surrounding. Incorporation of the sub-villages to the

respective town/city administration is usually done in consultation with the rural administration or the regional council. Demarcation of revised city/town boundary is enacted after the respective development plan is approved by the local council (FDRE, 2008). This procedure ultimately creates a new boundary to the town/city but eventually shrinks land resources to the incorporated sub-villages. But it is important to keep in mind that landholding of the farm households is usually fragmented and within the village (locally known as *tabia*). This means it is possible for the village, which was previously in rural administration, to split into urban and rural administration after the new urban boundary is demarcated. Consequently, some households in the urban may have farmlands in sub-villages under the rural administration or the other way round.

In Ethiopia, land is owned by the state and the dispossessed household (individual) receives land compensation when land is expropriated for investment purposes (FDRE, 2005). By the law, the local authority has the mandate to expropriate land within its jurisdiction for investment by giving prior notice to the landholder. Usually the practice is the household receives cash as compensation to the lost property (land and/or housing). But the household can use the land until investments by the other party starts although received compensation and have no user rights.

The urban administration allocates the land under its jurisdiction for investments to different entities. Subsequently, follows implementation of the investments such as construction of new residential houses, institutions, manufacturing plants or installations of other urban amenities. This is the stage where urbanization of the included peri-urban villages (or peri-urbanization) starts formally.

Peri-urbanization in Ethiopia, generally, follows a formal procedure where inhabitants of the targeted (included) rural villages become urban inhabitants by law. In other words peri-urbanization, via land policy, affects the entire population of the targeted villages. This implies these villages are now governed by the urban development priorities which is a complete shift in their means of living. In situation like these, dispossessed farm households likely face time and resource constraints to accustom themselves into urban livelihood systems and to benefit from the emerging employment opportunities.

Implementation of the different investments virtually starts after two years since delimitation of the new urban boundary. The rapid land use conversion– from subsistence agriculture to industrial, residential and other urban purposes – creates heterogeneous social compositions

and economic structures in the urban peripheries. For instance, it is observed that new residents mostly engaged in different sectors of the urban economy migrate to the locality; subsistence agrarian activities overtaken by nonfarm activities within five years; new land policies put in place and new land markets emerge resulting in commoditization of land and housing. These transformations force the livelihoods in peri-urban areas to shift from farm to nonfarm activities which ultimately affect welfare of the subsistence farmers in the locality. Such types of transformations are apparent in the peri-urbanization experiences of many developing countries (Simon et al., 2004; Webster et al., 2004).

3. Estimation Framework

Peri-urbanization, via the land policy, affects the entire population of the targeted villages. Like any other policy interventions, peri-urbanization is considered as a program targeted on the lives of farm households in the peri-urban areas. As described previously peri-urbanization in Ethiopia, and particularly in Tigray, follows a formal procedure. This means inhabitants of the targeted sub-villages should comply with implementation of the urban development plan by law. Hence, a household in the targeted sub-villages can hardly be outside the treatment. The control group for such kind of policy intervention is known as synthetic group (Abadie et al., 2010) and should have similar characteristics to the entire population under the treatment but not affected by the treatment.

Empirical studies that focus on investigating the effect of social programs or interventions, generally, apply families of "average-treatment-effect" (ATE) methods (Wooldridge, 2002). The average treatment effects of peri-urbanization can be assessed using either matching methods or regression model because selection model is unfit. Matching methods: are complementary to regression; can identify the presence of sufficient overlap regarding covariate distribution; and have diagnostics to assess their performance (Stuart, 2010). But matching methods have no cure for perfect predictability of the matching index and for selecting the right conditioning covariates (Stuart, 2010). Being cautious of the pros and cons, matching methods is applied and ordinary least squares (OLS) for comparison purposes. Formulation of the estimation model is presented next.

3.1 Estimation Model

To formulate the effect of peri-urbanization (the treatment) on welfare of the treated farm households, i.e. outcome of the treatment: let Y_{it}^R be welfare of household i at time t in the absence of the treatment. Similarly, let Y_{it}^U is the i^{th} household welfare at time t under the treatment. Consequently, the welfare gain (or loss) of the treated household is given as

$$G_{it} = Y_{it}^U - Y_{it}^R. \quad (1)$$

However, it is impossible to observe both outcomes, Y_{it}^R and Y_{it}^U, for the i^{th} household concurrently which means G_{it} cannot be constructed because of missing data problem (Wooldridge, 2002). But the counterfactual welfare (Y_{it}^R) can be generated from the control group under some restrictive conditions[2].

To account for participation in the treatment, a dummy variable is generated where $D_i = 1$, if the household is treated and $D_i = 0$, otherwise. The sample units have two observations for the outcome variable. Let $t = 0$ and $t = 1$ represent observations before and after the treatment, respectively. The observed welfare for the treated household is defined as:

$$Y_{it}^U = Y_{it}^R + G_{it}, \ (i = 1, \dots, n) \quad (2)$$

where Y_{it}^U is the observed welfare and Y_{it}^R is the counterfactual welfare. Therefore, in hypothetical situations, the expected effect of peri-urbanization on welfare of randomly selected farm households, i.e. "*average treatment effect*", is specified as $E(G) = E(Y^U - Y^R)$. Similarly, the average effect of peri-urbanization on welfare of the treated farm households, i.e. the "*average treatment effect on the treated*", is given as:

$$E[(Y^U - Y^R)|D = 1] \quad (3)$$

When the treatment is completely randomized, then *average treatment effect* and *average treatment effect on the treated* are identical. But most social experiments suffer from selection bias arise from observed or unobserved factors.

[2]The restrictive condition is known as ignorability of treatment which means conditional on the observables, x, the outcome (y_1, y_0) is independent of the treatment, w, (Rosenbaum and Rubin, 1983). This implies that $E[y|w = 1, p(x)] - E[y|w = 0, p(x)] = E[y_1 - y_0|p(x)]$ which is the average treatment effect conditional on *pscore*, p(x).

Other than the treatment, the outcome variable (welfare) can be affected by confounding factors, (X), specific to the household. Hence, the average effect of peri-urbanization on welfare of the treated farm households conditional on observed covariates is defined as:

$$E[(Y^U - Y^R)|X, D = 1] = E[Y^U|X, D = 1] - E[Y^R|X, D = 1] \quad (4)$$

The second term on the right hand side of equation (4) is expected welfare of the treated farm households had they not been include into urban administration, which is impossible to observe. The standard approach is to match with welfare of the control group imposing the conditional independence assumption (CIA) (Heckman et al., 1998). Rosenbaum and Rubin (1983) propensity score matching method is applied to generate predicted probabilities of all observables and to create comparable groups where entities with similar propensity scores are considered as matches (Heckman et al., 1998). Hence, the propensity score is generated by:

$$P(X_i) = Prob(D_i = 1|X_i) \quad (5)$$

where $P(X_i)$ is a propensity score (*pscore)* estimated using discrete choice model on pre-intervention covariates, X_i, of the household that satisfy the CIA condition (Caliendo and Kopeinig, 2008). The common support condition ($0 < P(X_i) < 1$) is imposed to identify sufficiently close matches and consistently estimate the average treatment effect (Wooldrige, 2002). Imposing the common support condition likely throws away observations in both groups. Let this sample be represented by θ which is a sub-sample of the total observations. Hence, the *average treatment effect on the treated* in the region of common support is given as:

$$\mathrm{E}[(\mathrm{Y^U} - \mathrm{Y^R})|\mathrm{P(X)}, \mathrm{D} = 1] = \mathrm{E}[\mathrm{Y^U}|\mathrm{P(X)}, \mathrm{D} = 1, \theta] - \mathrm{E}[\mathrm{Y^R}|\mathrm{P(X)}, \mathrm{D} = 0, \theta]. \quad (6)$$

Although matching eliminates bias due to observable differences, welfare can be affected by unobserved differences peculiar to the household. Additionally, a set of criterion might have been applied by the respective town administration to decide which rural sub-village should be incorporated. Such decisions could possibly aim to maximize the economies scale of pre-existing socio-economic infrastructures in the locality. This indicates that administration of the treatment was not completely random although self-selection is not a concern. These exogenous latent conditions of peri-urbanization decision are time-invariant but can be sources of unobserved selection bias.

The difference-in-difference method (DD) is ideal to mitigate time-invariant selection bias (Heckman et al., 1998; Galasso and Ravallion, 2004; Ravallion and Chen, 2005). However, I have *ex-post* observations of the outcome variable and *ex-ante* and ex-*post* observations of the confounding factors. Hence, the DD method cannot applied rather the model in equation (6) is modified to estimate the outcome of interest. Accordingly, the effect of peri-urbanization on welfare of the targeted farm households over time in the region of common support is defined as:

$$E(\Delta G) = E\left[\left(Y_{i1}^{U} - Y_{i0}^{U}\right) - \left(\widehat{Y_{i1}^{R}}^{*} - \widehat{Y_{i0}^{R}}^{*}\right) | P(X_i), D_i = 1, i \in \theta\right] \qquad (7)$$

where Y_{i1}^{U} and Y_{i0}^{U} are observed welfare for the treated groups for two consecutive years, respectively; $\widehat{Y_{i1}^{R}}^{*}$ and $\widehat{Y_{i0}^{R}}^{*}$ represent estimated counterfactual welfare generated from the control group. Model (7) is similar to DD matching estimator (Heckman et al., 1997) and applied to control selection on observables and time-invariant unobserved factors.

4. Data and Descriptive Statistics

4.1 Data, Terms and Definitions

The data were collected in January 2011 and 2012 from farm households in peri-urban areas of Tigray, northern Ethiopia. Four out of ten big towns in Tigray Regional State – namely Mekelle city and Adigrat, Axum and Alamata towns – were selected for survey purposely (see Figure 1 for location) considering population , size of the economic activities and natural resources endowments. These differences have the potential to capture type, pattern and employment opportunities available in the localities.

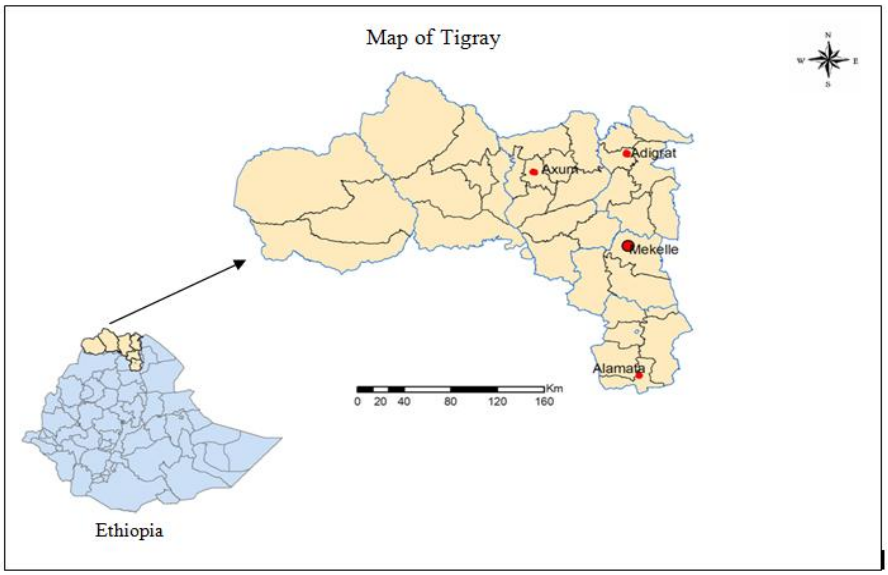

Figure 1: location of survey sites

Population has grown tremendously, at different rates, in all the selected towns (Table 1). For instance, the 2007 population census of Mekelle is more than double that of the previous 1994 census which is exceptional. It represents a population explosion which needs to be explored but it is outside the objective of this study. Although annual population growth rates of Axum and Adigrat towns are comparable, availability of land for expansion seems limited in Adigrat.

Table 1: Area and population distribution of the survey towns

	Area in km^2			Population size (in 000s)			Population growth rate 1994-2007
Town/*woreda*	1994	2007	2011	1994	2007	2011	
Mekelle	20.34	102.4	192	97	216	261	6.5
Adigrat	NA	18	18.77	37	58	70	3.5
Axum	7.78	17.28	18.12	27	45	54	4
Alamata	NA	4.7	9.46	26	33	40	1.8

Source: compiled from CSA (1995); CSA (2010a); CSA (2011b); BoFP (2011a); BoFP (2011b) and the respective administrations for area size of Axum and Alamata.

Note: Population figures of 1994 and 2007 represent census data while those of 2011 are projected population sizes by CSA. Annual population growth rate is computed by the author. NA represents data not available.

The selected towns represent urban expansion situation of Tigray Regional State particularly and Ethiopia generally for the following reasons. Firstly, the towns applied the land compensation guidelines issued by the Federal Government of Ethiopia (FDRE, 2008) which is uniform and fail to properly account irreversible investments on the farmlands. Secondly, the scale and type of land compensation given to the dispossessed farmers varies depending on revenue of the town. There other is the towns differ in terms of size of economic activities, access to infrastructure and information, market size, population, and agricultural production potential of the adjacent rural districts (locally Known as *woreda*).

After selecting the towns, villages (locally known as *tabias)* were selected from the adjacent *woredas* of the respective towns. Selection of *tabias* was done in collaboration with the respective *woreda* administration units. Level and direction of the town's expansion was the main criteria used to select the *tabias* and, then subsequently, the sub-villages. However, households were randomly selected from each sub-village.

Each survey site (town) has its own control and treatment groups. The treatment group consist farm households in the sub-villages under urban administration, hereafter known as rur-urban households[3], who: (i) officially recognized as urban residents before 2009; (ii) gave up fully or partly their farmland between 2006 and 2009; and (iii) received land compensation before 2010. Additionally, the treatment group was drawn from inhabitants either born in or related via marriage to minimize self-selection problems.

The urban expansion policy of Ethiopia affects the entire population of the targeted (sub-) village where treatment non-compliance is impossible. Following Abadie *et al* (2010), the (synthetic) control group were drawn from the sub- villages adjacent to the treatment group for two reasons. Firstly, both groups would have been in similar situations without urban expansion (treatment). The other reason is that sub-villages, where the control group was drawn from, are prospective targets when the next town expansion plan is considered. The treatment and control groups were drawn from the sub-villages located within 15kms from edge of the city/town built up.

The surveys were commenced towards end of the main harvest season in the agricultural calendar of Tigray Regional State particularly and Ethiopia generally. A panel data of 478

[3] The word rur-urban created from two words – rural and urban – to represent the households' living style and the administration they belong to, respectively.

farm households were observed and the dataset consists of details of the household's demography, asset holding and consumption. Additionally, ex-ante (2006 same period) asset holdings of the household were collected to account for pre-intervention covariates.

Rainfall and inflation are crucial for the households' welfare in subsistence farming communities. The volume and distribution of rainfall in the wet season (*kiremt*[4]) is crucial to food security of the subsistence farmers. According to the respondents, in all the survey sites except Axum, the amount and distribution of rainfall in *kiremt* 2010 was good but in 2011rainfall started late and stopped earlier than the usual. As a result, agricultural production in southern and eastern parts of the region was negatively affected which in turn had direct negative impact on food security of the households, particularly in 2011/2012.

On the other hand, inflation was rising in 2010 in the nation. To curb the rising inflation, particularly on food items, the Federal Government has introduced price ceiling for about 18 commodities in January, 2011 and removed in July, 2011 for most of the goods (Mesfin, 2011). But introduction of the price caps was counter-intuitive and exacerbated inflation, i.e. inflation had reached to 40% in July, 2011 from below 20% in January, 2011 (Figure 2).

Figure 2: Inflation rate in Ethiopia, 2010 - 2012

Note: the figure is adopted from www.tradingeconomic.com| Central Statistics Agency of Ethiopia (CSA)[5].

[4] The wet season (locally known as k*iremt*) stats in June and stops in September.
[5] Accessed via: http://www.tradingeconomics.com/ethiopia/inflation-cpi

Terms and Definitions

The household's food consumption expenditure was collected on a weekly recall basis from all sources such as purchased, own produce, transfers and gifts. The local market price was used to convert consumptions from non-purchased sources. The 7-day recall is effective compared to longer recall periods although not free of errors from recall or expenditures outside the purview of the respondent (Beegle et al, 2012). Expenses on non-food consumable items were collected on a monthly recall basis and purchase frequency of each item for the year. School and medical expenses are excluded from the expenditure list because mostly available for free or at subsidized price and might not reflect the true value if collected.

The monthly food expenditure was constructed from the weekly data and adjusted to December 2010 prices using consumer price indexes of the Central Statistical Agency of Ethiopia (CSA). To capture sex and age composition of the household, consumption expenditure is constructed in per adult units using indices of Dercon and Krishnan (1998). The farm household's *ex-ante* asset holdings are also in per adult units. But it is important to note per adult units cannot fully capture the scale of economies gained from the joint consumption of housing services and durable goods available in the household.

The household's livestock ownership is represented in constant prices and tropical livestock unit (TLU). Local market prices, as proxy to farm gate prices, are adjusted for inflation using the CSA producer price index (PPI)[6]. However, the TLU indices do not have conversion factors for cross-breed/high-yield cattle (see Annex 2). Hence, indices for local breed are applied to compute the corresponding TLU of all cattle breeds which understates the TLU of improved or high-yield cattle breeds.

4.2 Descriptive Statistics

Farmland and livestock ownership of the rur-urban households has reduced between 2006 and 2012 (Table 2). The rural households' livestock ownership has increased while size of farmland has decreased between 2011 and 2012 although larger compared to rur-urban households. Both groups had similar landholdings in 2006, on average, except in Adigrat

[6] All values are represented in ETB and in December 2010 prices. The database is accessible via www.csa.gov.et .

where rur-urban households have bigger farmlands than their counterpart. The proportion of landless farm households, in general, increased over time for rur-urban households but relatively unchanged for the rural. Peri-urban Adigrat has the highest proportion of landless households – about 65% of the rur-urban farm households have become landless due to urban expansion – and the smallest landholdings compared to the other peri-urban areas. This indicates, relatively, peri-urban Adigrat is densely populated which concurs with the CAS data (see Table 1).

Table 2: Distribution of farmland and livestock holdings by year and group

	Rur-urban (treatment)			Rural (control)		
	2006	2011	2012	2006	2011	2012
Mekelle town						
Average land holding per HH	3.98 (2.05)	1.85 (1.68)	1.90 (1.58)	3.38 (1.90)	3.22 (1.96)	3.15 (1.98)
Landless HH (%)	2.36	11.81	9.76	4.8	4.8	4.92
Observation (N)	127	127	125	125	125	122
Adigrat town						
Average land holding per HH	2.15 (1.51)	0.29 (0.54)	0.27 (0.54)	1.42 (1.06)	0.99 (0.94)	1.04 (0.97)
Landless HH (%)	15.91	70.47	70.73	9.09	23.26	23.68
Observation (N)	44	44	43	43	43	39
Axum town						
Average land holding per HH	3.84 (2.05)	1.15 (1.08)	1.15 (1.09)	3.60 (1.55)	3.61 (2.06)	3.70 (2.00)
Landless HH (%)	2.56	30.77	31.58	7.69	5.13	2.63
Observation (N)	39	39	37	39	39	37
Alamata town						
Average land holding per HH	3.70 (2.04)	2.45 (1.69)	2.45 (1.69)	2.75 (1.91)	2.67 (1.97)	2.75 (1.97)
Landless HH (%)	3.33	6.67	6.67	6.67	10	7.14
Observation (N)	30	30	30	30	30	28
Household head main job farming (%)	62.08	46.25	36.59	68.9	70.1	61.94
Livestock in TLU	3.86 (3.96)	2.63 (3.04)	2.62 (3.09)	3.13 (2.80)	3.14 (2.64)	3.15 (2.67)
Real Livestock value (in 000 ETB**)**		6.76 (11.5)	6.26 (9.62)		6.64 (6.99)	8.14 (9.34)
Total observation	240	240	234	238	238	227

Note: landholding is represented in *tsimdi* (1 *tsimdi* ≈ 0.25 hectare). ETB is Ethiopian currency (1USD was equivalent to 16.54ETB and 17.23 ETB on average during the first and second survey periods). Figures in the parenthesis represent standard deviations.

Farming as main job of the household head generally decreased between 2006 and 2012. For instance, it has decreased from 62% in 2006 to 37% in 2012 for rur-urban but for rural households it decreased from 71% to 62%. This concurs with the observed trends for livestock and farmland ownerships. Although access to farmland is being limited, many rur-urban households still consider farming as the main source of living.

Distributions of the pre-intervention variables (covariates) are presented in Table 3. The covariates distributions of the treatment and control are similar except few namely age of household head, old aged members and number of rooms per adult. The rur-urban farm households have older heads and more old age members and number of rooms compared to their rural counterparts.

Table 3: Sample means and standard errors of pre-intervention covariates

Variable definition	Treatment Mean (Std.)	Control Mean (Std.)	Difference Mean (Std.err)
Household head age	50.59 (1.53)	43.53 (13.52)	-7.06*** (1.33)
Number of adults	3.02 (1.69)	2.84 (1.51)	-0.17 (0.15)
Number of children below 15 years old	2.15 (1.75)	2.33 (1.77)	0.18 (0.16)
Number of adults above 65 years old	0.24 (0.49)	0.07 (0.27)	-0.17*** (0.04)
Livestock in tropical units (TLU) per adult	0.80 (0.85)	0.77 (0.85)	-0.08 (0.07)
Farmland in *tsimdi* per adult	1.00 (0.98)	1.02 (1.07)	0.01 (0.09)
Number of rooms per adult	0.72 (0.81)	0.65 (0.70)	-0.32*** (0.06)
Female headed households (%)	0.30 (0.03)	0.26 (0.03)	-0.04 (0.04)
Household head farming main job (%)	0.62 (0.03)	0.69 (0.03)	0.07 (0.04)
Household head level of literacy:			
Illiterate (%)	0.60 (0.03)	0.55 (0.03)	0.05 (0.05)
Adult literacy and church school (%)	0.80 (0.02)	0.10 (0.02)	0.02 (0.03)
Completed grade 1-4 (%)	0.13 (0.02)	0.17 (0.02)	0.04 (0.03)
Completed grade 5 plus (%)	0.19 (0.03)	0.18 (0.02)	0.00 (0.04)
Sample size(N)	240	238	

Note: Std. represents for standard deviations, Std.err represents standard errors and *** means significant at 1%.

In 2011, consumption expenditure of the treatment group was significantly higher than the rural households (Table 4). A year later, however, consumption expenditure of the treatment group has significantly decreased while for the control consumption it has improved although statistically insignificant. This shows that, on average, welfare of the control group has

improved over a year while that of treatment group has reduced. This suggests that welfare of the rur-urban farm households might be systematically affected by the treatment (i.e. peri-urbanization) instead of differences in the observed covariates.

Table 4: Mean and Standard error of consumption expenditure

	Treatment			Control			Double difference ($\Delta Y_1 - \Delta Y_0$)
Expenditure in 000 ETB	2011 Mean	2012 Mean	Difference (ΔY_1)	2011 Mean	2012 Mean	Difference (ΔY_0)	
Real expenditure per adult	4.24	3.93	-0.78***	3.42	4.07	0.16	-0.96***
	(1.92)	(1.77)	(0.16)	(1.52)	(2.06)	(0.18)	(0.20)
Real food expenditure per adult	3.42	3.15	-0.46***	2.96	3.42	0.29	-0.76***
	(1.55)	(1.38)	(0.13)	(1.31)	(1.77)	(0.15)	(1.68)
Real non-food expenditure per adult	0.83	0.78	-0.32***	0.49	0.66	0.13**	-0.20***
	(0.71)	(0.61)	(0.05)	(0.40)	(0.56)	(0.06)	(0.06)
Sample size (N)	240	236		238	227		

Note: figures in parenthesis indicate standard errors, *** is significant at 1% and ** is significant at 5%.

Availability of basic infrastructures such as school, market, road and health centers in the sub-villages are important to ensure if the two groups are comparable. Although no ex ante data for the amenities, ex post data is used to address the issue. The basic social services[7] such as market, school, health center and veterinary are located in less than an hour walking distance in 2011, except in Mekelle (Table 5).

The rural households are a little farther away from the service stations particularly secondary schools. Although the travel time to services seems longer for the rural households, it is important to note that the differences are less than half an hour on average and usually people in urban are nearer to services than rural. In fact, in 2012, most of the sub-villages in the control group have been incorporated to the respective town administration as part of the new development plan. This signifies that the sub-villages in the control group are in a situation

[7] Elementary school (i.e. grades 1 to 4 and grades 4 to 8), health clinics, veterinary posts and village (*tabia*) administration centers are usually located nearby to each other. Hence, distance to elementary school also represents distance to those amenities as well.

where the sub-villages in treatment group before the intervention which substantiates comparability of the groups.

Table 5: Distribution of distance to amenities in 2011, single trip in minutes walk

	Mekelle		Adigrat		Axum		Alamata	
	Mean	Mean diff.	Mean	Mean diff.	Mean	Mean diff.	Mean	Mean diff.
To town center	85.49 (1.60)	18.14*** (3.0)	42.56 (1.92)	11.25*** (3.8)	31.15 (1.99)	23.33*** (3.0)	26.83 (2.03)	12.67*** (3.8)
To elementary school	20.51 (0.79)	3.74*** (1.6)	22.36 (1.40)	9.27*** (2.6)	23.84 (2.12)	25.90*** (3.1)	13.58 (1.14)	2.83 (2.3)
To secondary school	64.99 (2.58)	45.73*** (4.3)	49.66 (2.38)	15.23*** (4.5)	38.46 (2.61)	28.46*** (4.1)	31.67 (2.30)	23.67*** (3.6)
Obs. (N)	252		88		78		60	

Note: Mean diff. represents the difference in mean travel time between control and treatment and *** represents significance levels at 1%.

5. Estimation Results and Discussion

5.1 Propensity Score

The pre-intervention covariates were used to estimate the propensity score (*pscore*) to ensure the covariates are free of contamination or anticipation of the treatment (Dehejia and Wahba, 2002; Caliendo and Kopeinig, 2008). The covariates consist of factors associated with household welfare such as the household's demographic composition and asset holdings and the local environment. The household head is influential in the consumption decision of the household. Hence, the household head's age, sex, main job and education status are considered. Family size is directly linked to consumption expenditure. Asset holdings (such as farmland, livestock and housing) and location of the household are included in the model to capture their indirect effect on consumption expenditure. Presumably, keeping other factors constant, households with higher asset holdings have likely higher consumption expenditures and vice versa. Similarly, the household's production behavior is likely influenced by the local environment where town dummies are used as the proxy.

A *logit* model is regressed on the above discussed pre-intervention covariates to generate the *pscore* for matching, conditional on sharing similar pre-intervention covariates distributions. Interpretation of the parameter estimates is not relevant because decision to participate in the treatment is not an option. The estimation outputs of logit regression indicate that most variables are insignificant (Table 6). But few variables such as age of the household head and number of adults above 65 years old are strongly significant. Similarly, main job of the household head and number of adults in the household are weakly significant. This indicates that the treatment and control group are different with respect to the corresponding covariates which is similar to the summary statistics presented in Table 3.

Table 6: Logit regression estimation results

Variable	Coefficient	Std. Err.
Female headed households (yes=1)	0.34	0.25
Household head age	0.03***	0.01
Household head literate (yes=1)	0.25	0.22
Household head farming main job (yes=1)	-0.43*	0.24
Number of adults	0.12*	0.07
Number of children below 15 years old	0.04	0.06
Number of adults above 65 years old	0.89***	0.34
Farmland in *tsimdi* per adult	-0.19	0.13
Livestock in tropical units (TLU) per adult	-0.01	0.12
Number of rooms per adult	0.28	0.18
Location: base category Alamata		
Mekelle	0.02	0.31
Adigrat	-0.18	0.38
Axum	-0.08	0.38
Constant	-1.73***	0.58
Sample size (N)	454.00	
Psuedo-R^2	0.07	
LR χ^2	43.63	
Log-likelihood	-292.76	

Note: The sample size has reduced to 454 due to missing observation for some covariates. ***, **, and * represent significant at 1%, 5% and 10% respectively.

Following the logistic regression, the common support condition was imposed and five optimal blocks with the same mean *pscores* are identified and the region of common support

is created in the range of [0.20, 0.95]. But *pscore* is a continuous variable which makes impossible to get exact matches (Becker and Ichino, 2002). To overcome this problem, the commonly applied methods include *nearest neighbor*, *kernel* and *stratification* matching methods though one method is not preferred over the other.

To ensure robust estimation of the matching algorithms, balancing tests were conducted on distribution the covariates before and after matching (see Table 7). The standardized mean deviation of the *pscore* is about 9.5% before matching for all the algorithms and below 5% after matching, the acceptable level of bias (Caliendo and Kopeing, 2008). This indicates that the estimation results are robust to the different matching algorisms. After matching, the pseudo-R^2 decreased from 7.6% to 0.4% and p-values of the likelihood ratio tests become insignificant. These tests ensure that the proposed model reasonably identifies the *pscore* in terms of distribution of the covariates between the treatment and control groups.

Table 7: Matching quality indicators

Matching Algorithm	Pseudo-R^2 before	Pseudo-R^2 after	LR χ^2 (P-value) before	LR χ^2 (P-value) after	SMD before	SMD after
LLM[A]	0.0759	0.004	47.58 (0.001)	2.95 (0.58)	9.5	2.9
KM[B]	0.076	0.004	47.58 (0.001)	2.33 (1.00)	9.5	3.7
NNM[C]	0.076	0.004	47.58 (0.001)	2.46 (1.00)	9.5	2.3

Note: Variables included in psmatch2 stata command are: hhsex98, hhage98, hhage2, hhedu98, hhjob98, hagb, nadult98, nchildb1598, hhadt2, nadult6598, pfland98, ptlu98, proom98, Mekelle, Adigrat, axum (definition of the variables is provided in Annex 3)
A: represents local linear matching with band width 0.02, *biweght* weighting and common support.
B: represents kernel matching with band width 0.04, *biweight* weighing and common support.
C: represents the nearest neighbor matching with replacement, caliber 0.03 and common support.

5.2 Estimation Output of Average Treatment Effect

The regression outputs of ordinary least squares (OLS) are reported in (Table 8). Although magnitudes of the estimates are different, the sign and significance level of the point estimates are similar to the matching within-stratum estimates. The single difference (i.e. equation 6) and the double difference (i.e. equation 7) matching estimation outputs are presented in Table 9. In general, the matching algorithms have produced similar estimation outputs. All matching algorithms have bias below the acceptable level while the *nearest*

neighbor algorism has the lowest bias (Table 7). For this reason, the discussion focuses on the estimation outputs of *nearest neighbor* matching. Discussions of the single and the double difference estimation outputs of the average treatment effect on the treated (ATT) are presented separately.

Single Difference

In 2011, on average, the rur-urban farm households' consumption expenditure was significantly higher than the rural households (Table 9). The results show that consumption expenditure of the treated households has improved by about 800ETB where the major effect (about 60%) is on food expenditure. In general, the results suggest that rur-urban farm households were in a better position in terms of consumption expenditure compared to the rural household. But the caveat is this result could partially reflect consumption bubble that arises from utilizing the land compensation for consumption purposes because land compensation was given mostly between 2007 and 2009.

In 2012, the rur-urban households' consumption expenditure becomes lower than their counterparts although not statistically significant. On average, food consumption expenditure of the rur-urban households is not different from that of the rural households. The effect on non-food expenditures is weakly significant suggesting that the rur-urban households' consume higher compared to the rural households'. However, it should be noted that the rural households' expenditures on utility is understated because of the free access to alternative sources (for instance energy for cooking) or lack of access (for instance telephone services, tap water). Overall, the total consumption expenditure of both groups is not statistically different indicating peri-urbanization has no effect on the welfare. Looking at the changes in consumption expenditure between 2011 and 2012, however, the results show that the consumption expenditure of the rural households catches up with that of the rur-urban households. This in turn signifies the rural households able to sustain, if not improve, their existing level of consumption while maintaining or improving their asset base.

Double Difference

From the single period matching estimates, it happens difficult to conclude what the effect of peri-urbanization is. However, the double difference matching estimation output shows that ATT is negative and strongly significant (Table 6). This indicates that, on average, the rur-urban farm households' consumption is significantly decreased compared to their rural

counterparts. For instance, between 2011 and 2012, the rur-urban farm households' expenditure decreased by about 1000ETB per adult of which expenditure on food consumption comprises of about 80%. This in turn indicates that rur-urban households in the poorest cohort are the worst affected by peri-urbanization.

In sum, the estimation results indicate that peri-urbanization negatively affects welfare of the rur-urban farm households for the following reasons. The first is change in the production behavior of the rur-urban farm households due to of peri-urbanization coupled with high inflation. Most of the rur-urban households are net purchasers of the major food items and the high inflation rate likely erodes their purchasing power a year later. Additionally, as observed during the survey periods, most of the fields were under farming activities in 2011 while in 2012 the fields became active construction sites for nonfarm purposes. Secondly, the high consumption expenditure in 2011 could be a reflection of spending the cash (land compensation) and might run out with time if the household is unengaged in productive employments. Thirdly, the households might not be motivated to save the cash in financial institutions rather invested it on household durables – i.e. saving interest rate was about 5% while inflation rate was about 33% in 2011 (Geiger and Goh, 2012) – then lack the resource to finance their consumption.

Table 8: Ordinary least squares (OLS) estimation outputs of the treatment effect

	Real food expenditure per adult		Real nonfood expenditure per adult		Real total expenditure per adult	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Year 2011						
Treatment	463.99**	201.54	459.46***	99.32	923.45***	279.96
Peri-urban Mekelle (rur-urban=1)	120.41	221.10	-56.02	121.09	64.39	309.88
Peri-urban Adigrat (rur-urban=1)	-177.88	370.07	-343.44***	115.52	-521.32	426.49
Peri-urban Alamata (rur-urban=1)	-294.38	334.90	-384.73***	131.95	-679.11	431.53
Constant	2962.25	85.14	497.54	26.15	3459.80	98.61
R-squared		0.03		0.10		0.06
Obs.		478		478		478
Year 2012						
Treatment	144.12	295.38	206.96**	102.81	351.07	359.91
Peri-urban Mekelle (rur-urban=1)	-511.94*	287.89	-135.59	106.57	-647.53*	353.57
Peri-urban Adigrat (rur-urban=1)	-549.44	372.99	64.22	178.25	-485.22	487.28
Peri-urban Alamata (rur-urban=1)	-458.51	400.12	-161.52	147.37	-620.03	507.31
Constant	3424.07	118.20	657.54	37.11	4081.61	137.54
R-squared		0.02		0.02		0.01
Obs.		459		459		459
Difference between 2011 and 2012						
Treatment	-282.86	271.03	-269.31***	92.91	-552.17*	305.01
Peri-urban Mekelle (rur-urban=1)	-684.42**	284.12	-66.52	110.10	-750.93**	326.80
Peri-urban Adigrat (rur-urban=1)	-503.25	487.12	412.80***	165.97	-90.45	544.18
Peri-urban Alamata (rur-urban=1)	-197.00	358.96	235.33**	110.68	38.33	404.73
Constant	457.68	117.19	164.67	38.87	622.35	128.45
R-squared		0.05		0.06		0.07
Obs.		459		459		459

Note: ***, **, and * represents significance levels at 1%, 5% and 10%, respectively.

Table 9: Impact of urbanization on rur-urban farm households' welfare

Year	Matching Algorithm	N. treatment	N. control	Real food expenditure per adult		Real non-food expenditure per adult		Real total expenditure per adult	
				ATT	Std. Err.	ATT	Std. Err.	ATT	Std. Err.
In 2011 (single Difference)									
	LLM[A]	169	222	375.95***	193.43	341.66***	74.55	717.61***	253.31
	KM[B]	186	221	440.81***	177.86	376.71***	68.63	817.37***	211.91
	NNM[C]	181	221	460.14***	178.47	376.23***	69.46	836.37***	185.92
In 2012 (single Difference)									
	LLM[A]	173	222	-426.12**	219.90	175.59**	79.79	-249.55	261.81
	KM[B]	186	221	-324.85**	204.66	197.33**	73.83	-127.52	244.79
	NNM[C]	181	221	-362.98*	201.15	196.29*	76.18	-166.67	241.52
Between 2011 and 2012 (Double Difference)									
	LLM[A]	173	222	-773.29***	247.16	-171.92***	91.11	-945.20***	278.08
	KM[B]	186	221	-765.65***	238.65	-179.23***	85.96	-944.88***	261.52
	NNM[C]	181	221	-823.11***	235.85	-179.93***	86.67	-1003.04***	261.41

Note: significance levels at 1%, 5% and 10% are represented by ***, **, and * respectively. Matching was done within stratum and the variables included in *psmatch2* are: hhsex98, hhage98, hhage2, hhedu98, hhjob98, hagb, nadult98, nchildb1598, hhadt2, nadult6598, pfland98, ptlu98 and proom98 (see variable definition in Annex 5.3).

A: represents local linear matching with *biweight* weighing, band width (0.05) and common support

B: represents kernel matching with *biweight* weighing and band width (0.04)

C: nearest neighbor matching with replacement, neighbour(10), caliper(0.03) and common support.

6. Conclusions

This paper has presented the effect of urban expansion on welfare of farm households included to urban administration. Using panel data, collected in 2011 and 2012, from farm households in peri-urban Tigray, Northern Ethiopia changes in physical asset holdings and welfare (as measured in real consumption expenditure per adult) were analyzed. The difference-in-difference matching method was employed to estimate changes in the households' consumption expenditure. The analysis is robust to selection of observables and unobserved fixed effects.

The results show that urban expansion (or peri-urbanization) has diminished the physical asset, particularly livestock and farmland, holdings of the dispossessed (rur-urban) farm households. Availability of farmland is reduced due to nature of the peri-urbanization and livestock ownership is positively associated with farmland in subsistent farming systems. But this in turn suggests that the treated farm households, given their experience in the farm sector, are not engaged in the dairy sector. Consumption expenditure of the rur-urban farm households, in 2011, on average, was significantly higher compared to their counterparts. No significant difference was observed between the two groups in 2012. However, the change in consumption expenditure, between 2011 and 2012, is significantly lower for the rur-urban households than their counterparts.

The rur-urban higher consumption, in 2011, might indicate consumption bubble resulted from spending the land compensation (cash) for consumption purposes and being actively engaged in farming activities in 2010. This partly signifies consumption based on asset-depletion. But the reduction in consumption expenditure, after a year, is possibly due to the high inflation coupled with limited resources to finance and/or being out of farming and inability to engage in other productive activities.

It can be safely generalized that the rur-urban farm households' consumption expenditure and asset base has diminished over time. The analysis shows that the rur-urban households would have been in a better condition had they continued farming with the privileges that their counterparts have. This in turn signals the gradual development of urban-induced poverty in the localities. Hence, it is imperative to review the existing land compensation packages and design targeted interventions, particularly on urban agriculture and other business advices, to mitigate the hurdles of rural-urban livelihood transitions and poverty.

Annex 1: Tropical Livestock Unit Indexes

Animal type	TLU index
Camel	0.1
Cattle	0.7
Sheep and goat	0.1
Horse	0.8
Mule	0.7
Donkey	0.5
pig	0.2
Chicken	0.01

Source: Adopted from Jahnke (1982)

Annex 2: Adult Equivalent Scales

Years of age	Men	Women
0-1	0.33	0.33
1-2	0.46	0.46
2-3	0.54	0.54
3-5	0.62	0.62
5-7	0.74	0.70
7-10	0.84	0.72
10-12	0.88	0.78
12-14	0.96	0.84
14-16	1.06	0.86
16-18	1.14	0.86
18-10	1.04	0.80
30-60	1.00	0.82
60 plus	0.84	0.74

Sources: Adopted from Dercon and Krishnan (1998)

Annex 3: Covariates included in the balancing test

Variable name	**Definition**
hhsex98	Household head sex in 2006; dummy female=1, otherwise=0
hhjob98	Household head main job in 2006; dummy farming=1, otherwise=0
hhage98	Household head age in 2006
hhage2	hhage98 squared
hagb	an interaction term for hhjob98 and hhage98
nadult98	Number of adults in the household in 2006
nchildb1598	Number of children below age 15 in the household in 2006
nadult6598	Number of adults age 65 plus in the household in 2006
hhadt2	nadult6598 squared
pfland98	Household farmland ownership in tsimdi in 2006 per adult
ptlu98	Household livestock ownership in TLU in 2006 per adult
proom98	Number of rooms owned by the household in 2006 per adult
Mekelle	Dummy for Mekelle town peri-urban, Mekelle=1, otherwise=0
Adigrat	Dummy for Adigrat town peri-urban, Adigrat=1, otherwise=0
axum	Dummy for Axum town peri-urban, Axum=1, otherwise=0
Alamata	Dummy for Alamata town peri-urban, Alamata=1, otherwise=0

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