Examining Participation and Time Allocation to Non-Market Household Agricultural Production in Pakistan

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Abstract

Time allocation to the unpaid non-market work has an important impact on the development process of the country. A large number of females in our country are involved in a number of unpaid household activities. But, their valuable services in the production of household commodities are never recognized at the individual, societal and national level. Therefore, this study analyzes the determinants of time allocation to the unpaid non-market agricultural activities in Pakistan. The time allocation behavior of females is examined with respect to selected social, economic, and demographic variables by using the cross-sectional data from the Pakistan *Labor Force Survey Data.* Logit and Tobit techniques are applied for the sake of analysis. The important findings of the study suggested that age has a positive and age square has a negative relationship with the number of hours allocated per week to unpaid household agricultural work. Educated females allocate relatively lesser number of hours per week to household agricultural work as compared to females with lower level of education. Females having small children in the family allocate more time to the household agricultural activities. The results indicate that a negative association exits between joint family system and time allocation to the household agricultural work. Females from Sindh, KPK, and Baluchistan allocate more time per week to the household agricultural activities as compared to the Punjab.

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1. Introduction

According to modern household economics, the time of households is a crucial factor of production. Moreover, it is the dominant resource of production for poor households. Thus, we cannot say that the household services provided by household female member are value free (Gronau, 1977). Non-market work like cleaning houses, food preparation, childcare, shopping, construction, management and clothing care etc. are performed by all family members. However, females whether employed or unemployed allocate majority of their time to household work as compared to the male members of the family (Tasnim, 2020). The contribution of males in household activities is just a drop in the ocean (Murphy, 1976). In fact, one of the important sources of support and comfort in daily life of people comes in the form of this unpaid household work performed by some family members. People cannot live comfortable life as an individual and as a society without having provision of these household services (Mazurkiewicz, 2016). No one disputes over the fact that household produces different commodities like healthy meals, well maintained homes, and cleaned clothes that contribute towards the health and well-being of household individuals.

The development of "new home economics" provides an insight towards understanding the behavior regarding allocation of time by household members to activities within the home. Although every one of us know that the unpaid care work is also vital part for the smooth functioning of the economy but still it is treated as the part of non-economic labor by United Nations System of National Accounts of 1993 (UN-SNA). According to LFS (2017-2018), 50.4 percent females are working as unpaid family helper as compared to the 11.6 percent males.

Like other developing countries, women in Pakistan make a significant contribution in agriculture, household and other rural activities directly or indirectly. A study by Hafeez and Ahmad (2002) show that women are high likely to work in the rural areas. Despite recent increases in the proportion of working women, the number of working women is still quite small. The main reason for the low involvement of women in economic activities is various socio-economic constraints, which hinder women's participation in the formal labour market. Moreover, married women have several commitments at home. They have to look after their children and perform numerous household chores, (Gondal, 2003). According to Khan and Hafeez (2017), Pakistan is an agrarian economy, many families relay on the agriculture sector for their livelihood. Females in rural areas of Pakistan devote more of their time to various

agricultural operations particularly food processing in order to meet the needs of the family. Approximately 60% of female's labor in rural areas of Pakistan is performed without any sort of reward in form of wages, which makes the condition of these workers extremely concerning (Kaleem, 2018).

In Pakistan, females make up almost half of the entire population. Majority of the females are primarily employed in agriculture sector as low wage or mostly unpaid contributing family workers in rural areas. According to the 'Rural Women in Pakistan Status Report 2018', published by Pakistan Centre of Gender and Policy, 67 percent of females in rural areas of Pakistan are working in agriculture sector. Out of total work, 60 percent of their work is categorized as unpaid. Transplanting rice, harvesting vegetables, picking cotton, weeding, dairy work and caring of livestock are all mainly seen as activities of the females in Pakistan (LFS, 2018).

The issue of the unpaid participation women in household agricultural production has been mainly ignored worldwide and particularly, this issue has not been focused in Pakistan. Therefore, main contribution of this study is to explore the key factors which determine the probability of participation decision to the non-market agricultural work. In addition, the study examines allocation of time to numerous non-market agricultural activities. These activities are mainly performed for household production of commodities without any sort of paid reward in Pakistan by using the LFS (2018-2019) data. Therefore, two main objectives are focused in the study. The first objective is to determine the factors affecting the probability of participation of females to household agricultural work. The second important objective is to determine the factors affecting the time allocation of females in terms of number of hours per week to the household agricultural work in Pakistan. These objectives are aligned with the Sustainable Development Goal (SDG) about care-giving and domestic work performed by women. The study has applied Logit and Tobit techniques for the sake of analysis.

Section 2 provides review of some important studies related to the topic at the national and international level. Section 3 provides methodology of the study. The estimation results along with explanation are given in section 4. Conclusion and policy implication of the study are given in section 5.

2. Literature Review

Economic approaches of time allocation are based on the basic assumptions of neo-classical theory. The primary source of most labor supply models is associated to the Neo-classical economic theory. The regard to represent the theory of Neo-classical labor supply goes to the Mincer (1962). The concept of Mincer theory was based on traditional utility maximization. According to his theory, the maximization of individual utility depends on the rational division of time between household work, market work, and leisure. The trade-off relationship between work and leisure is determined by individual preferences and relative value of leisure and additional income. Non-market activities are another factor that affects labor force participation decisions of the married women (Mincer, 1962).

The major drawback of time allocation theories is that it ignores the household related production. So, this does not work well for the non-industrial societies. The problem of not incorporating the non-market work of women is recognized by Mincer (1962) and Becker (1965). Becker (1965) solved this problem by presenting the time allocation theory in which he introduced the non-market work in the labor supply theory. His model consists of market work, home production and leisure. Due to this contribution, Becker (1965) is called the founder of '*New Home Economics*'. According to this approach, private households act like an economic institution, which produce beneficial commodities by using time utility and market commodities. A household mutually takes decision about the paid and unpaid work and leisure and this depends on the relative productivity of the individual members of the household. Different household members can gain the comparative production advantages through specialization. The main variables of this approach are family income and labor market productivity. In this theory, it is assumed that the individual preferences for the personal benefits are constant for all members of the household. This theory was subsequently extended taking other individual characteristics like age, education, and number of children etc.

2.1. Empirical Evidence on Non-Market Work

In this section, some studies that deal with the determinants of participation and time allocation to the non-market work at the national and international level are reviewed. Limited number of studies has been conducted about the subject issue at national level. No recent research has found since decades in Pakistan.

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Table 1

Review of Studies on Participation and Time Allocation to the Non-Market Work

Name of the Study	Data Source	Sample	Methodology	Results
Evenson (1978)	Laguna project collected data, 1977	225 rural households	OLS model	This study found that non-wage income has a negative relation with the time allocation by a husband belonging to the non-farming house on the market work. The results also supported the positive influence of the wife's wage on the wife's market time and a reduction in the farms and home's time. Education has also a favorable influence on the market time. The results also supported that presence of younger children results in more amount of time spend at home than in the market and vice versa in case of older children.
Khandker (1987)	Data collected through survey in rural Bangladesh	500 households	Probit, OLS, and Tobit	The results showed that the women involvement in the market is enhanced by the rise in the wage rate of women, husband's education, and location of the school. The results of the censored regression technique discovered that the constraints related to the individual, market, household, and community play an important role towards explaining the time allocation by women to market production.
Sultana et al. (1994)	*International Food Policy Research Institute* panel survey data, 1993, Pakistan	2454 women	OLS and tobit models	Women's age, women's education, number of dependents, and men's anticipated wages have an important negative influence on the amount of time assigned to domestic work by the participating women. However, women's age and her predicted wages have an important positive influence on the amount of time allotted to household work by non-participating women. Predicted wage rate of females and males increased the women's time in market activities.

Miller and Mulvey (2000)	*Time Use Survey* data, 1992, Australia	1612 married females	OLS technique and tobit model	The results of the study showed that well educated women allocated more time towards childcare as compared to the less educated women. Those women who have done tertiary studies allocated 21 minutes more than those who are less educated. Presence of disabled child resulted in a rise of time towards domestic work and childcare.
Kimmel and Connelly (2007)	*American Time Use Survey*, 2003 and 2004	4552 mothers	Tobit model	This study found that the increased wages have a positive association with the care giving time and a negative association with the time for leisure and home production. The price of childcare and number of children has a positive relation with the care giving time of mothers. As the increase in age of child is recorded it resulted into decline of mother's time for the care giving.
Nadal and Molina (2013)	*Multinational Time Use Survey* data, Spain (2002), and UK (2000)	1527 couples from UK and 4499 couples from Spain	Seemingly unrelated regression Tobit model, OLS model	This study categorized the childcare activities into basic, educational, and supervisory activities and analyzed how educated parents invest time on the childcare. This study explored that education of the mothers has a more positive influence on the amount of their time allocated for the educational care of the children as compared to the fathers both in UK and Spain.
Bruins (2017)	*American time use survey* data, 1975, 1985,1995, and 2005	7809 mothers and 5333 fathers	OLS technique	The increase in wages of both men and women has positive effect on parent's time for children. When there was an increase of 5% in the wage rate of male and female, it would raise one-hour amount of time for the childcare. As the parents spent more time on the education of their children their time for the secondary child related activities decreased when there is a rise in their wage rates.

Singh and Pattanaik (2019)	*National Sample Survey, 1993-1994 to 2011-2012*	66000 females	Logit model	It has been found that married females participated more in unpaid work and unmarried females participated more in paid work. However, overall, participation of females in unpaid work has been significantly increased and the major determinants behind are low education and poor household background.
Yaqoob & Hafeez (2020)	*Labor Force Survey (2017-2018)*	74457 women of age 15-64 years.	logit model	Age, being married, and belonging to KPK province have positive and significant effect on participation in unpaid household work Age square and educational categories have significantly inverse effect on the participation of women in unpaid household work.
Nazier and Ezzat (2021)	*Labor Market Panel Surveys (LMPS),* 2012, Egypt and Tunisia	38107 and 12879 individuals	Tobit model	Age has a positive association and age square has a negative association with female's time allocation to housework. Educated females allocated lesser number of hours to housework as compared to uneducated females. Married females spent more number of hours to housework as compared to unmarried females. Household size has a negative relation with female's time allocation to housework.
Smiljanić, Pepur, & Bulogb, (2023).	Field Survey 2021	869 Respondents	Multiple regression model, Kruskal–Wallis test	The results revealed that women's financial literacy negatively affects women's willingness to take on more unpaid work while the deteriorating family financial situation in the pandemic has a positive effect.

Nayyabb & Kanwal (2023)	Labor Force Survey (LFS) 2018-19.	LFS (2018-2019)	Calculation of average hours calculated	On average, a woman daily spends around 3 hours on non-market work that is economically not counted. Women allocate their longest time in kitchen for cooking food, followed by cleaning home and washing, and child/old care. Although women spend limited hours, and labor, in the market economy, their time is diverted to non-market economy which is not given any value, monetary or otherwise.

3. Data and Methodology

Household agricultural work includes activities like agricultural operations, food processing, and livestock operations. Agricultural operations include sowing, ploughing, transplanting rice, picking cotton, collection of fruits and vegetables, weeding field, and harvesting crops (Rathnayaka & Weerahewa, 2015; Drucza & Peveri, 2018). Food processing activities are also added into agriculture operations. Food processing activities comprised of milling, grinding, drying maize and rice husking. Livestock operations and poultry raising are also part of agriculture operations. Various agriculture operations include activities like meat processing, feeding animals, milking animals, whipping milk, grassing, gathering of cow dung, making dung cakes, feeding poultry birds, eggs collection and packing, medication to birds and feeds preparation.

The data for the household agricultural work participation is obtained from the Pakistan LFS (2018-2019). The sample consists of females of age 10-64 years and their participation to the household agricultural work is examined with respect to the various social, economic and demographic factors. A standard approach from the literature is adopted by keeping in view of the prevailing socio-economic circumstances of Pakistan and availability of data during the process of selection of determinants.

The dependent variable, time allocation decision of females to the household agricultural work is a qualitative variable which is equal to 1 if female is involved in the household agricultural work and zero otherwise. After analyzing the determinants of household agricultural time allocation decision of the females, the very next question is that how many hours, females may allocate to the household agricultural work.

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The explanatory variables are divided into three main categories. These are: 1) Characteristics of females 2) Characteristics of household and 3) Residential province. The detail of dependent along with independent variables is given in Table 2.

Table 2

Description of variables

Variables	Description	Measurement of variables
Dependent Variables		
NMWork_awf	Household agricultural work decision	= 1, if individual female is involved in household agricultural work during a reference week; = 0, otherwise.
TAMNW_awf	Time allocation to household agricultural work.	If individual female allocates at least one hour to the household agricultural work during a reference week.
Explanatory variables: characteristics of females		
Age_f	Age	Completed years.
Age^2_f	Square of age	Completed years square.
Edup_f	Education category	= 1, if the highest level of education completed by female is primary, and = 0 otherwise.
Edumi_f	Education category	= 1, if the highest level of education of female is middle, and = 0 otherwise.
Edum_f	Education category	= 1, if the highest level of education of female is matric, and = 0 otherwise.
Edui_f	Education category	= 1, if the highest level of education of female is intermediate, and = 0 otherwise.
Eduh_f	Education category	= 1, if the highest level of education of female is higher than intermediate that is B.A/B.Sc., M.A/M.Sc. and M.Phil./Ph.D., and = 0 otherwise.
Married_f	Marital status	= 1, if female is married, and = 0 for unmarried females.

Explanatory variables: Characteristics of household		
SC	Number of small children	Total number of small children of age less than equal to five years in the family.
HHS	Size of the household	Total number of members of the family.
JOINT	Type of the family	= 1, if individual is living in the joint family, and = 0 for nuclear family.
Explanatory Variables: Residential Characteristics		
Sindh	Residential province of Sindh	= 1, if individual is currently living in the province of Sindh, and = 0 otherwise.
KPK	Residential province of Khyber Pakhtunkhwa	= 1, if individual is currently living in the province of KPK, and = 0 otherwise.
Baluchistan	Residential province of Baluchistan	= 1, if individual is currently living in the province of Baluchistan, and = 0 otherwise.
Punjab	Residential province of Punjab	= 1, if individual is currently living in the province of Punjab, and = 0 otherwise. It is used as a base category.

3.1. Logit Model

An important non-linear model that deals with the problem of limited dependent or dichotomous variable is the logistic or logit model. There are number of reasons that make the logit model fit in case of binary variables. One reason is that it eliminates the probability of falling the non-market participation outside the limit of 0-1 (Gujarati, 2009). Another reason is that it is easier to correct the bias in case of outliers as it is not sensitive in comparison to the probit technique. In addition to this, it has less restrictive requirements as it does not assume homoscedasticity in contrast to the simple linear regression model (Batool et al., 2019). The logistic transformation of household agricultural work participation p is $\text{Log}\frac{p}{1-p}$ and it is written in the form of logit (p). Where the odds of participation are $\frac{p}{1-p}$ and it converts the log p from the limit of (0-1) to $-\infty$ to ∞. If the probability of participation is p, then the odds of participation are $\frac{p}{1-p}$. And, the odds in this case are shown as:

$$\frac{P(Y=1|X)}{P(Y=0|X)} = \frac{P(Y=1|X)}{1-P(Y=1|X)}$$

Where Y=1 represents the odds of participation and Y=0 represents the odds of non-participation to the household agricultural work (Gujarati, 2009). Thus, the relationship between dependent and independent variables in the form of linear logistic model is represented as:

$$\text{Logit } P_i = \frac{exp(\beta_o + \beta_1 X_1 + \cdots + \beta_k X_k)}{1 + exp(\beta_o + \beta_1 X_1 + \cdots + \beta_k X_k)} \tag{1}$$

Maximum likelihood estimation is used for the estimation of unknown parameters, which is given as:

$$L(\beta) = \sum_{i=1}^{n} P_i^{y_i} (1 - P_i)^{1 - y_i}$$

Model 1: Participation to Household Agricultural Work

Equation (2) represents the functional relationship between decision of the females to do the household agricultural work and a set of independent variables.

$$\text{NMWork}_{\_awf} = \begin{bmatrix} \text{Age}_{\_f}, \text{Age}^2_{\_f}, \text{Edup}_{\_f}, \text{Edumi}_{\_f}, \text{Edum}_{\_f}, \text{Edui}_{\_f}, \text{Eduh}_{\_f}, \\ \text{Married}_{\_f}, \text{SC, HHS, JOINT, Sindh, KPK, Baluchistan} \end{bmatrix} \tag{2}$$

The dependent variable (NMWork_awf) is the women participation decision to household agricultural work. The independent variables include age and age^2 of women, primary education of women (Edup_f), women with middle education certificate (Edumi_f), women with secondary education (Edum_f), women with intermediate level education (Edui_f), women having higher than intermediate level education (Married_f), number of small children (SC), household size (HHS), family set up (JOINT) and residential provincial dummies for provinces of Sindh, Khyberpakhtoonkha (KPK) and Baluchilstan.

3.2. Tobit Model

Tobit model also called censored regression model is a form of linear regression. Specifically, Tobit model is used, if a continuous dependent variable needs to be regressed, but is skewed to one direction. Tobit model allows regression of such a variable while censoring it, so that regression of a continuous dependent variable can happen (Sayer et al., 2004; Shen et al., 2016). It allows the researcher to specify a lower (or upper) threshold to censor the regression while maintaining the linear assumptions needed for linear regression. The tobit technique uses all observations i.e., both at and above the limit in order to estimate the regression line (McDonald Moffitt, 1980). The data which has been used for the analysis has censoring issue. Therefore, the best option is tobit model (Glick, 1999; Anxo & Carlin, 2004). Hence, the same

has been employed for analysis in this article. A remarkable number of males and females do not participate in at least one of the two types of work, i.e. market work and non-market work (Sultana et al., 1994; Bloemen et al., 2010). Also, a sizeable number of females do not spend time on agricultural activities (Malathy, 1994). Consequently, the dependent variable contains many zero values and the problem of censored data arises in these cases, which is solved by applying maximum likelihood (ML) tobit technique in estimation (Shen et al., 2016).

As consequence of the above discussion, we have found Tobit model as an appropriate estimation technique to estimate time allocation equation. The model in equation form is as follows:

$$Y_i^* = \beta_0 + \beta_1 X_i + e_i \tag{3}$$

$$Y_i = \begin{cases} \beta_0 + \beta_1 X_i + e_i & \text{if } Y_i^* > 0 \\ 0 & \text{if } Y_i^* \leq 0 \end{cases}$$

Where Y_i is an observed continuous variable that is equal to Y_i^* which is latent variable. X_i is a set of exogenous variables. $Y_i = Y_i^*$ if $Y_i^* > 0$, that is if females allocate time to household agricultural activities. $Y_i^* = 0$, if females do not spend time on either activity. e_i is the error term (Gujarati, 2009).

Model 2: Time Allocation to Household Agricultural Work

Equation (4) shows the relationship between number of weekly hours allocated to the household agricultural work by females and a set of independent variables.

$$\text{TANMW\_awf} = \gamma_0 + \gamma_1 \text{Age\_f} + \gamma_2 \text{Age}^2\_f + \gamma_3 \text{Edup\_f} + \gamma_4 \text{Edumi\_f} + \gamma_5 \text{Edum\_f} + \gamma_6 \text{Edui\_f} + \gamma_7 \text{Eduh\_f} + \gamma_8 \text{Married\_f} + \gamma_9 \text{SC} + \gamma_{10} \text{HHS} + \gamma_{11} \text{JOINT} + \gamma_{12} \text{Sindh} + \gamma_{13} \text{KPK} + \gamma_{14} \text{Baluchistan} + e_i \tag{4}$$

The dependent variable (TANMW_awf) is the number of weekly hours allocated to the household agricultural work by females. The independent variables include age and age[2] of women, primary education of women (Edup_f), women with middle education certificate (Edumi_f), women with secondary education (Edum_f), women with intermediate level education (Edui_f), women having higher than intermediate level (Married_f), number of small children (SC), household size (HHS), family set up (JOINT) and residential provincial dummies for provinces of Sindh, Khyber Pakhtunkhwa (KPK) and Baluchistan.

4. Empirical Results of Time Allocation to Household Agricultural Work

The first part of this section presents the results of participation decision equation of household agricultural work. The second part shows the results of model of time allocation to household agricultural work.

Results of Model 1: Participation Decision in Household Agricultural Work

The results of logit model for the determinants of household agricultural work by females are given in Table 3. The signs and significance of all explanatory variables are found appropriate. The value of pseudo R^2 is found appropriate. This shows that explanatory variables play a significant role in explaining the behavior of dependent variable. In addition, the intercept term is significant. This demonstrates that there may be other variables that are omitted from the model but may reasonably impact the household agricultural work participation decision of females.

The coefficient of age is found positive. This means that the probability of participation of females in the household agricultural work increases with the increase in females' age. It is found that each additional year of age is expected to increase the females' involvement in household agricultural work by 0.2 percentage points. This is so because females become more energetic and experienced with the increase in age. Therefore, they are likely to participate better in performing the household agriculture work. In this way, they are helpful to save the household finances that the household would have to otherwise spend in order to hire the external services to perform these activities for the family. The significance of result is enhanced by findings of the studies by Zaheer & Hafeez (2017), Hafeez and Ahmad (2002) & Sultana et al. (1994). The Results indicate that participation of women workers increases overtime as they get mature with the years of age. However, the coefficient of our variable, age square is negative and significant. This indicates that females are less likely to participate in household agricultural work during later years of their age. This may be due to the deteriorating health conditions of females during older years.

Table 3

Results of Females' Participation Decision to Household Agricultural Work

	Logit Model		
Explanatory Variables	**Coefficients**	**Z-values**	**Marginal Effects**
Intercept	-2.242***	-18.24	
Age	0.012*	1.75	0.002**
Age^2_f	-0.000**	-2.04	-0.000**
Edup_f	-0.446***	-10.42	-0.064***
Edumi_f	-1.021***	-13.74	-0.122***
Edum_f	-1.367***	-18.64	-0.151***
Edui_f	-1.959***	-14.66	-0.174***
Eduh_f	-2.229***	-13.41	-0.182***
Married_f	-0.047	-0.84	-0.008
SC	0.038***	2.71	0.006***
HHS	-0.014**	-3.00	-0.002***
JOINT	-0.078**	-2.21	-0.012**
Sindh	1.665***	38.00	0.328***
KPK	1.507***	35.04	0.285***
Baluchistan	0.842***	16.74	0.157***
Loglikelihood	-15244.151		
Pseudo-R-square	0.128		
Sample	52748		

Note: ***, **, * indicates the significance at 1%, 5%, and 10% respectively.

As far the education level is concerned, the coefficients of all the five educational categories are negative and statistically significant. This indicates that educated females are less involved in household agricultural work as compared to those females who have no formal education. This may be because educated females are more productive in other household activities like child care activities as compared to the less educated females. This explains that educated females can

well perform in better upbringing of children. Therefore, they may be less likely to perform household agriculture work.

The coefficient of marital status indicates that probability of married females to do the household agricultural work is lower as compared to those of unmarried females. The result is found statistically insignificant. It has been found that married females bear more responsibilities of housework and child work, which restraint them from bearing additional work burden in form of doing household agricultural work. However, unmarried females may bear relatively lower burden of other household and child chores and may be more involved in household agricultural work. The other effect may be that married females participate more in household agricultural work. Agricultural activities are mainly performed outside the household domain. Since, married females have prestigious social status and are therefore, more likely to participate in agricultural work outside the household domain. So, the second effect may be positive. However, the overall effect may be neutral but negative. The results are supported by Nazier and Ezzat (2021).

The estimation results indicate that the value of coefficient of number of small children is positive as well as statistically significant. This means that presence of younger children in the family raises the probability of participation of females in the household agricultural work. This may be because presence of small children increases the household consumption expenditures. Therefore, the females have to participate more in the agricultural activities besides other household members to fulfill the household demand for agricultural products.

It has been observed that females belonging to the larger household size and joint family setup participate less in the household agricultural work. This may be due to the fact that the presence of other family members in larger household size and joint families share the females' burden of household agricultural activities in contrary to females belonging to the small and nuclear families.

As far as the residential provinces are concerned, the coefficients of all the categories are positive as well as statistically significant at 1 percent level of significance. This reveals that females from Sindh, KPK, and Baluchistan are more likely to get involved in the informal unpaid household agricultural work in contrary to females from the Punjab. This may be because working environment of Punjab is more favorable for formal paid work than in other provinces. Since, economic activities are larger in Punjab; females have higher access to formal paid market

work here. Therefore females from Punjab may prefer to perform more paid labor market activities as compared to do unpaid household agricultural work.

Results of Model 2: Time allocation to Household Agricultural Work

The estimates of the Tobit for time allocation to household agricultural work are presented in Table 4.

Table 4: *Results of Weekly Hours of Time Allocation to Household Agricultural Work for Females*

Explanatory variables	Tobit Model		OLS Model	
	Coefficients	**t-values**	**Coefficients**	**t-values**
Intercept	7.281***	14.56	7.296***	14.61
Age_f	0.145***	4.38	0.145***	4.40
Age ^{2}_f	-0.001***	-2.83	-0.001***	-2.86
Edup_f	-0.511	-1.20	-0.513	-1.21
Edumi_f	-0.321	-0.95	-0.322	-0.95
Edum_f	-0.689**	-2.02	-0.672**	-1.98
Edui_f	-1.617***	-2.53	-1.580***	-2.48
Eduh_f	-1.219**	-2.10	-1.228**	-2.09
Married_f	-0.370	-1.64	-0.373	-1.63
SC	0.091**	2.04	0.091**	2.01
HHS	-0.026	-1.40	-0.027	-1.43
JOINT	-0.238*	-1.68	-0.240*	-1.67
Sindh	1.476***	7.61	1.494***	7.72
KPK	2.224***	11.66	2.236***	11.74
Baluchistan	1.554***	6.79	1.576***	6.90
Loglikelihood	-23316.095			
R-squared	0.180		0.195	
Sample	11866			

Note: ***, **, * indicates the significance at 1%, 5%, and 10% respectively.

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According to the estimates, age is positively and age square is negatively related with female's time allocation to household agricultural activities. Both of these variables are found to be statistically significant. This shows that a quadratic relationship exists between allocation of time to the household agricultural work and age of the females. Based on the Labor Force Survey of Pakistan (2007-2008), a study by Hafeez and Ahmad (2015) found that workers exhibit higher probability of participation and allocate more hours to the work over time in the rural areas of Pakistan. According to Ahmad and Hafeez (2007), female workers are likely to increase their time allocation to economic activities with age. Moreover, it has been found that age and education of unmarried workers exert positive effect on women participation in economic activities (Hafeez, 2013).

As far education is concerned, the coefficients of all educational dummies are negative. This indicates that educated females allocate lesser number of hours per week to the informal unpaid household agricultural work (Rathnayaka & Weerahewa, 2015; Nazier and Ezzat (2021). It is found that educated females allocate more time to childcare activities as compared to uneducated females. However, they are less likely to contribute to informal household agriculture activities. This may be because educated females consider these activities as inferior. Therefore, they are reluctant to perform these activities. Instead, they may prefer to allocate more of their time to the formal labor market work, where they can be hired at better wage rates. According to Ahmad and Hafeez (2007), highly educated female workers are likely to decrease their time allocation to economic activities with age.

Empirical result for marital status indicates that married females allocate less number of hours per week to the household agricultural work as compared to the unmarried females. There may be two effects resulting from this. One effect may be that married females allocate lesser time to the household agricultural activities as they bear more burden of other household chores like housework and child work. Housework and child work are more time intensive commodities as compared to the household agricultural work. The other effect may be that agricultural activities are mainly performed outside the household domain. Since, married females have stable social status; they are more likely to allocate greater number of hours per week to these activities outside the household domain as compared to the unmarried females. These two effects may cancel out each other and can result into neutral behavior of this variable. Thus, the overall effect may be negative but insignificant. The results are supported by Nazier and Ezzat (2021).

The coefficient of number of small children is found to be positive and statistically significant (Rathnayaka & Weerahewa, 2015). This implies that presence of small children in the family raises the household demand for agricultural products. This may be because small children increase the household consumption expenditures. Therefore, females have to allocate more time to the agricultural activities in order to fulfill the household demand for agricultural products. Females from larger household allocate lesser number of hours per week to the household agricultural work as compared to those belonging to nuclear family system. However, the result is found to be statistically insignificant. One effect of this may be that females allocate lesser number of hours per week to the household agricultural work because other family members present in larger families share the females' burden of agricultural activities. The other effect of this may be that females belonging to larger families may bear more burden of household agricultural work to fulfill larger household need of agricultural products. The overall effect may be negative but insignificant.

Similarly, the coefficient of joint families is found negative and significant. This shows that females from joint household size allocate less time to the household agricultural work due to presence of other members in the family who share household agricultural burden of females. The coefficients of all the residential provinces categories are positive as well as statistically significant at 1 percent level of significance. Females from Sindh and Baluchistan allocate about more than 1 hour per week on the household agricultural work as compared to females from Punjab. Females from KPK spend about 2 hours in a week more on the household agricultural work in contrary to females from Punjab. This may be because working environment of Punjab is more favorable for paid labor market work than in other provinces. Since, economic activities are larger in Punjab; females have higher access to paid market work here. They are also rewarded at higher rates for their work. Therefore, females from Punjab may prefer to allocate more of their time to paid market work in contrary to the informal unpaid household agricultural activities.

4. Conclusion

The important contribution of this study is the analysis of the determinants of time allocation decision and number of weekly hours allocated to unpaid non-market work i.e. household agricultural work by females. This study finds out that there are many significant socio-economic

and demographic factors that influence the time allocation decision and number of weekly hours allocated to the non- market work.

Our analysis reveals that education, presence of small children in the family, joint family system and provincial location are important variables that influence the participation and time allocation of females towards the unpaid household agricultural activities. Educated females work relatively fewer hours per week on the household agricultural work in contrary to females with no formal level of education. Presence of younger children in a family raises the amount of time of females allocated to the non-market household agricultural work. Females belonging to joint family system allocate relatively lesser hours in a week to the household agricultural work due to presence of helping hands in the family. It is observed that females from Sindh, KPK, and Baluchistan allocate greater number of hours per week to the non-market household agricultural work as compared to the females from Punjab.

Therefore, we can say that the amount of time that the females spend on home production in the form of non-market household agricultural work is a significant resource at household and societal level. It is the time to recognize the value of the time that females spend in making home heaven not only at the household, societal, but also at the socio-economic levels. At household level, the efforts of females must be appreciated and accepted by all members of the family.

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Appendix- A

Table 5

Descriptive Statistics

	Females	
Variables	**Mean**	**Standard deviation**
Dependent variables		
NMWork_awf	0.225	0.4178
TAMNW_awf	8.618	5.462
Explanatory variables: characteristics of females		
Age_f	28.495	14.237
Age²_f	1014.694	955.554
Edup_f	0.280	0.449
Edumi_f	0.116	0.321
Edum_f	0.113	0.316
Edui_f	0.055	0.228
Eduh_f	0 .055	0.228
Married_f	0.546	0.498
Explanatory variables: Characteristics of household		
SC	2.041	1.260
HHS	7.539	3.651
JOINT	0.589	0.492
Explanatory Variables: Residential Characteristics		
Sindh	0.218	0.413
KPK	0.198	0.399
Baluchistan	0.122	0.327
Punjab	0.462	0.499
Sample size for NMWork_awf	52748	
Sample size for TAMNW_awf	11866	