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Article

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Provided in Cooperation with:
Czech journal of social sciences, business and economics

Article history: Received 10 January 2016; last revision 10 March 2016; accepted 30 March 2016

FEMALE EDUCATION AND HOUSEHOLD PER CAPITA INCOME: EVIDENCE FROM 3D SURFACE MAPS

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Abstract

Women have been the crucial socio-economic sufferer, which is especially true for those women who live in the rural areas of Third-world developing countries. It has been established through extensive research that women represent the major percentage of poor on the global landscape. The answer why this has to be so is not very difficult. Gender biases, gender exploitation, low income, deprivation, violation of basic rights are all social ailments that female has to face in society. In this scenario, female education has significant role. With female education, poverty reduces and socio-economic status of the households improves.
This paper investigates the critical linkage between female education and per capita income of households in a small village of Khyber Pakhtunkhwa Province of Pakistan. Computer Assisted Qualitative Data Analysis Software (CAQDAS) was used to develop three dimensional digital models of the female education and per capita income of the households. Based on the these models, three dimensional 3D surface maps were prepared for female education and per capita income for the whole village which revealed that parts of village with higher female education had higher per capita income compared to parts of village with low female education. The paper clearly addresses the significance of female education to improve socio-economic fabric of the rural society of Pakistan.

Keywords: gender issues, female studies, education, poverty, income, 3D maps

JEL Classification: D11, D12, I25, I26.

Introduction

In many countries, female education is scarce but can clearly have positive influence on the whole family. Everyone would probably agree that education of a mother is far more important than education of a father. With access to educational facilities, women in the rural areas of Pakistan are capable of making a socio-economic impact. Although Pakistani government initiated serious efforts to foster female education in rural areas, the desired rate of female literacy in rural areas yet remains poor. Female education plays important role in socio-economic development of a society especially the rural society. To have an overall assessment of the impacts of female education, a study was conducted in Naryab, which is a small village in the northern hills of Khyber Pakhtunkhwa Province. Primary data about the female education and per capita income was collected from the households. Data was meticulously analyzed with

computer assisted qualitative data analysis software (CAQDAS) to determine relationship between female education and per capita income of the households of village.

This paper reports the results of an analysis that indicated that per capita income increases with female education even if the share of income spending on females is less than the males. After this analysis, three dimensional surface maps were prepared with latest mapping software SURFER to show the spatial distribution of these two aspects in the village. Strangely, there was a striking similarity between the two maps which validates that parts of the village with higher female education has higher per capita income and vice versa. The paper elaborates on the analysis and its implications and as well as draws relevant policy implications as part of the discourse on female education and economic development.

Literature review

Recently, many researchers have focused on finding spatial impact of education on per capita income. Recent research in social sciences has established a strong relationship between development and women's education. For instance, according to Arpino (2007) women's education is positively correlated with socio-economic development (Arpino, 2007). Deaton has elucidated that household benefit from female education in terms of net socio-economic gains over time (Deaton, 2003). Notable economist Lawrence Summers elucidated that investment in female education is one of the highest return investment in the developing world. According to Hanushek (2008), one extra year of education to females increases their wages by 18%. This increase is 4.5% more than corresponding returns on an extra year of schooling of a boy. This advantage creates an increase in the overall economic productivity of a country (Hanushek, 2008). Chaaban has investigated that countries that low investment in female education grow with snail’s pace. Looking holistically at the opportunity cost of not investing in girls, the total missed GDP growth is between 1.2% and 1.5%. When looking at different regions, it is estimated that 0.4-0.9% of the difference in GDP growth is accounted for solely by differences in the gender gap in education (Chaaban, 2011). According to Birdsall (2005), female education increases the equitable distribution of wealth in a society. Moreover, lower gender disparity in education is essential for lower socio-economic inequality (Birdsall, 2005). As explained by Janet (1991), female’s education leads to substantial social development which includes decreased fertility rates and lower infant mortality rates (Janet, 1991). Similarly, Subbarao (1995) has elucidated that gender equality in education is vital for socio-economic development and ensuring equal rights and opportunities without gender bias (Subbarao, 1995). King investigated that female's education increases their cognitive abilities such as being able to make prudent decisions related to education and health and increased political participation (King, 1998). Klasen (2002) has found that with female’s education their participation in social gatherings and political activity increases. This fact has been manifested by examples in which educated females were able to lead political efforts in the developing world for the greater benefit of society (Klasen, 2002). Levine (2008) has indicated that education increases the woman’s role in the household. Educated women actively participate in the decision-making process of the family especially the decisions which greatly affect the socioeconomic life of household members (Levine, 2008). The same point has also been explained by Ainsworth (1996) that an educated woman brings social benefits for the household members. In a household with educated mother, children and especially girls are more likely to attend school. In households where a mother is not educated, education of children may not be emphasized

(Ainsworth, 1996). Patrinos (2008) has indicated that survival rated and nutrition of children gets better with an educated mother more than with educated father (Patrinos, 2008). Schultz (2001) has elucidated a significant impact of the female's education by indicating that when girls are educated, the chances of preventing child marriage, teen pregnancy, HIV/AIDS are more compared to uneducated girls. The empirical results at the global level validate this conclusion of Schultz. Moreover, the socio-economic improvement of girls with education helps in breaking the progression of poverty from generation to another (Schultz, 2001). One study by Birdsall (2005) has shown that educated women are comparatively less misers than the educated men. For example, empirical results show that educated females spend 15 times more income on her family and community than males. Educated girls have the tendency to marry at an older age, have fewer children, and seek healthcare for themselves and their children (Birdsall, 2005).
As long as female's education is ignored, the chances of socio-economic change at the world level are blurred. Educated female means chances of better lives for household members and community. Improvement in female's life through education has positive effect on the socio-economic status of household and community. An educated female is a willing, positive and optimist socio-economic agent compared to uneducated female. We believe that society flourishes fast with female's education.

Research area

Village Naryab is located in tribal region at distance of 350 kilometers west of Islamabad. It is surrounded by mountains having heights up to 100 meters. Location of village Naryab is shown in Figure 1. Village has scattered population. There are approximately 2600 houses made of mud and bricks with 5to 6 rooms in each house. Population of the village is approximately 26000 to 30000 at the rate of roughly 9-10 individuals per house.

Figure 1: Location and satellite view of village Naryab

Source: Google Earth (2015).

Electricity is available through laid out aerial wire network. Only 23% of the population has access to clean drinking water. There are two high schools and five primary schools for male education in the town. There is a primary and a high school for female education in the village.

Sanitation and waste disposal is mostly done on self-help basis. People speak Pashto language with tribal slangs. The gender ratio for males and females has been estimated as 1.08:1. There is one hospital bed for every 2000 patients, and there is one doctor for every 7000 patients. 15% of men and only 7% of women receive education in the village.

Research methods

Primary data was collected from 1000 houses out of total 2600 houses in village Naryab. Research design consisted following sequential steps:

- Environmental and climatic aspects of Naryab were ascertained from satellite imageries.
- Prevailing socio-economic conditions of the village were assessed by conducting field visits. Village was divided into five zones. 100 Houses were randomly selected in each zone.
- Primary data on per capita income, male share in income, female share in income, male education and female education was collected through household survey from randomly selected 100 houses in each zone.
- Data obtained was digitally analyzed using latest software CAQDAS to determine the trends of female education and per capita income of households. Using software, digital attenuated models were developed.
- Correlation between female education and per capita income was determined.
- Latest mapping software SURFER was used to create maps for female education and per capita income of households. SURFER is a digital mapping software which can create different kind of maps. This software has an interface with research data in excel sheets. This data is converted into a data grid. This data grid is digitally processed by the software and a grid map is generated. This grid map is converted into surface map after digital iteration and attenuation.
- The comparison of these maps was carried out and conclusions were drawn.

Data collection

Primary data about per capita income, male share in income, female share in income, male education, and female education was collected from the village for evaluation of linkage between female education and per capita income of households in Naryab. For this purpose, village was divided into five zones as shown in Figure 2. Ten data collection teams were made and two teams were sent to each zone for collection of data. This household survey and field visits took about six months. Landscape view of each zone is shown in Figure 3.

Figure 2: Five zones for household data collection

Source: Google Earth (2015).

Figure 3: Landscape view of five zones

Source: Author's work (2015).

After distribution of research area for data collection, five variables of interest were selected for assessment of the linkage between female education and per capita income of households. Description of these variables is shown in Table 1.

Table 1: Variables for evaluation of linkage between female education and per capita income of households

Socio-economic Variables	Description
Per Capita Income (I)	Average per capita income per year in a zone (PKR)
Male share in income (I_{ms})	Average share of income (PKR) spent on male in a zone
Female share in income (I_{fs})	Average share of income (PKR) spent on male in a zone
Male Education (E_m)	Average number of educated males per house in a zone
Female Education (E_f)	Average number of educated females per house in a zone

Source: Author's own calculations.

Data analysis

Descriptive statistics of the data on five variables of interest were calculated and results are tabulated in Table 2.

Table 2: Summary of the data collected from the households

Zones	**Average Number of Educated Male Per House**	**Average Number of Educated Female Per House**	**Average Income Per Year in (PKR)**	**Male Share in Income Per Year (PKR)**	**Female Share in Income Per Year (PKR)**
	E_m	E_f	I	I_{ms}	I_{fs}
North Zone	4	3	156000	92040	63960
East Zone	5	4	123000	93480	29520
Central Zone	6	5	178000	147740	30260
South Zone	3	6	182000	152880	29120
West Zone	4	3	145000	111505	33495
Descriptive Statistics					
Mean	4.4	4.2	156800	119529	37271
Median	4	4	156000	111505	30260
Standard Deviation	1.14	1.30	24324.88	29183.60	15018.59

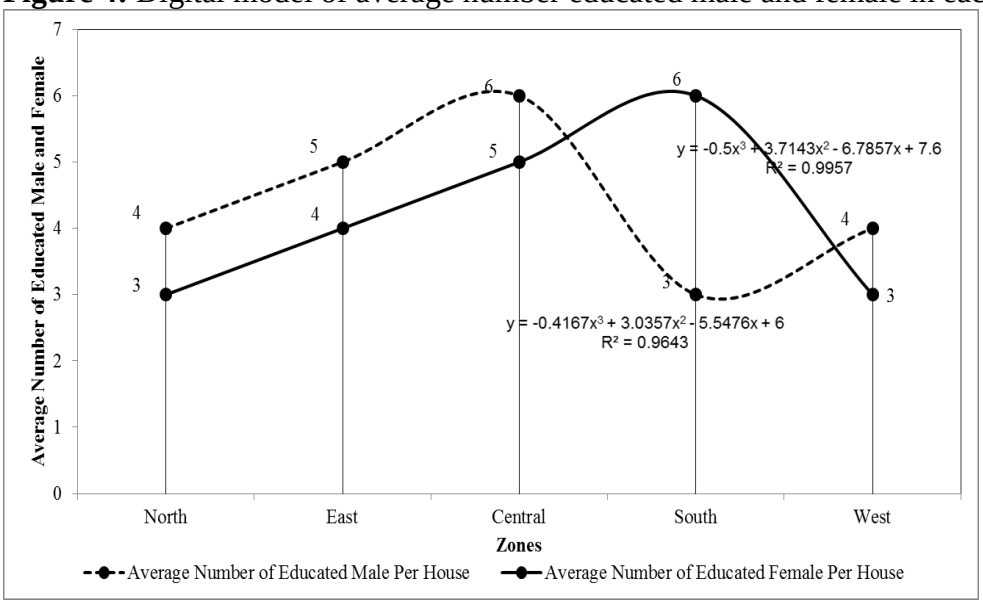
Source: Author's own calculations.

Table 2 indicates that corresponding to highest average number of educated females (6), the highest mean per capita income of households (182000 PKR) is in south zone while average share of income spent of female is the lowest (29120 PKR) in the same zone. This indicates the per capita income depends on female education but not on share of income spent on the females. In fact, the data indicates that highest per capita incomes are associated with higher numbers of educated females regardless of the female share in per capita income.

Digital modeling and validation

The data was analyzed through computer assisted qualitative data analysis software (CAQDAS) and digital models were developed. Digital model for average number educated male and female in each zone is shown in figure 4. The model shows representative equation and the value of coefficient of determination R^2. The coefficient of determination tells about accuracy of the model. In case of male education model is 96.43% accurate while in case of female education the model is 99.57% accurate.

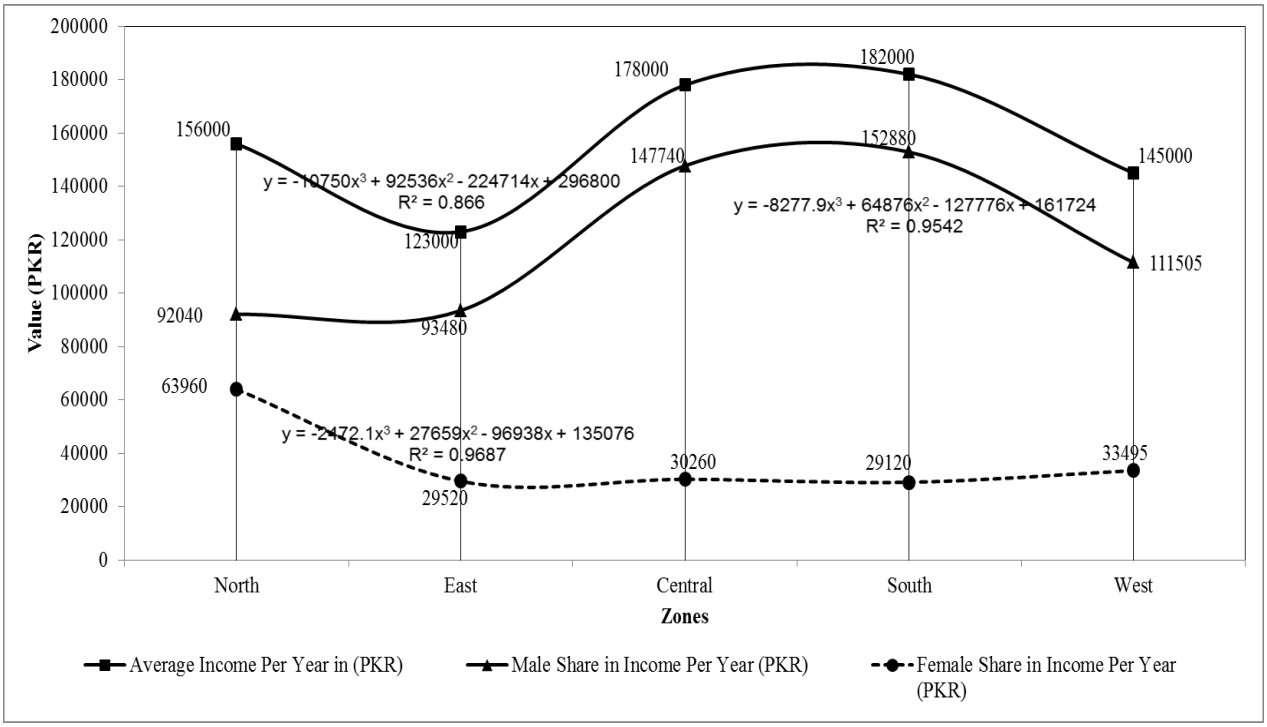
Figure 4: Digital model of average number educated male and female in each zone



Author's own calculations.

Similarly, the digital model for average per capita income of households and the average share of males and females in the income was prepared with CAQDAS and the same is shown in figure 5. Again the avarage share of females in per capita income has the highest accuracy.

Figure 5: Digital model for average per capita income of households and the average share of males and females in the income



Source: Author's own calculations.

After development of digital models, following important aspects were required to be validated by econometric process:

- Is there any correlation between female education (E_f) and per capita income of households (I)?
- Is there any correlation between female education (E_f) and female share in income (I_{fs})?
- Is there any correlation between per capita income of households (I) and female share in income (I_{fs})?
- What is the strength of correlation between these variables?

To ascertain these questions, Pearson's Correlation Coefficients (P) were determined from the data sets of respective variables. For example, Pearson's Correlation Coefficient between per capita income of households (I) and female education (E_f) was found by equation (1).

$$P(E_f, I) = \frac{\sum E_f . I - \frac{\left(\sum E_f\right).\left(\sum I\right)}{n}}{\sqrt{\left[\left(\sum E_f^2 - \frac{\left(\sum E_f\right)^2}{n}\right)\left(\sum I^2 - \frac{(\sum I)^2}{n}\right)\right]}} \ldots\ldots\ldots (1)$$

Where 'n' is number of number of data points. Similar equations were developed for correlation between other variables. The values of Pearson Correlation Coefficients obtained from these equations are summarized in table 3.

Table 3: Values of Pearson's Correlation Coefficients for different variables

Variables	**Value of Pearson's Correlation Coefficient**
Between Female Education (E_f) and Per Capita Income (I)	0.66
Between Female Education (E_f) and Female share in income (I_{fs})	-0.59
Between Per Capita Income (I) and Female share in income (I_{fs})	-0.05

Source: Author's own calculations.

Table 3 provides some interesting results. The correlation value between female education and per capita income of households is positive and strong. This means that they are strongly correlated and if the female education is increased the per capita income increases. On the contrary, the correlation values between female education and female share in income is negative. This means that female education does not depend on the female share in income. Similarly, the correlation value between female share in income and per capita income of households is also negative, which means that female share in income may not improve with increase in per capita income of households.

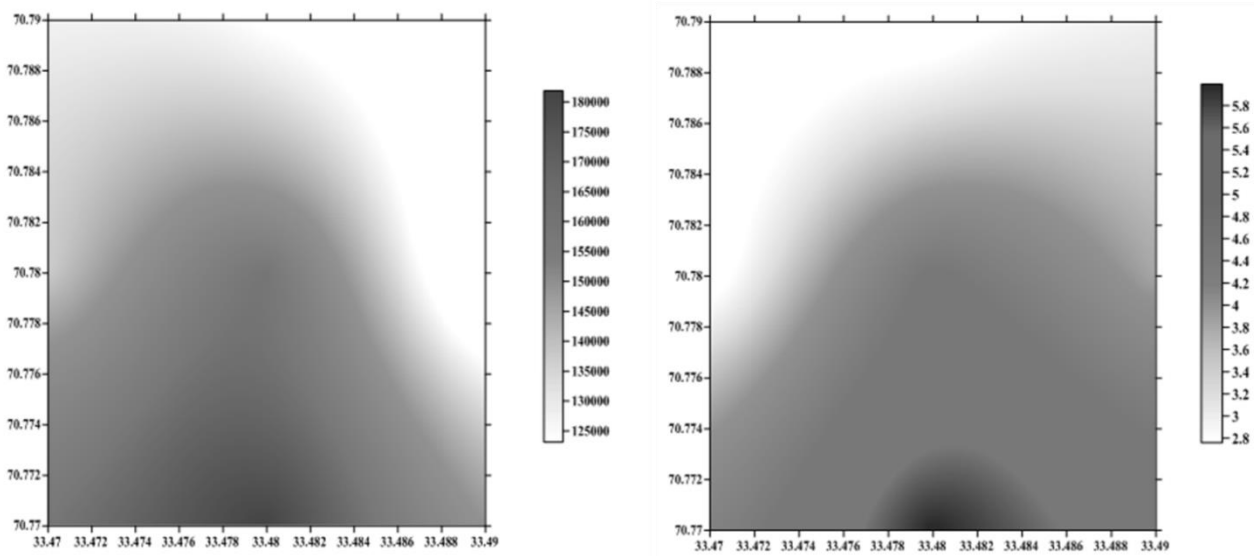
Spatial distribution of female education and per capita income

After assessment of the correlation between variables, spatial distribution of per capita income and female education was mapped using SURFER software. Firstly, the data grid was formed by

software for each variable. Secondly, using the values of latitudes and longitudes, this data grid was converted to grid map. Thirdly, grid map was converted into three dimensional surface maps by the software showing spatial distribution of variables. Key indicating the values of variables is available with each map which makes the map user friendly.

Figure 6 shows the 3D surface maps for female education and per capita income of households in village Naryab. The latitudes (easting) and longitudes (northing) values are indicated on the 'x' and 'y' axis respectively. The striking similarity between the two maps can be seen. Where female education is more, the per capita income is more and where female education is less, the per capita income is less. This spatial distribution of female education and per capita income of households indicates strong correlation between the two.

Figure 6: Spatial distribution of the female education and per capita income



Source: Author's own calculations.

Conclusions and policy implications

Spatial distribution of female education and per capita income of households in village Naryab reflects that there is a strong correlation between female education and per capita income of households. With more female education, the per capita income increases and standard of living improves manifolds. Therefore, improvement of female education statistics needs to be focused and female students should be provided with financial, moral and social support to attain respectable level of education and live respectable life.

Taking village Naryab (26000 inhabitants) as a model, the perspective explained in the paper has certain policy implications: First, female education needs to be focused in the rural areas of developing countries. For increasing female literacy rate up to 50%, construction of at least five high schools for females in a village of 25000 inhabitants may be institutionalized. Second, the linkage between per capita income, standard of living, social uplift and female education should be advertised at mass scale in the rural areas. Finally, it appears that financial aid should be provided to female students in the rural areas.

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