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Gender, Environment, and Sustainable Economic Growth

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1. INTRODUCTION

Both human and natural environment are interlinked with each other dynamically and keep this relation stable within themselves and with each other. The existence of all living organism including human being depends on the interlinkages between the physical human environment and natural environment. Natural resources and physical environment form a basis for sustainable livelihood system, in which human needs are met in the short and long run [Dankelman (2001)]. Although economic growth is an explicit goal in nearly every nation, but a wide range of independent scientific research provides undeniable evidence that the growth of the global economy is not sustainable because it consumes many of the environmental services that strengthen the production of goods and services [e.g., Houghton, *et al.* (1996); Vitousek, *et al.* (1997)]. Environmental services refer to the various ways that the environment influences production- and indeed-supports most part of human existence [Costanza and Daly (1992)]. There is a growing understanding that the degradation of environment and growth of waste materials can reduce the productivity of natural resources, as when ozone accumulates in the troposphere and lowers crop yields. This increases the quantity of human capital required to produce a specified quantity of food. The addition of wastes also slows the rate at which natural capital can process the waste material, as when sewage reduces the ability of aquatic ecosystems to process organic materials [Ayres (1996)]. There is also an increasing understanding that “economic growth does not necessarily go hand-in-hand with growth in the well-being of people”. It reflects the rising discrepancy between rich and poor and between genders in most countries [Ayres (1996)].

During past decades, the issues of gender and their relationship with environment have been internationally acknowledged, especially after the first U.N conference on environment and human settlements in Stock Home 1972. The issue of women place in relation to environment and natural resources got much notice during the U.N conference on women in Nairobi in 1985 and then during the Rio 1992, U.N conference on environment and development. It was decided during the world summit for social development in Copen Hegen 1995 that women must be involved in decision making at all level to foster sustainable

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economic development and growth [Friedlander (1996)]. As women make up more than half of world population, it is unthinkable to get the goal of sustainable economic growth and development in an economy with out considering their active participation. Their participation in economic activity justifies their role in sustainable economic growth and development. In developing countries 64 percent and in developed countries 79 percent of females are busy in economic activity. While the unpaid female workers make up 58 percent of the total family workers [UNDP (1998)]. About 60 percent of women are self employed in the informal sectors and their income generating activities directly or indirectly depend on the natural resources such as energy sources, crops, water, and non timber forest product. In North West Bangladesh women do 50 percent task of rice production [Jordan (1997)]. More over 45 percent, 60 percent, and 80 percent of consumed food is produced by the women in Latin America, in Asia and in Africa respectively. "Women work longer hours in the field than men as much as 43 percent. In the Noza sub watershed in Pakistan a Brahui woman on average works seventeen longer hours during the production season" [FAO (1997-1)]. "In the Indian Himalaya a pair of bullock works for 1604 hours, a man for 1212 and woman 3485 hours in a year on one hectare farm [Singh (1988)]. Women work varies during the year, as in Himachal Pradesh 37 percent are involved in sowing, 59 percent in intercultural, 66 percent in harvesting, 59 percent in trenching and 69 percent in trending the animals" [Bhata and Singh (1987)]. "By so doing, they contribute time, energy, skills and personal visions to family and community development and progress. Women's extensive experience makes them an invaluable source of knowledge and expertise on environmental management" [Dankelman (2001)] and sustainable growth.

2. LITERATURE REVIEW

Many studies, such as those by [Davidson and Myers (1992); Agarwal (1992); Dankelman and Davidson (1988) and Dankelman (2001)] have indicated that women are responsible for the environment care and play a predominate role in the management and use of natural resources [Davidson and Myers (1992)]. Food procurement, property and territory, fencing and care of livestock, maintenance of sanitation, physical cleanliness [Menon (1991)] provision of water, energy, and shelter protection are considered women house hold chores. In rural areas women gather fruits, edible leaves, nuts, mushroom, roots and tubers, medicinal herbs and flowers. Studies on present-day gather-hunter communities show that vegetable foods and fish make up 60 to 80 percent of the total calorie intake of the community. In spring the Brahui women in the Noza sub watershed in Balochistan (Pakistan) go out early in the morning and bring mushroom and spinach for their families which are a major source of nutrition during spring [FAO (1997), Dankelman (2001)]. According to Boserup (1989) women are more knowledgeable than men about the forest products and conservation methods of foods. During a study in Dehra Dun women provided the information of about 145 species of forest plants and their operations too [Shiva and Dankelman (1992)]. "The Brahui women in Balochistan identify 35 medicinal plants during field walks" [FAO (1997)]. A study in Northern India found that women play a major role in animal husbandry. "They harvest the crop, transport the leaf fodder, graze the cattle on distant grazing lands, carry animals to the water source for water, take care of young calves, milk the animals, clean the animal shed and execute all others

activities related to animal husbandry” [Singh (1988)]. Women are also responsible for water provision. They not only provide water for household use but also provide water for animals, crop growing and food processing. So women are responsible to carry water for hygiene and filter water for drinking. “In Sri Lanka the women walk up to 1 to 1.5 km to fetch a pot of drinking water because the level of water is lower due to commercial farming “[Wickramasinghe (1994)]. The provision of energy is another responsibility of women. Collection of fuel woods, foodstuff and fodder take many hours per day. “In Asia 73 percent, in Sri Lanka 84 percent, in Nepal 64 percent, and in Philippines 84 percent of women are involved in such activities [Wickramasinghe (1994)]. Women usually carry load up to 35 kilograms and bring these things at home by walking a distance of 10 kilometers from their homes” [Dankelman (2001)].

During 1980-1995 deforestation damaged 200 million hectares of land in developing countries [FAO (1997)]. Deforestation confines women access to and control over natural resources and increases their liabilities. So they have to work more to provide basic needs to their families. “Four to eight Km deforestation in the Ganjam areas in India increases the walking time of women from one to two hours per day to get their livelihood” [Fernandes and Menon (1987)]. “Women and children now spend 100 to 300 days to collect fire wood in some part of Himalayas and African Sahel” [Wickramasinghe (1994)].

Commercialisation in agriculture also increases women responsibilities. Transition from subsistence farming to commercial farming increases the time to work for women and reduce for men. Women role in agriculture diminished due to introduction of new technology and they have lost their control over production and access to resources [Shiva, *et al.* (1990)]. “In Sri lank commercial agriculture has increased the work load of collecting firewood; 4000kg of fuel wood is needed for curing 1000kg of tobacco. During the season of tobacco her sleeping time reduces 4-5 hour per day and 40-50 percent of the families do not use boiled water due to lack of fuel wood” [Wickramasinghe (1994)]. In addition commercialisation in agriculture and rapid industrialisation forced men to migrate to urban areas in search of high paid wages which have also increased women difficulties and responsibilities to ensure food, water and energy [Dankelman (2001)]. Similarly in urban areas women are more vulnerable to environmental conditions, her working environment is difficult, she is poor socially and politically, and her access and control over resources is limited.

From the above mentioned literature we conclude that most often women activities related to the natural resources, physical environment and ecological functions. So it is the woman who suffers more from the environmental condition changes. However, the emphasis on women as victims of the environmental problems can easily be “shifted to their roles as efficient environmental managers within the developmental process” of the economy. “The argument for the increased participation of women in environmental management has been derived from their privileged knowledge and experience of working closely with the environment” (INSTRAW)¹ and nature. Thus women should be seen as a source of solution for the environmental problems. The rest of the study is organised as under.

¹United Nations international research and training institute for the advancement of women.

3. CONCEPTUAL FRAMEWORK

Standard growth models such as those of Nelson and Phelps (1966); Lucas (1988); Rebelo (1992); and Mulligan and Sala-i-Martin (1992), have highlighted the role of human capital in economic development in the form of education attainment. A common interpretation of standard growth theory is that substitution and technical change can successfully “de-couple economic growth from resources and environmental services”(Ayres and Nair 1984). These models assume that production can be sustained with an insignificant amount of natural resources and environmental services if labour and capital can be adequately improved [e.g., Dasgupta and Heal (1979)]. A prominent result in this framework is the Hartwick rule [Hartwick (1977)], stating that production in an economy can be sustained forever simply by reinvesting the earnings from “resource extraction in people and machines, which in turn can substitute for resources”. The notion that the economy can grow sustainably forever depends in large part on the assumption that technological improvements can trim down the number of units of natural capital necessary to produce a unit of economic output [Ayres, *et al.* (1996)]. There is a considerable evidence which indicates that” substitution and technical change have reduced the quantity of many forms of energy, metals, and minerals required to produce a unit of GDP over the last fifty years” [Wernick, *et al.* (1996)]. Similarly, “some of the research on environmental Kuznets curves postulates that rising incomes eventually reduce the use of resources and the emission of wastes” [Ayres (1996)].

The models, such as developed by Lucas (1988), also emphasise the significance of human capital externalities. “The microeconomic counterpart of the aggregate human capital externalities emphasised by the new growth theorists are the “neighborhood effects” emphasised by sociologists such as William Julius Wilson and the “social capital” concept associated with James Coleman” (Katz). The experimental research by Case and Katz (1991) using data sets that join information on “individuals with the socioeconomic characteristics and behaviours of their residential neighbors, family members, and schoolmates” present reasonably powerful empirical support for the idea of important neighborhood effects in educational attainment and other events of human capital accumulation (Katz).

The study explicitly recognises the idea that human capital can substitute for services resulting from natural capital and that human capital externalities lead to efficient use of natural resources and hence to economic growth.

4. MODEL, DATA, AND METHODOLOGY

Based on the conceptual framework depicted above, this paper develops an empirical model to show that increase in human capital of women substitutes natural capital and hence leads to sustainable economic growth in Pakistan. The general framework is specified as follows:

$$GGDP = \alpha_1 HFMHK + \alpha_2 GFMLF + \alpha_3 GK + \alpha_4 GPOP + \alpha_5 GEX \\ + \alpha_6 GIM + \varepsilon_1$$

$$GFMHK = \beta_1 GGDP + \beta_2 GWS + \beta_3 GDEEC + \beta_4 GPCI + \beta_5 GFMTR \\ + \beta_6 GHNE + \varepsilon_2$$

$$GFAC = \gamma_1 GFMHK + \gamma_2 GWS + \gamma_3 GDEEC + \gamma_4 GAUC + \gamma_5 GFEIN \\ + \gamma_6 GEXD + \varepsilon_3$$

$$GFMLF = \delta_1 GGDP + \delta_2 GFAAC + \delta_3 GAUC + \delta_4 GFEIN \\ + \delta_5 GPESTICIDE + \delta_6 GPINV + \varepsilon_4$$

$$GWS = \lambda_1 GGDP + \lambda_2 GFAC + \lambda_3 GPOP + \lambda_4 GAUC \\ + \lambda_5 GPESTICIDE + \lambda_6 INDUSTRY + \varepsilon_5$$

The model is simultaneous in nature. All the variables² are in growth form, and are stationary at level. The time period is specified from 1963–2007. GDP is taken at constant prices of 1999–2000=100 base. To get GDP at constant prices of 1999–2000=100 the values of GDP are deflated with GDP deflator (1999–2000). For human capital proxy, we used female enrolment at primary, middle, high, professional colleges, arts and science colleges, secondary vocational institution and university level. Model satisfies the tests such as coefficient test,³ residual test⁴ and stability test.⁵ Model also satisfies order and rank condition of identification. As the model is over identified, we can use 2SLS and GMM technique. However, we used GMM technique because its estimated mean, variance and kurtosis follow the BLUE property.

5. RESULTS

We estimated the above model seven times at different level of education i.e. Primary, Middle, High, Secondary vocational institutions, Arts and science colleges, Professional colleges and Universities. We summaries these result as follow:

In the first regression, all the determinants affect growth of GDP in expected manner. Both growth in female-male enrolment in primary level of education (4.393815) and female-male enrolment in arts and science colleges have positive and significant impact on economic growth. Results are consistent with the theory. Increased educational attainment increases growth by three primary routes. First, education has a direct effect on growth, this direct effect is likely to be a sign of a positive outcome of a more educated labour force on an economy's ability to accept and develop new technologies. Second, improved educational attainment is linked with enhanced physical capital investment. This feature may be of more significance in the future since the ability of a nation's labour force to adopt new technologies is likely to be vital in attracting internationally mobile capital in an increasingly globalised economy. Third, a more educated population likely to have a lower fertility rate and reasonably more intensive parental investment in each child (Katz). These findings are quite similar to those of previous empirical studies such as those by Benavot (1989), Romer (1990a), Barro (1991), Summers (1992), Barro and Lee (1992) and Forbes (1998). Growth in female-male enrolment in middle education ahowever has negative sign (−4.746061). The reason is that the growth in the ratio of female-male enrolment in middle increases from 0.26 to 0.67 during our study period. When a student enrolled in middle class then he/she and his parents desire to get more

²See Appendix for variable detail.

³We used Wald test to check the over all goodness of fit.

⁴Residual test such as Jarque Bera test used to check whether errors are normally distributed or not. White heteroskedasticity test is used whether errors are homoskedastic or not. Serial correlation or Durbin Watson test is used to check the auto correlation between the errors terms.

⁵Remsey reset test is used to test the misspecification of the functional form.

education and they enter late in the labour market so their impact is negative as found in the Qaisar Abbas study (2001). Growth in physical capital stock has positive (3.147698 to 0.888786) impact on economic growth. The results are consistent with the theory that “higher rate of physical capital leads to higher rate of economic growth” and with those found by Easterly and Rebello (1993); Barro (1991); Khan and Reinhart (1990); Stephen Klasen (1999) Iqbal and Zahid (1998) and Sandarajan and Thakur (1980). The impact of population growth on the growth of GDP is (-2.206660 to -0.0451493) negative impact. This may be due the dependency burden. Growth in exports (2.808756 to 0.096290) has a positive impact on the growth in GDP. The reason is that as the export increases the foreign earning of a country increase and its trade deficit improves.

Again the coefficients of all the determinants of growth in female-male enrolments have expected signs. Estimated coefficients of growth in GDP (21.98327 to 2.362432) and growth in per capita income (14.26386 to 0.051807) are positively related to the growth in female-male enrolments (HK). It is easy to interpret that people and government have more resources to spend on education. Estimated value of growth in availability of water supply (16.62407 to 0.743264) has positive impact on the growth in female-male enrolments (HK). Similarly growth in availability of gas has a positive (23.37772 to 4.474034) impact on the growth in female-male enrolments (HK). It is understandable, studies, such as those by Davidson and Myers (1992), Agarwal (1992), Dankelman and Davidson (1988) Irene (2001), INSTRAW (1991), Wickramasinghe (1994), NEDA (1997), and Menon (1991), in different geographical settings indicated that provision of basic needs like collection of fuel wood for the sake of energy and water are often considered women liability. The provision of water and energy sources at door step considerably reduces the efforts level and time consumed in collection of fuel wood and water, hence likely to induce them to go to schools. Growth in female-male teacher ratio at different level, primary (20.13283) and middle (6.194165) has positive impact on the growth in female-male enrolments (HK). Results are consistent with Card and Krueger (1992) and Finn and Achilles (1990). These studies found that increase in number of teachers increases number of students and reductions in the pupil/teacher ratio for elementary school students significantly increase test scores [Finn and Achilles (1990)]. But surprisingly not consistent (-19.47171) at university and (-8.097736) at science and arts colleges level. Growth in health expenditure has positive (14.72657 to 4.155566) impact on female-male enrolment (HK). Again results are similar to those of Barro (1991), and Arora (2001). According to Arora, among the many causal factors of low literacy rate and disappointing growth in many economies that economists have proposed, poor health stands out as a likely candidate.

Growth in water supply also positively (20.24177 to 1.296011) impacts the growth in forest area. The coefficient of growth in female-male enrolment (HK) is also positively correlated with growth in forest area. The coefficient value (9.930294) at primary and (2.410478) at high level of education confirms the notion that increase in human capital can successfully substitute natural resources to a certain level in the process of economic growth. However the effect of primary education is greater than other levels of education. The study also confirms the arguments presented by women activists, such as Davidson and Myers: 1992, Dankelman and Davidson: 1988, Irene (2001), that women are efficient environmental managers within the developmental

process of the economy. Growth in gas consumption also has positive (6.457484 to 1.864196) impact on the growth in forest area which is understandable as availability of gas substitutes for fuel wood. Growth in area under crops is negatively (-7.772609 to -1.388513) related with the growth in forest area. Because the land is fixed and increase in area under cultivation (AUC) means a decrease in forest area. Growth in forest production is estimated positive (20.89737 to 7.659299) while growth in external debt is negative (-15.21996 to -12.92750) to impact the growth in forest area.

Both, growth in forest area (21.79566 to 13.69084) and growth in forest production have positive (5.245123 to 3.173033) impact on the growth in female-male civilian labour force. The results are encouraging as for as policy makers are concerned that preservation and growth of natural resources can contribute to eliminate rural unemployment and poverty. Growth in area under crops has negative (-7.647408 to -6.328841) impact on the growth in female-male civilian labour force. The transitional shift from traditional farming to modern farming might be the possible interpretation. Growth in GDP has a positive (4.921372 to 2.524052) impact on the growth in water supply. Growth in GDP increases spending on reservoirs and canals by the government to protect wastage and overflow of water. The coefficient of growth in population is negatively (-5.661192 to -3.493554) related with growth in water supply. Growth of industrial share in GDP also has a negative (-4.930990 to -4.260118) impact on the growth in water supply. Most of the industries contaminating fresh sources of water by throwing their wastes in the water with out any recycling processes.

6. CONCLUSIONS

Different efforts at international and local levels, studies and publications on gender and environmental subjects have been developed since the past 15 years. These studies develop theoretical frameworks and guidelines to help integrating gender and environmental aspects into sustainable economic growth and development and their inter-linkages. The data confirmed the idea of economic theory that enhanced human capital substitutes for the services derived from the natural resources in Pakistan. The improvement in human capital substantially reduced the extraction and consumption of natural resources. However study also found a strong inter-relationship between environment and human capital accumulation. The depletion of natural resources and environmental pollution inversely effect the human capital accumulation. Shortages of basic supplies, such as water, forest products, and energy diminish income generation possibilities. The families especially women suffer directly whose burdens have become heavier, limiting their access to education and worsening their health. The study highlights the need for more coordination and cooperation between organisations working in the field of environment, gender and women's empowerment. The study also proposes that introduction of time- and energy-saving devices and provision of alternative income possibilities through developing vocational and natural resources training and educational programs especially at primary and secondary levels of education is vital to promote sustainable economic growth. In addition, the provision of basic necessities, such as safe drinking water, electricity, and gas must be ensured at door step to improve human capital accumulation and to strengthen sustainable economic growth.

APPENDIX

Description of Variables

GGDP	→	Growth in GDP
GWS	→	Growth in Water Supply
GFMHK _i	→	Growth in Female-Male Human Capital
GFMCLF	→	Growth in Female-Male Civilian Labour Force
GFS	→	Growth in Forest Area
GK	→	Growth in Physical Capital
GPOP	→	Growth in Population
GEX	→	Growth in Export
GIM	→	Growth in Import
GGC	→	Growth in Gas Consumption
GPCI	→	Growth in Per Capital Income
GFMTHK _i	→	Growth in Female-Male Teacher Ratio HK _i
GHE	→	Growth in Health Expenditure
GAUC	→	Growth in Area Under Crops
GFA	→	Growth in Forest Area
GFP	→	Growth in Forest Production
GEXD	→	Growth in External Debt
GPESTC	→	Growth in Pesticides Consumption
GFDI	→	Growth in Foreign Direct Investment
GISGDP	→	Growth of Industry Share in GDP

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