ARE CLIMATE SMART AGRICULTURE TECHNOLOGIES GENDER SMART? : AN IN-DEPTH ANALYSIS USING GENDER ANALYSIS FRAMEWORKS

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Abstract: Women play an important part in agriculture, performing multiple roles of production, household and cultivation or allied activities. In rural India, almost 75% women are involved in agriculture. The past decade has seen the increasing feminization of agriculture as women are involved in all domains of agriculture. This can be attributed to a combination of factors such as male out migration for jobs due to economic necessities, climatic stresses and extremes as well as the trend towards nuclear families with small-holdings and their inability to hire labor for agricultural work. As per estimates of the World Bank in 2014, the world population is expected to increase to 9.7 billion by 2050, which, will require an additional 60% increase in food production. This will lead to increase in GHG emissions leading to further climatic changes. Therefore, in order to keep a check on the GHG emissions while increasing the food output, Climate Smart Agriculture (CSA) is desired. Such agriculture may not necessarily be women friendly and may have a negative impact on them. The present study examines and emphasizes the need for analyzing climate smart agricultural practices using the gender lens and promoting technologies, which are both gender and climate smart.

Keywords: Women, Climate Change, Climate smart agriculture, Gender Analysis

Introduction: Agriculture is the backbone of Indian economy as almost 70% of rural households derive their income from this sector. Women play an important part in agriculture and undertake activities such as crop production, livestock, post-harvest activities as paid/family labor and farm managers. Of the total female work force in rural India, 75% are involved in agricultural activities [1]. Trends show that agriculture in India is gradually being feminized because of male out migration for jobs due to economic necessities, coupled with climatic stresses and extremes [2]. The role of women in agriculture is becoming increasingly important because of greater demand for food owing to changes in demography and consumption patterns. The current world population of 7.3 billion is expected to reach 9.7 billion in 2050 [3] and meeting their food requirement will require a 60% increase in agricultural production [4]. This increased agricultural production means an increased uptake of natural resources, leading to increased GHG emissions, ultimately leading to climate change. To keep a check on this while increasing the food output, Climate Smart Agriculture (CSA) is desired. CSA may be defined as 'agriculture that sustainably increases productivity, resilience, reduces GHGs enhancing achievement of food security and developmental goals [5]. Such agriculture may not necessarily be women friendly and may have a negative impact on them. It is therefore important to examine the impact of various climate smart technologies on the empowerment of women using gender analysis frameworks. Gender analysis is a sub-set of socio-economic analyses that explores and highlights the relationships of women and men in society, and the inequalities in those relationships, by asking questions pertaining to access, control and ownership over resources along with distribution of activities performed by the two sexes. The various frameworks are The Moser Framework, Harvard Analytical Framework, Social Relations Framework and Women's Empowerment Framework. The Moser framework is used to study the impact of CSA on the fulfillment of Practical Gender needs (PGN) (freshwater, fuel, fodder etc.) and Strategic

Gender Needs (SGN) (education, skill, income, decision making), which are very crucial for women. The Harvard Analytical Framework was one of the first frameworks for gender analysis developed by researchers at the Harvard Institute for International development in collaboration with Women in Development (WID) office of USAID. This framework, analyses the type & amount of work done by males and females for the household, productivity and community. It also documents the gender differentiated access, control and ownership of assets and resources. The Social Relations Framework aims to analyze if the CSA technologies are gender negative, blind or neutral. It can also help to identify, which technologies are gender positive or transformative and which can either enhance the position of women in the family and community. Appropriate frameworks need to be chosen depending on the objectives of analysis and the data available.

Objectives: The present study has been conducted to assess the impact of CSA technologies on the role, fulfillment of goals and needs of women using selected Gender Analysis frameworks. Another objective of the study is to create evidence to show how adoption and promotion of gender smart technologies in agriculture, have the potential to reduce gender inequities and inequalities and enhance the status of women in society.

Methodology: The study has been conducted using secondary data, published in various journals and reports. The studies examining the gender dimensions of existing CSA practices being used or promoted have been considered for the present analyses. The studies highlighting the relation between the adoption of technologies and impact on the status of women have also been considered to achieve the second objective of this study.

Two frameworks were considered most appropriate for the analysis of CSA practices, namely the Moser Framework and the Social Relations Framework. The 'Moser framework' was developed in 1980's by Caroline Moser and helps in mapping the triple role of production, reproduction and community work by women vis-à-vis men. It challenges the inequality between men and women by the use of PGNs and SGNs. This helped to assess if the use of CSA technologies enabled women to satisfy their PGN or/and SGN and how it changed their status in society. The other framework, the 'Social Relations Approach' was developed by Naila Kabir in 1994, at the Institute of Development studies, UK in collaboration with policy makers, academicians and activists. The framework helps to assess if a given technology is gender positive, negative, neutral or transformative in its nature. About 20 studies on gender differentiated impacts of climate smart technologies were examined and analysed in terms of the two frameworks selected. The evidence generated by the research studies was used as input for the framework and ascertain the impact on women.

Results and Discussion: The impacts of various CSA technologies adopted across the globe were examined and analyzed in the current study. Their impacts on women as well as various components of Gender Analysis Frameworks were also examined in detail and have and been consolidated in Table I.
A study conducted in Yemen in 2015 revealed that when water harvesting reservoirs along with biogas plants were used by farmers to cope up with the water shortage it impacted women positively. Since women were spending a large amount of time and energy in collecting water and fuelwood for the household, they missed out on skill development opportunities available in the community. The time saved from water and fuel collection, was gainfully utilized by the women in other income generating activities. Hence, the adoption of the technology of water harvesting led to multiple benefits of helping families to save and conserve water, making irrigation easier, enhancing crop productivity and income as well as enhancing the socio-economic status of women in the society [6]In a similar study on creating water harvesting structures conducted in Rwanda on 200 beneficiaries of which 62 % were women, it was found out that the women's increased access to water at closer locations led to enhanced crop production and income. The free time generated resulted in increased participation of women in various community organizations bringing various benefits to women [7]

A study conducted in Maharashtra on Direct seeded rice with drum seeders, pointed out that the technology has a mixed impact on different categories of women as the technology changed the entire

rice plantation process by eliminating the need for transplantation. The reduced need for labor and time invested in transplantation led to a positive impact on the land owing women as it reduced their drudgery involved in poor posture, back pain and high chances of gynecological and other infections due to constant standing in water. On the other hand, women laborers employed in transplantation had to lose their jobs and were negatively impacted by the technology. Though the technique helped reduce women's drudgery and relieved them from severe health problems but it rendered them jobless without any alternative forms of employment [8] Similar results were observed when in Vietnam, the direct seeded rice technology had a mixed impact on women but in both the cases, women laborers were rendered jobless without any alternative forms of employment [9].

Table I: Gender Analysis of Various CSAP using Multiple Gender Analysis Frameworks

Technology (Author and year)	Impact of Technology	Impact on Gender	Gender Analysis Framework	
			Moser Framework	Social Relations
Rain Water harvesting [6],[7]	Saving of water & labor, better irrigation availability throughout the year especially during dry spells, economic gain	Saving of time and energy, enhanced income round the year	The resources of time, energy and money can be used to fulfill PGNs and/or SGNs	Gender positive, could be gender transformative
Direct Seeded Rice [8] [9], [10],	No transplantation required, lowered GHG emissions, reduced labor (time and energy) requirement, increased health benefits for women	Reduced drudgery no back pain and gynecological infections, more time available to women, economic benefits	The saved time, energy and money can be used to fulfill PGNs and/or SGNs	Gender transformative for land owning women; negative for laborers
Drip irrigation [11]	Saves water, better irrigation facilities, higher output, economic gains	More money available to the household	Can be used to meet PGN and SGN	Gender positive
Zero tillage [10],[11]	Saves labor, time and energy. Caused health problems and increased work burden	Time and energy saved can be used for other activities	Can be used to meet PGNs and SGNs	Gender transformative for land owning women; negative for laborers
Bio gas (Clean fuel) [6],[11]	Saves time, labor and fodder. Reduced GHG emissions	Reduced drudgery of women, lowered GHG emissions, saving of time and energy, improved health condition	Time and energy saved can be used to meet PGN and SGN	Gender positive and transformative
Agroforestry nursery [11]	Sapling growth led to increased farm work along with household	Increased burden of on farm activities but offset by increased income	Money can be used for better education and nutrition of	Gender transformative as it enhanced status of

	work though leading to increased income		family	women
Site specific nutrient management [6],[11]	Increased incomes, yields and reduced costs of fertilizers. Enhanced entrepreneurial skills.	Increased socio-economic status and self-confidence of the women	Can be used to meet PGN and SGN,	Gender positive and transformative
Conservation Agriculture [11]	Sustainable agricultural methods	Reduced GHG emissions, increased income	Can be used to meet PGN and SGN	Gender positive

The Zero tillage technology is an important climate smart technology since in the long run, it leads to an increase in the agricultural production. It not only reduces the amount of inputs required but also saves money due to less labor requirement. In Brazil, it was found that this technology had a mixed impact on women. The use of this technology led to benefits for farm owning women due to increased finances in terms of reduced labor and input costs, but for the women laborers, it increased their work burden which was already significantly on a higher side. This was because use of zero tillage led to increase in growth of weeds and additional time and energy as weed management was to be performed. Though, this provided an additional income to women laborers, it also led to severe health issues for these women as they had to sit in the same uncomfortable posture for a longer period of time [11].

In a study conducted in Guangxi province of China, where human and animal waste, were converted into methane for use for lighting homes and for cooking food, the activity directly benefitted women. This action not only reduced GHG emissions but also reduced poverty as the average work load of women reduced by 60 days per year by not having to spend time collecting fuel wood. This time was instead invested in raising livestock, improving crop produce which increased the income. This study also shows that climate smart activities extended to the home because of multiple roles performed by women[6],[11]

As a part of a training session on CSAP, 1150 women in Tanzania and Kenya were trained in Agroforestry. The project was a huge success as the saplings provided in nurseries run by these women were in huge demand. This intervention increased the socio-economic status of women by giving them more money and value in the family and society. At the same time, it also increased the work burden of women on the farm in additional to their household duties. The same study has also documented that despite increased work burden, women were happy with the technology and were willing to practice it the increase in their income compensated for the work burden. Besides, the women could spend additional money on providing better educational facilities for their children [11].

The use of Urea Deep Placement technique (UDP) in Bangladesh, led to an increase in farmer's incomes owing to increased yields and reduced costs of fertilizers. This site specific nutrient management consequently also led to opening of approximately 2500 new small briquette making enterprises in the region, majority of which were owned by women, as the demand for briquettes increased. The number of on-farm jobs has also increased as the briquettes were made by hand, which required 6 to 8 days of labor per hectare of land. The women benefitted by increased on farm employment and by entrepreneurial activity [11].

In Zimbabwe, to reduce the impacts of economy failure, multiple extension programs were launched to make the farmer aware about sustainable production methods. Methods such as conservation agriculture, were promoted and the public agricultural extension service was strengthened. Within the project region, up to 68% of all households were led by women. The project led to increased

productivity on farm, better harvesting methods thus enhancing the harvest of grain and vegetables. By the end of the project around 56% of the female-headed households started marketing the grains and vegetables as they produced more crops than needed for self-sufficiency and thus were gaining additional income. Due to sustainable production methods, food security was enhanced and the production risks were also reduced. [11].

Conclusion: Gender is a critical dimension of CSA. The last decade has seen the participation of women in all spheres of agriculture including pre and post-harvest stages and this trend is likely to continue. At the same time women continue to fulfill their traditional roles of the household, reproduction and child care as well as participate in community activities and networks. It is important to examine that the new technologies do not create undue, unmanageable and unsustainable burdens on women without benefitting them. Some technologies have a differential impact on different classes of women, the interest of the poorest need to be looked into. When time and energy are saved, drudgery is reduced; women can spend the same on fulfilling their household chores, child care or else taking up income generating activity if opportunities are available. When income is enhanced, it can lead to better food and education of children and families leading to better human resource in future.

Since women farmers are most often neglected and excluded from extension services, but are responsible for the food security of the family, it is very important to educate and train them in modern agricultural technologies which are not only climate smart but also gender smart. These technologies should not only be gender positive but transformative in nature, so that they help women fulfill their PGNs and work towards achieving their SGNs. Such efforts have the potential to reduce the gender-based inequities in society and ultimately empower women.

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