



# Does climate-smart village approach influence gender equality in farming households? A case of two contrasting ecologies in India

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## Abstract

Evidence from climate-smart village (CSV) approach to mainstream climate-smart agriculture (CSA) demonstrates improved productivity, income, and reduced climatic risks. However, its contribution to gender empowerment in diverse farming households is not documented. This study creates a Gender Empowerment Index for climate-smart villages (GEI-CSV) based on four major measurable indicators—political, economic, agricultural, and social. The gender gap was derived by mapping difference in empowerment levels across selected CSVs and non-CSVs. These indicators can be used as a vital tool to understand the process of gender empowerment that can trigger the entry points to achieve gender equality, which is also an important aspect in the adoption of climate-smart agriculture practices (CSAPs). The study measures empowerment at the inter-household and intra-household level across CSVs and non-CSVs from the individual household survey with both female and male members of the same household. This paper provides evidence demonstrating how gender empowerment differs in CSVs and non-CSVs from selected climate-smart villages (community-based approach) in two contrasting ecologies and socio-economic settings of India. The study documents the existing gender gap in CSVs and non-CSVs across India's western (Haryana) and eastern (Bihar) Indo-Gangetic Plains (IGP). Irrespective of CSVs and non-CSVs, considerable differences in outlook and gender gap were observed between Bihar and Haryana. Both women and men in Bihar are less empowered than they are in Haryana. High empowerment level in CSVs than non-CSVs shows that the concept of CSVs has brought a change towards knowledge and capacity enhancement of both women and men farmers promoting gender equality in farming households with a varying scope of interventions made and required for scaling CSAPs across the diversity of farming households.

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## 1 Introduction

South Asia is a densely populated and extremely vulnerable region to climate change, which faces multiple challenges for food security and stability for the livelihoods of millions of people (IPCC 2007). Millions of the South Asian population is expected to get affected because of 2–4% of temperature increase in the region leading to water stress, loss of yields, and other climate disasters (IFAD<sup>1</sup>). Under the emerging scenario of growing climatic risks, appropriate technological solutions together with empowering social environment are prerequisite for ensuring food and livelihood security. A large-scale adoption of technologies and practices to adapt to climate risks will require social inclusiveness accompanied by technological development, refinement, and dissemination.

Farmers in India are mainly men, although women also play an important part in agricultural activities (Lal and Khurana 2011). According to the 2011 census, the percentage share of male as cultivator and agricultural laborer workforce is 50% of the total male in the workforce while that of women is 65.1%. Participation of women in agricultural activities is increasing over time; however, women's access to available technical exposure, experience, and training is limited, which affects their capacity and limits opportunities for them to contribute to farming decision-making. In addition, rural women have less access and control over resources in comparison to men, who have more access to credit, extension, farm inputs (e.g., seed supply), market services, etc., a result of gender inequalities in agricultural production and socio-economic development in India. Addressing the constraints faced by women and accentuating their empowerment is required to achieve sustainable agricultural production and inclusive economic growth (ICAR 2011). Gender empowerment, identified as one of the key Sustainable Development Goals (SDGs) of the United Nations, is given major emphasis globally. The studies by several researchers across different crops, agriculture commodities, and farming systems in India (Das et al. 2015; Chayal et al. 2013; Waris and Viraktamath 2013) have identified the importance of gender empowerment in agriculture and found that a large gender gap in agriculture exists in India.

In the Bihar and Haryana states of India, climate-smart villages (CSVs) have been developed and piloted by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) to test and validate several climate-smart agriculture (CSA) options for managing climate-related risks and promote gender equality in agricultural production. The CSV approach adopts a wide range of interventions that cover the full spectrum of farm activities in the category of “water-smart” technologies (e.g., direct seeded rice, precision land leveling, bunding, micro-irrigation); “nutrition smart” (e.g., Nutrient Expert decision support tool, Green Seeker, legume integration); “carbon and energy smart” (e.g., no-tillage, residue management); and “weather and knowledge smart” (e.g., weather forecast, index-based insurance, ICT-based agro services). The portfolio of interventions is customized as per the local needs of farmers and villages (CIMMYT-CCAFS 2014; Jat et al. 2015, 2016; Jat 2017). The objective of such interventions is to generate the adaptive capability of households, enabling them to mitigate the risk of climate change. Since most of the households in the villages are still agriculture-based, interventions are largely targeted

<sup>1</sup> <https://www.ifad.org/documents/10180/55aca6fe-7127-4c48-b63d-13cfd7766527>

towards improving productivity and reducing losses due to climatic uncertainty (Mehar et al. 2016; Mittal 2016). CSA not only aims to sustainably increase productivity and profitability but also raise awareness among the farming community in relation to climate change and its effect on agriculture, thereby empowering them to adapt to projected climate-linked changes and risks (Jat 2017). As climate change disproportionately affects poor and socially marginalized groups such as women due to their lower adaptive capacity (HLPE 2012), understanding how the CSV approach helps address the varying challenges that women face to adapt to climate change is an important dimension.

To date, studies focused on understanding gender equality issues in climate change adaptation are limited. Studies (e.g., Udry 1996; De Groote and Coulibaly 1998; Agarwal 2003; Chen et al. 2011; Fletschner and Mesbah 2011; Mittal 2016; Mehar et al. 2016) have shown that women's participation in political, economic, social, and agricultural domains is confined, inhibiting their empowerment and contributions through informed decision-making, thereby restricting gender equality. This emphasized that political and social participation is an important aspect in the adoption of technologies and thus capturing that change is also important. In the context of development strategy, participation in the process of decision-making and having access to inputs and resources can be a means to empowerment. Promoting participation leads to a change in social and cultural barriers which creates a conducive environment for empowerment (Narayanan 2003). Participation creates capacity in people to be involved in the decision-making process and as an implication, it creates empowerment Cornwall and Brock (2005).

Within the CSV approach, it is believed that the technologies and practices for climate change adaptation will be successfully adopted if women in the farming households are equally aware, participate, and empowered to adopt the technologies (Huyer et al. 2015; Huyer 2016; Mehar et al. 2016). However, such assumptions are yet to be verified. Given that climate change has varying effects on diverse groups it is important to understand how community-based approaches to climate change adaptation, such as the CSV approach, affect the decision-making capability of individuals in climate change adaptation (Mehar et al. 2016; Dankelman 2010). Access and control over resources across gender is vital in mainstreaming CSA interventions. To effectively scale CSA interventions using the CSV approach, active participation and empowerment of women in tandem with their men counterparts are essential. Within this framework, the main objectives of our study were as follows: (i) to understand the empowerment of women and men in CSV and non-CSV locations across contrasting ecologies using specific political, social, economic, and agricultural participation indicators; (ii) to create a gender empowerment index and document the difference in gender empowerment among CSV and non-CSV; and (iii) to understand the gender equality among households in the CSV and non-CSV. The study seeks to analyze if the CSV approach can lead to the better empowerment of both women and men across the political, social, economic, and agricultural domains and if it can contribute to gender equality. The data in the study is captured in the form of participation. Empowerment in the study is reflective of the process and mainly implies a better participation in the decision-making process. Participation in decision-making and opportunities is gender equality is captured in the study to showcase that both women and men in the households have equal opportunity to participate in different activities and play role in decision-making.

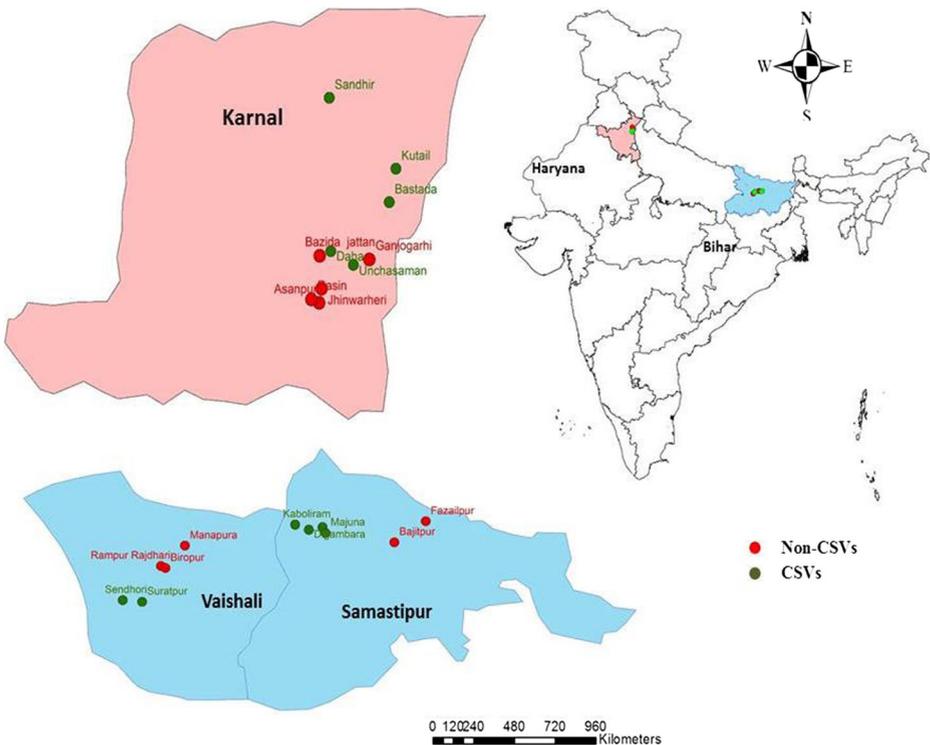
## 2 Data and methodology

### 2.1 Study location

The survey was undertaken from randomly selected climate-smart villages and non-climate-smart villages in Haryana (western Indo-Gangetic Plains) and Bihar (eastern Indo-Gangetic Plains (IGP)). Figure 1 shows a map of the study locations. Haryana and Bihar are the chosen locations under the CCAFS project to study the long-term impact of CSA interventions to mitigate the risk of climate change. These two geographies are vulnerable to climate change. In both states, annual temperatures are projected to rise by 1.5 to 2.5 °C in 2030 (Chaturvedi et al. 2012). However, the two states have contrasting agro-ecological conditions and agricultural activities (Jat 2015).

### 2.2 Methods of data collection and analysis

A simple random sampling method was used from both the categories of villages and details of the villages and number of households from CSVs and non-CSVs are given in Table 2. The information on the participation of women and men of the same in different domains was collected separately using a structured questionnaire. The survey was conducted using a team of two women and four men enumerators in each location to ensure that we are able to capture the responses of women respondents appropriate. But due to cultural construct, the no response



**Fig. 1** Study sites in two contrasting geographies (Haryana and Bihar, India)

rates of women respondents were very high. The survey instrument was prepared after conducting two focus group discussions (FGDs) separately for women and men in each location separately for CSVs and non-CSVs. The FGD has 10–12 participants and was crucial in identifying the domains that are included in the questionnaire and assigning the weights for each domain. We compare and map the change in access and control perceived by women and men after 4 years of CSV (2015) interventions. Additionally, we map the status difference of interventions, initiated in 2012. The survey was conducted in 150 households in Haryana and 122 households in Bihar.

Two indexes Global Gender Gap Index (World Economic Forum 2014) and woman empowerment in agriculture index (WEAI) of Alkire et al. 2013 were referred as guidelines to construct the gender empowerment index (GEI-CSV) in this study. The conceptual framework of these studies was used to fit into the context of the concept of climate-smart villages to come up with the most representative domains.

Based on this the study built the empowerment index around these four domains- political, economic, social and agricultural sector (Table 1), and weights were assigned to each domain to understand the level of participation by women and men in the household. The domains used for the study and weights assigned to them are political (0.1), economic (0.3), social (0.3), and agricultural (0.3).

**Table 1** The four domains of gender empowerment index

Domain	Code	Indicators	Weight
Political (P)	p1	Independent right to vote	1/2
	p2	More participation in village level decision making	1/2
Economic (E)	e1	Improved earning opportunity	1/2
	e2	Improved skill set and capability to work	1/2
Social (S)	s1	Increase access to credit/KCC/bank and its facilities	1/8
	s2	Improved participation in the decision on spending money for agriculture	1/8
	s3	Improved participation in the decision on spending money on home expenses	1/8
	s4	Improved participation in decision on spending money on child education	1/8
	s5	Better control of money for education for children	1/8
	s6	Better control of money For health for family	1/8
	s7	Better access to a mobile phone	1/8
	s8	Better access to insurance	1/8
Agricultural (A)	a1	Better awareness that climate variability can be a risk to agriculture	1/17
	a2	Better access to information to manage agricultural risk	1/17
	a3	Better information on nutrient application	1/17
	a4	Better access to nutrient application practices	1/17
	a5	Improved soil/land quality	1/17
	a6	Improved water use efficiency	1/17
	a7	Better access to improved seeds	1/17
	a8	Better access to quality inputs	1/17
	a9	Increased use of weather-based insurance/crop insurance	1/17
	a10	Better access to machines	1/17
	a11	Better access to markets (input and output)	1/17
	a12	Better participation in the sale of livestock products	1/17
	a13	Better participation in training/workshops/seminars	1/17
	a14	Better crop diversification/ any change in cropping pattern	1/17
	a15	Improved role in decision-related to change in cropping pattern	1/17
	a16	Better access to information through mobile-based agro-advisories	1/17
	a17	Improved income through selling output	1/17

The weights assigned for each indicator are based on the responses gathered during the FGDs which was conducted separately for women and men, before conducting the household survey. These domains are subdivided into different indicators referring to the domain and the indicators were further divided into subsections. The domain like political participation is given a lower weight of 0.1 because there is no evident gender inequality in political participation. In the context of India and our study locations, female and male have equal right to vote and to contest for any political position. From the FGD's, it was evident that both women were equally participating in the election process and were holding political positions as well. In locations where this equality does not exist, the weights to this domain can be higher.

Within the concept of CSV, the most prominent focus is given to the agricultural technologies and management practices. These are likely to have the maximum influence on the agricultural participation of the respective households. Thus, the conceptualization of the index domain of agricultural participation is much more comprehensively represented.

The participation responses of women and men in the households were captured using a five-point Likert scale, accepted universally for different indicators in each domain. The response options cover both positive and negative aspects of the questions asked, responses are comparable across different questions, easy to understand, construct, score, and analyze (Johns 2010; Miller and Wolf 2008). The individual items in the Likert type scale have five alternatives, which are coded as follows: strongly disagree-1, disagree-2, neither agree nor disagree-3, agree-4, and strongly agree-5.

The questions in the survey were formulated in a way to capture the change in the participation of the respondent over time between 2012 and 2015. Thus, in the analysis, we rescaled the responses given on the five-point Likert scale to three indicators as reduced, unchanged and improved. The Likert items of the sub-sections of different indicators are summated and rescaled by using the average values for the indicator for further analysis (Bard and Barry 2000; Johns 2010). The participation in the different indicators are rescaled as reduced (for strongly disagree and disagree), unchanged (for neither disagree nor agree), and improved (for agree and strongly agree) and tabular analysis is performed.

These rescaled groups are used to understand the change in the participation of women and men in CSV and non-CSV across the four domains and two locations. This was further used to create a gender empowerment index (GEI-CSV) and document the difference in gender empowerment among CSV and non-CSV. These methods are used to meet the objectives 1 and 2 of the study.

The responses for each indicator were recorded as 1 (either agree or strongly agree) and others are coded as 0. Finally, the Gender Empowerment Index was calculated as the summation of the weighted domains as:

$$GEI = (0.1 * \sum P) + \left( 0.3 * \sum E \right) + (0.3 * \sum S) + (0.3 * \sum A)$$

where:

$$\begin{aligned} \text{Political, } \sum P &= \sum_{i=1}^2 p_i, \text{ Economic, } \sum E = \sum_{i=1}^2 e_i, \text{ Social, } \sum S = \sum_{i=1}^8 s_i, \text{ Agricultural, } \sum A \\ &= \sum_{i=1}^{17} a_i. \end{aligned}$$

After generating the GEI-CSV, women, and men in the households with index values more than 0.8 were categorized as empowered as they meet the minimum required adequacy level of being empowered and others are categorized as less empowered (Alkire et al. 2013). The minimum Likert scale value for empowerment is 4 out of 5. As we made the index from the Likert scale, the minimum required value is 0.8 (4/5). Our results were then used for tabular analysis.

For the third objective of the study, we calculated the gender equality. For this among women and men in the households, women-headed households were excluded from the data and for all the other households the GEI-CSV of women was subtracted from GEI-CSV of men. The resulting values are regrouped into three categories as equality less than men (values more than 0.1); equality more than men (values less than  $-0.1$ ); and equality at par with men (values between  $-0.1$  to 0.1). The recoded variable is further explained using tabular analysis.

### 3 Results and discussion

#### 3.1 Data- descriptive analysis

Most households in both Haryana and Bihar were male-headed households (Table 2). The average age of men in the households of CSVs in Haryana was 42.1 and the average age of women was 38.5. In the non-CSVs of Haryana and in both CSVs and non-CSVs of Bihar, the average age of men was more than 45 years and the average age of women was more than 40 years. The majority of women respondents in both CSVs and non-CSVs were illiterate. Low literacy levels can have a considerable impact on the potential for empowerment of women in the households of both the states. Additionally, India's caste system, which divides people into different social stratifications, placing them in a hierarchy, plays a significant role in gender equality. The households in both CSVs and non-CSVs in Haryana were mainly from the general category (cast), whereas in Bihar most households belong to Other Backward Caste (OBC) and some households from Scheduled Caste (SC), Scheduled Tribe (ST) and Muslim communities. Caste has a major impact on the participation of women in activities under the different domains considered in the study, as respondent women belong to culturally and socially differentiated households. The area owned and operated (including leased-in) by the households from CSVs and non-CSVs is much higher in Haryana than that of Bihar. The small operational land holdings in Bihar can hinder the easy adoption of climate-smart agricultural practices (CSAPs). Thus, there is a need to develop a framework for land integration to avail advantage of CSAPs. In most of the households in Bihar from the general category and in some of the households from the Other Backward Community (OBC), classed between traditional upper castes and the lowest castes, women refrained from responding to the survey. Although they made joint decisions with men in the household regarding economic and social activities mentioned in the survey instrument, the existing social norms kept them away from performing such activities and their role in the household is limited to household chores and doing agricultural activities. As a result, we had several non-respondents of survey in Bihar. This implies that the present results might not be conclusive about the group of households who did not responded.

Levene's test of equality of variance for homogeneity was conducted on the samples of CSV and non-CSVs and it is found that the samples are homogeneous. An independent  $t$  test is conducted for continuous data for testing the means of two samples. Only the average age

**Table 2** Descriptive analysis of survey data

Parameters	Haryana (150)				Bihar (122)			
	CSV (75)		Non-CSV (75)		CSV (65)		Non-CSV(57)	
Type of household	MH	FH	MH	FH	MH	FH	MH	FH
Percentage share	100	–	97.3	2.7	86.2	12.3	91.2	8.8
	M	W	M	W	M	W	M	W
Average age (Years)	42.1	38.5	45.8	42.4	45.2	44.4	48.0	43.0
Literacy level (percentage)								
Illiterate	24	32	20	44	12.3	15.4	5.3	31.6
Primary (until 5th grade)	14.7	21.3	13.3	17.3	12.3	15.4	22.8	22.8
Secondary (until 10th grade)	41.3	28	46.7	30.7	26.2	20	35.1	26.3
Senior secondary (until 12th grade)	9.3	8	8	4	27.7	3.1	28.1	7
Graduate and above	10.7	10.7	12	4	20	6.2	7	–
Caste/Religion of the household (percentage)								
General	97.3		97.3		49.2		24.6	
OBC	–		2.7		41.5		52.6	
Scheduled Caste	–		–		–		14	
Scheduled Tribe	–		–		1.5		–	
Muslim	1.3		–		4.6		5.3	
Average owned land (acres)	7.7		6.1		3.8		3.2	
Average operated land (acres)	11.8		11.3		3.1		2.8	

MH, male-headed household; FH, female-headed household; M, men; and W, women

variable for women and men were significant at 10% and 5% significance level respectively. For the categorical variables, the CSVs and non-CSVs are compared using the chi-squared test for two samples, the literacy level of men and Caste variable are found significant at 10% and 5% significance level respectively.

### 3.2 Participation of women and men in different activities in CSVs and non-CSVs

The gender empowerment measurement of UNDP<sup>2</sup> has shown an improvement in the index for Bihar but a slight decline for Haryana between 1996 and 2006. Economic participation domain of the GEI-CSV has shown improvement for both the states. Similar trend is shown by Bansal, 2017<sup>3</sup> that compares between 2015 and 2005. In the present study, the emphasis is on the participation in decision-making related to agricultural sector with focus on intervention of CSA. The UNDP and Bansal Index do not take account of the agricultural domain and thus the GEI-CSV helps to measure empowerment better in context of agricultural households.

The participation of women and men in the different activities in the households of CSVs and Non-CSVs in both states are given in Table 3. Overall, men exhibit a better index level for all the activities, but the situation is much better in CSVs between the periods 2011 and 2015. The men in non-CSV displayed reduced participation in activities other than political participation. Women in both CSVs and non-CSVs showed an improved level of participation in political, social, and agricultural activities over the time 2011–2015. However, for women in non-CSVs, their level of participation in economic activities has not improved. Information regarding the participation of women in different activities is not available from a number of households in both CSVs and non-CSVs, but in the given information, most of the women have responded an improvement.

<sup>2</sup> [http://www.undp.org/content/dam/india/docs/gendering\\_human\\_development\\_indices\\_summary\\_report.pdf](http://www.undp.org/content/dam/india/docs/gendering_human_development_indices_summary_report.pdf)

<sup>3</sup> <https://www.hindustantimes.com/interactives/women-empowerment-index/>

**Table 3** Participation of women and men in different activities in the households in CSVs and non-CSVs

Type of participation	Percentage of women and men in households that observed change between 2012 and 2015							
	Reduced		Unchanged		Improved		No information	
	Men	Women	Men	Women	Men	Women	Men	Women
CSV (150)								
Political	2.9	4.3	6.4	2.1	87.1	65.0	3.6	28.6
Economic	9.3	6.4	0.7		82.9	59.3	7.1	38.6
Social	2.1	2.1	0.7		90.7	59.3	6.4	38.6
Agricultural	9.3	5.0	1.4	0.7	84.3	60.7	5.0	33.6
Non-CSV (132)								
Political	2.3	0.8	4.5	5.3	85.6	65.9	7.6	28.0
Economic	55.3	20.5	7.6	44.7	31.8	3.8	5.3	31.1
Social	19.7	12.1	2.3		72.0	53.8	6.1	34.1
Agricultural	20.5	11.4	6.4		74.2	57.6	5.3	31.1

The figure in the parentheses is the number of households

Test of independence of categories using chi-squared test was done with the alternative hypothesis that there is an association between CSVs and non-CSVs related to improvement in the type of participation. The results show that for men, economic and social participation was significant at the 1% level, and agricultural participation at 5%. For women, political participation is significant at the 10% level and economic and social participation at 1% level

Although there is an improvement in the participation of women and men in different activities in CSVs, there are differences in the level of participation between the states (Annexure 2). In Haryana, the reduced participation of men in the non-CSVs is observed for economic activities. In all other activities related to political, social, and agricultural participation, the men in the non-CSVs are at par with the CSVs in Haryana. The men in non-CSVs of Bihar reported that their participation in economic activities and social activities were reduced in the year 2015 in comparison to 2011. The share of participation in different activities clearly indicates that the participation of men in different activities from 2011 to 2015 improved more in CSVs than the non-CSVs.

The women in the CSVs of Haryana improved their level of participation in all activities although only 12% of women felt that their level remained unchanged in economic activities. Similarly, women in non-CSVs in Haryana improved their participation in political, social, and agricultural activities. However, a major proportion of women in this group did not experience any change in their participation in economic activities in the households and 14.7% of the women reported a reduced level of participation in the same activities. In Bihar, the level of participation of women in agriculture and household economic and social activities are limited. The woman mainly participates in agriculture if the male in the household has migrated or if she is a widow. The men in most of the households in Bihar reported that although women make joint decisions with men regarding economic and social activities, their participation on the farm is limited to household chores. Although the participation of women in both the category of villages in Haryana cannot be compared with Bihar, there is a slight improvement in the level of participation of women in CSVs in Bihar (?) in all activities, compared to the 2011 level, offering hope for further improvement in participation levels in different activities by women in CSVs of Bihar.

### 3.3 Women empowerment in the CSVs and non-CSVs

A Gender Empowerment Index (GEI-CSV) ranging from 0 to 1 was created to categorize the women and men in the households in the CSVs and non-CSVs of Haryana and Bihar. The higher level of the index shows a higher level of empowerment. A level of adequacy is determined to further categorize them as more empowered and less empowered. The level of adequacy determined is 0.8 on the index scale, which includes women and men from those households if they agree that they have improved the level of participation in respective indicators for different domains, including political, economic, social and agricultural. The comparison of gender empowerment among men and women in Haryana and Bihar are shown in Fig. 2. The men in Haryana are more empowered than the men in Bihar as their increased level of participation in all activities is taken into consideration in the study reveals. Similarly, the women in Haryana are better off than the women in Bihar. The households with an empowerment index of 0 for men in Bihar are those to which men have migrated. Similarly, the empowerment index is 0 for women in the households of Bihar where no information is available regarding their participation in political, economic, social, and agricultural activities. The women in 52% of the households in the CSVs of Haryana show better levels of empowerment when compared to a level of non-empowerment in the households of non-CSVs in the state (Annexure 3). In the case of Bihar, the women in both CSVs and non-CSVs are not adequately empowered.

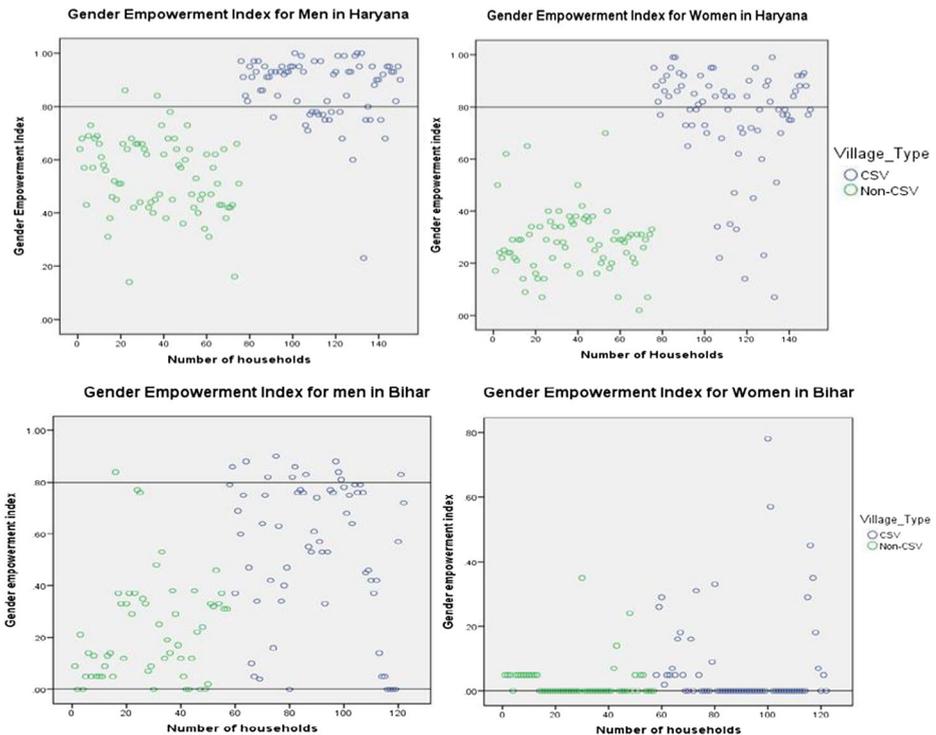


Fig. 2 Gender empowerment index for women and men in Haryana and Bihar

### 3.4 Gender equality in the households of CSVs and non-CSVs

Gender equality in each household was measured by subtracting the GEI-CSV of women from the GEI-CSV of men. Those households with migratory men were not considered while calculating the gender equality in the household. The results were then grouped into three categories as equality less than men (value more than 0.1), equality more than men (value less than  $-0.1$ ) and equality at par with men (values between  $-0.1$  to  $0.1$ ). The details of the results are given in Table 4. In the CSVs of Haryana, 36.1% of women in the households who were less empowered were at par in gender equality with the men in the household whereas in the households where women were more empowered the gender equality too is on the higher side. There are 76.9% of households where women have equal status with men. Women in a small share of households enjoyed higher status than men in their households in the CSVs of Haryana. In the less empowered households in the non-CSVs of Haryana, the majority of women have lesser benefits when compared to their counterparts. The situation in Bihar is different from Haryana, as most households have women and men who are relatively less empowered in both CSVs and non-CSVs compared to Haryana. The parity of women in both CSVs and non-CSVs are due to the lesser benefits enjoyed by the households in these villages. Although marginal improved financial decision-making and access to markets were observed among women in CSVs in Bihar. Overall, it can be inferred that gender parity is better in the households of CSVs of Haryana when compared to CSVs of Bihar. The equality in Haryana is related to empowerment of women. Whereas gender parity is not a positive thing in Bihar, since both women and men are disempowered or less empowered.

## 4 Conclusion

Climate-smart agriculture (CSA) within the CSV is an integrative approach<sup>4</sup> to address the interlinked challenges of food security and climate change, that explicitly aims for sustainably increasing agricultural productivity, to support equitable increases in farm incomes, food security, and development. Gender and social analysis are critical to achieving desired development outcomes of increased production, improved outcomes for poverty alleviation, increased well-being for all, and a fairer distribution of burdens and benefits in agriculture among women and men. With a strong emphasis on inclusiveness, climate-smart village approaches lead to the identification of more appropriate CSA responses based on women and men's differing farming needs and constraints. In the CSV approach, CSA benefits are more likely to reach different household members in both male- and female-headed households.

In this context, this study aimed to find out the level of gender participation and empowerment in the CSV villages between 2012 and 2015. Both the states that are studied showed an increased economic participation of women in CSVs and political, social and agricultural participation of women from across Haryana. A slight improvement in economic, social, and agricultural participation is also visible in the CSVs of Bihar. To an extent, fostering change on gender equality contributes to the improved skill set and capacity development of women in the interviewed groups.

The evidence of benefits from CSA interventions in the CSV approach is seen in the analysis. The measurement of empowerment using the GEI-CSV can be further strengthened if

<sup>4</sup> <https://csa.guide/csa/climate-smart-villages>

**Table 4** Gender equality in the households of CSVs and non-CSVs

State	Type of village	Level of empowerment	Level of gender equality	Percentage of households	
Haryana	CSV (75)	Less empowered (36)	More than men	0	
			At Par	36.1	
			Less than men	63.9	
			No information	0	
			More than men	7.7	
	Empowered (39)	At Par	76.9		
		Less than men	15.4		
		No information	0		
		Non-CSV (75)	Less empowered (75)	More than men	2.7
				At Par	12
Less than men	85.3				
No information	0				
Empowered (0)					
Bihar	CSV (65)	Less empowered (24)	More than men	8.3	
			At Par	12.5	
			Less than men	58.3	
			No information	20.8	
			Empowered (0)		
	Non-CSV (57)	Less empowered (19)	No information (41)		
			More than men	0	
			At Par	63.2	
			Less than men	15.8	
			No information	21.1	
Empowered (0)	No information (38)				

The households with women empowerment are absent in the CSVs of Bihar and non-CSVs of both Haryana and Bihar. The figures in parentheses represent the number of households

the data is recorded at the baseline stage and is progressively measured over years of the interventions. This will also help to introduce corrective measures during the project interventions to create faster outcomes.

Based on GEI-CSV, we witnessed better gender equality with cases of households having high women empowerment than men in Haryana CSVs. However, Bihar denoted a lesser number of women empowerment, which could be attributed to the overall low level of empowerment across the state. The underlying factors leading to a lack of participation of women in decision-making in Bihar can be attributed to low literacy levels and social hurdles encountered in social, economic, and agricultural participation. On the other hand, we observed a decline in agricultural participation in non-CSVs and an increase in CSVs, to influence farmers to continue and improvise farming, although marginal improved financial decision-making and access to markets was observed CSVs in Bihar among women as compared to Haryana. The concept of CSVs has brought a perceptible change in participation in economic and agricultural activities which is a catalyst for their empowerment for both women and men farmers, promoting gender equality in farming households. Any change or empowerment is slow, and it is observed in the results that the women who were initially empowered get a greater benefit of the CSV approach. This approach has the capability to further improve role for women in agriculture and can create an impact of the designed interventions in the CSVs.

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