Assessment of agricultural sustainability – a study of farmers growing basmati rice under conventional and fair-trade systems in India

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Abstract: The agricultural sustainability at grass root level in India is under increasing debates, discussions and demonstrations with reasonable evidence towards economic vulnerability, environmental degradation as well as social disharmony. Initiatives like fair-trade are bringing agri-produce of organised farmer groups on premise and proclamation of making greater contributions towards sustainability. This research paper endeavours to identify most relevant factors and indicators for assessing the sustainability and compare for farmers growing basmati rice under fair-trade as well as conventional system. Primary data was collected on a self-administered questionnaire based on identified four factors of sustainability, i.e., economic, environment, social and governance, from farmers growing basmati rice under both, conventional and fair-trade systems. Data was analysed through descriptive statistics, structured equation modelling and discriminant analysis. Findings suggest that performance of fair-trade system on factors of sustainability is significantly better than conventional system and governance is most discriminating factor.

Keywords: sustainability; farmers; fair-trade system; conventional system; basmati rice.

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1 Introduction

Department of Agriculture Cooperation and Family Welfare (DAC&FW) in its 2016 report on Agriculture Situation in India categorically mentioned that though India has transformed in last 50 years from a food-deficient country to a food exporting country, the farm sector growth has decelerated and therefore will provide limited source of rural employment and economic development in future. In such a situation achieving the newest target of Prime Minister Modi to double the agriculture income in 2022 (Press Trust of India, 2016) is a formidable challenge that will seek sweeping reforms and multiple alternative solutions to be tried and implemented. In fact, the dilemma is further established when Ministry of Agriculture and Farmer Welfare and the institutions like National Bank of Agriculture and Rural Development (NABARD) are not on the 'same page' in context of selecting and then traversing a path towards sustainability in agriculture, despite having a consensus on acceptance of hard facts like 'rigged agri-commodity supply chains and continuing rural distress' (Hindustan Times, 2018).

In India sustainability at grassroots enveloping the issues of farmer livelihoods and vulnerabilities, social development and growing environmental concerns remain a sensitive and much debated topic. While Choudhary (2007) stressed that more farmers are becoming marginalised, DAC&FW in 2012 and again in 2016, clearly highlighted that despite support to rural livelihoods being distinct area for growth and sustainability, efforts through conventional systems in this direction have been weak and there is need for incorporating alternative mechanisms in agricultural production, trade and marketing. The conventional mechanism that links farmers to the market is controlled under the Agricultural Produce Marketing Committee (APMC) Act that mandatorily requires farmers to sell their produce only in the local market yard (locally called 'mandi') through designated traders (Ghosh, 2013). These controlled conventional mechanisms, in today's times, are inefficient because of collusion among these traders or brokers (Goyal, 2010), provide low prices to farmers (Prashant, 2010) with no provisions for alternate routes like contract farming, direct procurement or any other form of support to the farmers (Minten et al., 2011). Sharma and Pillaiyar (2011) observed that this age-old system has become flawed and ironically leading to exploitation of farmers. Indian Council of Agricultural Research (ICAR) in 2015, in its Vision 2030 document also articulated the need to tap opportunities through alternative mechanisms and partnership with different stakeholders at national and international level. While the debates continue, the situation is worsening over the years as the small famers continue to face the brunt of adverse circumstances (Singh, 2017). OECD (2018) has vehemently expressed that agricultural policies in India are designed and implemented by a complex system of disparate institutions and continue with fragmented trade chains that are not positive towards long-terms survival of farmers or sustainability at rural level.

The enormity of the challenge of sustainability as a state or synonymously sustainable development as the action path is evidently endorsed by World Summit on Sustainable Development as early as 2002 when it subtly accepted the inability of the governments alone to find solutions and therefore expressed the aspect of 'collective responsibility' and projected the need of multiple initiators and multiple initiatives. The multiple approaches theme becomes crucial in farm commodities as agriculture is not re-locatable as other typical manufacturing industries and therefore the problems related to concerned rural area and the farming community need to be solved in a specific way. Gilbert and Terrell (2012) reflected that governments, especially in developing countries, do not have willingness or capability to provide sustainable development and therefore businesses, religious, voluntary organisations and also the consumers through their purchase activity and endorsements are all important vehicles towards this cause (Anderson, 2014).

The need and potential of alternative trade mechanisms incorporating more responsible or sustainability aspects in agri-commodity chains emanated from the criticisms towards flawed conventional agri-chains. State of Sustainability review by International Institute for Sustainable Development (IISD) in 2012 commented that agri-commodities are crucial stepping stones for development because commodity production and trade have a direct link with rural livelihoods, incomes and environment, especially in the developing world. Since conventional global commodity markets, have been exposing farmers to livelihood insecurity besides negative social and environmental impact, developing alternative mechanisms for procurement makes ample sense. Oosterveer et al. (2014) concluded that various alternative mechanisms backed with their specific voluntary sustainability standards and certifications took shape primarily aimed at enhancing the sustainability of agricultural production, processes and trade.

Simultaneously, in context of sustainability at rural grass root level, while academic and political realms debate of alternative practices and systems towards agriculture and its trade, the acceptance of any new methods or practices at rural level by the farming community is a different ball game especially in lieu of economic insecurity, livelihood vulnerabilities or perceived 'no benefit'. Dahl (2012) and Robertson and Harwood (2013a, 2013b) expressed that intrinsic acceptance by farmers is vital for any alternative mechanism to take shape. Rockstrom et al. (2016) in their study for Sustainable Intensification of Agriculture suggest a new framework for research and development, which suggest major productivity enhancements are required, and a strategy is through sustainable intensification of agricultural practices for livelihoods that build farm, community, and biosphere resilience. New research and development is required to advance fresh integrated whole-of-system approaches for sustainable intensification, which can inspire and influence all domains involved in agricultural development, from economics to biotechnology.

2 Rationale and objectives of the study

Indian agriculture scenario reflects a simmering agrarian crisis with continued instances of farmer plights and protests. The conventional system of agricultural production and trade is entrenched with age-old practices and mechanisms that need an overhaul to make a positive contribution towards sustainability. The conventional Basmati production in India is not conducive in context of water usage and green house effects and eventual productivity in context of yield and price (Saptoka et al., 2017). There is inherent need of improving the social and environmental aspects in global rice supply chains as on one side almost one fifth of world population is involved in rice production, on the other side conventional rice production methods use 40% of irrigation and estimated 10% of greenhouse gases (Foodbev Media, 2017). Conventional rice farming in India carries low economic returns and tremendous environment impact, but alternative mechanism like fair-trade and organic can offer a meaningful solution (Eyhorn et al., 2018).

Alternative trade mechanisms have taken shape in global value chains of agri-commodities, linking marginalised farmers in developing countries with the ethical consumers in the west, on premise of inducing greater sustainability at farm level and along the supply chain. Mook and Overdevest (2017) critically pointed out that the economic benefits from fair-trade association has not been substantial but the aspect of capacity building of farmers drives the system. Whereas, Pyk and Hatab (2018) pointed that improvement in income and reduction in price uncertainty are underlying motives for farmers to break away from conventional trade mechanisms and try alternatives like fair-trade.

Haryana is the largest producer and exporter of Basmati from India but the state also has specific challenges in agriculture like small land holding, decreasing fertility, depleting water resource, increasing cost of cultivation and inadequate post-harvest management that makes sustainability a crucial issue for the state (Department of Agriculture and Farmers Welfare, Haryana, 2016).

Therefore, to have a comparative sustainability assessment (on the dimensions of sustainability) in the perception of farmers selling basmati rice to conventional or fair-trade procurement system is quite utilitarian. So, the objectives of this research paper are;

a Test the measures of construct 'sustainable procurement of basmati rice' are consistent with authors understanding from literature review.

b Assess and compare perception of farmers following conventional or fair-trade procurement system on indicators and dimensions of sustainability.

c Identify most discriminating dimension for sustainability invoking a starting point to induce change towards improvement on sustainability.

3 Literature review

The topics of sustainability and agriculture are closely linked because of their proximity to the farmers at the grass roots and also the nature. Terrell endorsed that governments alone are not adept or having means to ensure social development or benefits for the disadvantage citizens and therefore family employers, religious and voluntary organisation as well as consumers through their purchase activity are all important vehicles towards this cause. Anderson (2014) commented that with limited or ineffective government initiatives towards social development, various non-governmental, market-based, voluntary social change approaches like 'development trade' or the 'alternative trade mechanisms' have emerged and grown. In context of agri-commodities, these so called 'change approaches' or alternative trade mechanisms promote their own specific procurement processes backed by voluntary standards and certifications with objectives of making contribution towards sustainability.

Creative and ethical processes and practices strategies in food systems under the various sustainability certifications are perceived to make more positive contribution to economic, social and environmental development than is the case with so-called conventional food chains (Morgan and Sonnino, 2010). Sustainability standards and certifications like fair-trade provide normative frameworks (Ponte and Gibbon, 2005; Gibbon et al., 2008) as they strive to induce elements of coordination like rules, conventions, conditions of participation and working mechanisms that are typically absent in conventional agri-food chains (Ponte and Sturgeon, 2014). In context of fair-trade and other such initiatives, Smith and Barrientos (2005) earlier described the aspect of relational governance where stakeholders in the chain endorse each other's perspectives and work towards effective agri-chain that addresses mutual interest and contribute towards sustainability. Prasad (2015) analysed the development paradigms for India shaped by community needs, environment activism and sustainability push. He highlighted that local grass root communities need to strengthen their responsibility as custodian of environment and natural resources while civil society organisations and international agencies have to support them through various initiatives that increase contribution towards sustainability. Ponte and Sturgeon (2014) have indicated that that fair-trade and other voluntary sustainability initiatives or voluntary standards and certifications endeavour to address the social upgrading aspects through specific working mechanisms, rules and activities. Fair-trade concept is proclaimed for having a potential of benefiting small farmers through increased price, market access and a social premium for development activities, which are non-existent in conventional food chains.

In context of social acceptance of initiatives and indicators, Benoit and Niederman (2010) were in fact have been satirical in their expression that in already limited number of sustainability assessments, the indicators are developed and used in a manner that may not represent the views and priorities of the real impacted people or their communities, and therefore, it is important to involve them as much as possible in the study. The relevance of understanding by the farmers and thereby providing meaningful perceptions is crucial as Eastaway (2012) elucidated that especially in terms of social sustainability pillar, rather than merely discussing problematic issues related to imbalanced societies and inequality, coverage of intangible aspects like happiness, quality of life, feeling of fulfilment and perceived contribution to social cohesion is more important. Thivierge et al. (2014) through their studies in Quebec, confirmed interest of majority farmers to adapt their conventional agricultural practices, if indicators being assessed are understandable and easily relevant. Mascarenhas et al. (2014) also elaborated based on their research on self-assessment by different groups of stakeholders in agri-chain in Poland, that for effective response the indicator used and its question form must have a 'connect' with the stakeholder who is responding so that the captured perspectives of the asked stakeholders are good for drawing conclusions. Thangavelu and Yee (2017) analysed that sustainable supply chain for agricultural commodities needs an integrated effort by multiple stakeholders from plantation, procurement and downstream supply chain up to consumers. The governance can get rendered by voluntary standards that are willingly accepted and implemented by all stakeholders and a coordinated compliance and patronage. Since farmers are the vital link, through the procurement activity from farm to the agri-chain, any assessment on possible contributions by traditional or any new alternative system towards sustainable development on economic, social, environmental and governance aspects needs to capture farmers' perceptions on indicators that are relevant and understandable to them.

In context of sustainability assessment, Morse (2008) expressed that since the sustainable development concept attempts to merge economic objectives with social well-being and environment preservation which have been historically unrelated, disconnected and specialised faculties on their own, renewed and fresh thinking is required to create an effective developmental discourse of multiple, diverse, disparate and yet integrating or part playing initiatives. There are also limitations in studying the aspects of sustainability and sustainable development emanating from the fact that there is no consensus on dimensions of sustainability and therefore it is also, in parallel, being debated as to what sustainability entails. While claims about contribution towards sustainability are being made in the global supply chains, on the other hand, Food and Agriculture Organization (FAO) in 2011, through its report on Sustainability Assessment of Food and Agriculture (SAFA), cited that there is no international benchmark defining 'what sustainable production actually entails', but organisations are increasingly substantiating their sustainability claims on economic, social and environment dimensions by providing increased benefits to farmers and also attracting customers searching for more sustainable, ethical or green products.

FAO elaborated in 2011, that, though sustainable development in agriculture is one that is economically viable, socially acceptable, environmentally non-degrading and technically appropriate, there is still no international benchmark defining sustainable agriculture and agri-food chain and no universal indicator set to measure sustainability. The confusion about the indicators of sustainability was also evident from the expression in 2014 by United Nations Environment Programme (UNEP) in their report that there is a need for a set of internationally agreed principles and assessment system for sustainability.

For understanding the sustainability dimensions and indicators, numerous models were reviewed, such as, Response-Inducing Sustainability Evaluation (RISE) developed by Häni et al. (2003), Monitoring Tool for Integrated Farm Sustainability (MOTIFS) developed by Meul et al. (2008), Indicateurs de Durabilite des Exploitations Agricoles (IDEA) meaning farm sustainability indicators developed by Zahm et al. (2008), Synthetic Farm Sustainability Index (SFSI) suggested by Majewski (2013) and SAFA systems endeavoured by FAO (2013). Additionally, the aggregation of sustainability dimensions and indicators suggested by Hayati et al. (2010) and various context specific studies and suggested or used indicators by Gowda and Jayaramaiah (1998), Alam (2007), Singh (2009), Nirmala and Muthuraman (2009), Gafsi and Faveau (2010), Charyulu and Biswas (2010), Prakash and Singh (2013) and Chengappa et al. (2014) were also reviewed. Therefore. substantiation of impact at grass root level is an important pursuit towards credibility of the sustainability concept on parameters of economic, environment, social and governance.

4 Methodology

This study involved both exploratory and descriptive elements to review and develop the measure and then to compare perception of farmers growing basmati rice in India and following conventional or fair-trade procurement system on indicators and factors of sustainability. Initially the study carefully examined and reviewed existing literature and frameworks/models for measuring sustainability through integrative literature review to identify factors and indicators of sustainability for this study. Then the draft data-sheet (questionnaire) was subjected to experience survey with six academicians and six agri-extension experts to finalise the contextually relevant dimensions and indicators. After that the questionnaire was pilot tested and improved. Then data was collected from both the groups through the data-sheet and exploratory factor analysis was done. The entire experience in this exercise and insights of exploratory factor analysis were used to improve the questionnaire for this study.

4.1 Development of questionnaire

FAO (2013) highlighted that in context of agri commodities and systems, there are no benchmarks defining sustainable production and there is “no universally accepted set of indicators to measure sustainability.” It further expressed that the indicators must be adapted to regional or sectoral circumstance and the relevance to the assessed entity. Taking this direction, the indicators and factors such as economic, social, environment and newly suggested governance, were aggregated and presented to a panel of academicians and agri-extension experts for context specific adaptation and practicality of implementation at farm level. The resultant schedule was pilot tested (on two small groups of conventional and fair-trade farmers in Kaithal area of Haryana in India), and adapted subsequent to insights from an initial exploratory factor analysis and also taking into account the respondents’ views as well as experience with preliminary application and understanding. Table 1, summarises the details on assimilated sustainability dimensions, indicators and measures used in the survey.

Table 1 Assimilated sustainability factors, indicators and measures

Factor/indicator				*Measure/statement*		*Code*	*Reference*
1	Economic						
	1	Viability		1	Cost coverage (ECI1)	ECI1	Prakash and Singh (2013) and Charyulu and Biswas (2010)
				2	Income trend (ECI2)	ECI2	Charyulu and Biswas (2010) and Hayati et al. (2010)
	2	Vulnerability		3	Savings ECV1	ECV1	Häni et al. (2003)
				4	Debt increase (ECV2)	ECV2	Häni et al. (2003) and Zahm et al. (2008)
2	Social						
	3	Knowledge		5	Increased capabilities	SOK1	Singh (2009), Alam (2007) and Meul et al. (2008)
				6	Confidence	SOK2	Häni et al. (2003) and Majewski (2013)
	4	Quality of life		7	Improving wellbeing	SOQ1	Gafsi and Favreau (2010) and Hayati et al. (2010)
				8	Improving status	SOQ2	Hayati et al. (2010) and Majewski (2013)
	5	Food safety		9	Harvest quality	SOF1	Singh (2009)
				10	Safe for consumption	SOF2	FAO (2013)
	6	Social participation		11	Organised grouping	SOP1	FAO (2013)
				12	Contribution to village	SOP2	Gafsi and Favreau (2010) and Hayati et al. (2010)
				13	Fertility for next gen	SOP3	Meul et al. (2008)
3	Environment						
	7	Inputs		14	Fertiliser usage	ENP1	Zahm et al. (2008), Meul et al. (2008) and Hayati et al. (2010)
				15	Pesticide usage	ENP2	Singh (2009) and Gowda and Jayaramaiah (1998)
	8	Water		16	Water usage	ENW1	Singh (2009) and Gowda and Jayaramaiah (1998)
				17	Water pollution	ENW2	Gafsi and Favreau (2010)
	9	Soil		18	Soil pollution	ENS1	Nirmala and Muthuraman (2009) and Gafsi and Favreau (2010)
				19	Soil health	ENS2	Singh (2009) and Gafsi and Favreau (2010)
4	Governance						
	10	Traceability		20	Known processors	GOC1	Alam (2007) and Singh (2009)
				21	Link with consumers	GOC2	Alam (2007)

Table 1 Assimilated sustainability factors, indicators and measures (continued)

Factor/indicator			*Measure/statement*		*Code*	*Reference*
4	Governance					
	11	Transparency	22	Fair price and practices	GOT1	Nirmala and Muthuraman (2009)
			23	Empowerment	GOT2	FAO (2013)
			24	Responsible farming	GOT3	FAO (2013)
	12	Support	25	Financial support	GOS1	FAO (2013)
			26	Non-financial support	GOS2	Alam (2007)
			27	Certification help	GOS3	Alam (2007) and Chengappa et al. (2014)
			28	Market access	GOS4	FAO (2013)

A questionnaire (data-sheet) was prepared, utilising the above assimilated indicators and their respective measures, to collect the primary data from two distinct groups of farmers following conventional or fair-trade systems. The final questionnaire, carried 28 measures or statements covering 12 indicators representing four-sustainability dimensions. Farmer's perception on all indicators were measured on a five-point Likert scale (1 as strongly disagree to 5 as strongly agree) and each indicator was measured by at least two statement.

4.2 Sampling design

The study has collected perception of farmers growing basmati rice and sell their produce to either conventional procurement system or to fair-trade system. Any farmer can approach to conventional procurement system to sell basmati rice, whereas fair-trade procurement system does not allow a farmer to sell their produce (basmati rice) to it unless the farmer is a member of a registered society of farmers and produce 'authentic basmati'. One of the first initiative under fair-trade system in Indian Basmati was made in Kaithal District of Haryana state, a state which is largest producer and exporter of Basmati in India, others being Punjab, Uttarakhand and Jammu and Kashmir. Hence, Kaithal was the obvious choice of the geographical area of this study, as being oldest initiative, it provided most authentic data in terms of sustainability impact assessment.

Sampling frame for the farmers under fair-trade procurement system was 335 farmers, member of a registered society of fair-trade basmati farmers based in Kaithal. On the other hand, for selection of sample for farmers following conventional procurement system was the farmers in the same area of Kaithal, growing basmati rice and selling to conventional system.

Basmati can be 'original authentic' variety or various hybrid varieties with different yields and prices, therefore it was vital to focus on farmers growing same variety of basmati consistently. It was considered meaningful to include only those farmers who have had at least four-year consistency in cropping authentic basmati (non-hybrid). Judgement sampling was the most reasonable technique in such scenarios as per Dudovskiy (2016) and Saunders et al. (2012). As a result, out of 335 farmers of the registered society following fair-trade procurement system, all 122 farmers as homogenous purposive subgroup having four-year consistency in producing authentic basmati, became the sample size. Out of 122 identified farmers as a sample, authors could collect data from 118 farmers for this study.

Non-availability of specific cropping data for rice puts a constraint on the research to do any random sampling out of a given list or a population stratum of the conventional farmers. To overcome the challenge of reaching conventional farmers with same variety, the best option available and logically implementable was snow-balling, seeking help and information from visited fair-trade farmers. Accordingly, 118 conventional farmers with four-year consistency in growing authentic (non-hybrid) Basmati in the same area were reached through snowball sampling technique.

5 Analysis and discussion

Sharma et al. (2018) in their study reviewed, examined, and explored the construct to measure procurement system on parameters of sustainability and identified four factors, economic, environment, social and governance. They also identified four indicators each on economic and social factors and three each on environment and governance. They also developed measures on each indicator of all factors, verified through experience survey with academicians and agri-extension experts and improved with pilot test. They collected primary data from 120 farmers (60 each following fair-trade and conventional system) and analysed through exploratory factor analysis and found that, a review is required for indicators in social and governance dimensions (factors).

5.1 Confirmatory factor analysis

Based on the insights from the previous study of the authors and further literature review, a revised questionnaire was developed using 12 indicators on four dimensions as shown in Table 1. Data from 236 farmers on developed questionnaire were collected and was tested for reliability through Cronbach's alpha, a value of 0.97 confirmed a good internal consistency and reliability. Confirmatory factor analysis (CFA) was used for validation of the emergent factor structure. CFA was undertaken using the structured equation modelling (SEM) using software AMOS, and the following model in Figure 1 emerged.

Table 2 shows the confirmatory factor analysis and standardised regression weights. Majority of statements (indicator measures) carried standardised factor loadings greater than 0.70 in the initial model. In context of few statements with factor loadings less than 0.7, since these statements represent the indicators and we used at least two statements to study any indicator, it can be argued that if the factor loading of the other statement is reaching 0.7, the model is still fine if other fit measures are within the accepted thresholds. The correlation coefficient between the factors were positive. All the measurement criteria/indices were also significant, like the appropriateness of standard error, statistical significance and critical ratio greater than 1.96.

Table-3 presents the model fit summary on the initial 4 factor scale and indicates a good fit model based on goodness of fit criteria that can be used for inferences as given in Table 4. The ratio of CMIN/df was 2.28 (less than 3) is considered good. The model CFI and TLI stood at 0.918 and 0.931 and values above 0.9 is considered acceptable and indicates a perfect fit model. The model RMSEA of 0.076 which is less than 0.08 is moderate but within acceptable limit.

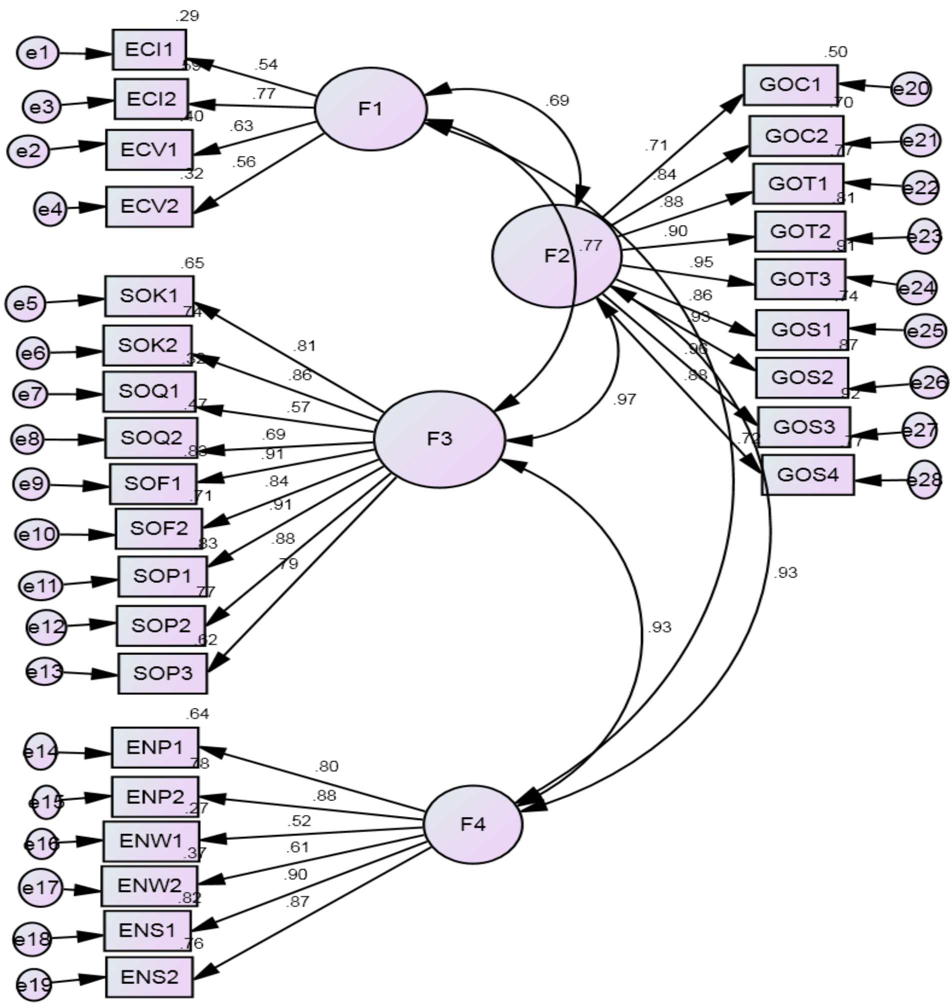
Table 2 Sustainability indicator measures – regression weights

Constructs and measures			*Coefficients*		*Standard error*	*Critical ratios*	*Probability*
			Unstandardised	*Standardised*			
ECI1	←	F1	1.000	0.537			
ECI2	←	F1	2.011	0.766	0.271	7.426	0.000
ECV1	←	F1	1.604	0.632	0.237	6.765	0.000
ECV2	←	F1	1.571	0.562	0.249	6.297	0.000
GOC1	←	F2	1.000	0.710			
GOC2	←	F2	1.517	0.839	0.118	12.827	0.000
GOT1	←	F2	1.650	0.877	0.123	13.423	0.000
GOT2	←	F2	1.702	0.898	0.124	13.748	0.000
GOT3	←	F2	2.315	0.954	0.158	14.607	0.000
GOS1	←	F2	1.393	0.859	0.106	13.145	0.000
GOS2	←	F2	1.859	0.932	0.130	14.266	0.000
GOS3	←	F2	2.358	0.959	0.161	14.690	0.000
GOS4	←	F2	1.423	0.876	0.106	13.397	0.000
SOK1	←	F3	1.000	0.808			
SOK2	←	F3	1.342	0.861	0.083	16.141	0.000
SOQ1	←	F3	0.658	0.570	0.070	9.369	0.000
SOQ2	←	F3	0.782	0.685	0.067	11.749	0.000
SOF1	←	F3	1.672	0.909	0.095	17.572	0.000
SOF2	←	F3	1.084	0.841	0.070	15.579	0.000
SOP1	←	F3	1.652	0.911	0.094	17.632	0.000
SOP2	←	F3	1.484	0.880	0.089	16.681	0.000
SOP3	←	F3	1.173	0.789	0.083	14.191	0.000
ENP1	←	F4	1.000	0.801			
ENP2	←	F4	1.180	0.884	0.073	16.245	0.000
ENW1	←	F4	0.496	0.519	0.060	8.269	0.000
ENW2	←	F4	0.577	0.610	0.058	9.965	0.000
ENS1	←	F4	1.250	0.904	0.074	16.809	0.000
ENS2	←	F4	1.057	0.874	0.066	15.967	0.000

Table 3 Model indices summary

Measure	*Result*
Chi-square/df (CMIN/DF)	2.38
Comparative fit index (CFI)	0.931
Normed-fit index (NFI)	0.894
Tucker-Lewis index (TLI)	0.918
Incremental fit index (IFI)	0.931
Root mean square error of approximation (RMSEA)	0.076

Figure 1 SEM initial model (see online version for colours)



Note: See Table 1 for codes used.

Table 4 Model fit criteria

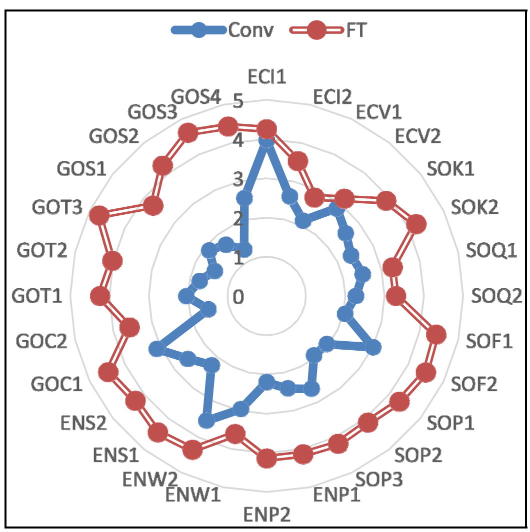
Measure	*Threshold*	*Ref.*
Chi-square/df (CMIN/DF)	<5	Schumacker and Lomax (2004)
Comparative fit index (CFI)	>0.90	Bryne (1994)
Normed-fit index (NFI)	>0.90	Bryne (1994)
Tucker-Lewis index (TLI)	>0.90	Hu and Bentler (1999)
Incremental fit index (IFI)	>0.90	Hu and Bentler (1999)
Root mean square error of approximation (RMSEA)	<0.08	Hu and Bentler (1999)

The overall measurement model therefore demonstrated reasonable goodness of fit. MacCallum et al. (1992) noted that in situation of initial model with reasonably good fit, it is unwise to modify it for achieving better fit. They also asserted that when sample size in above 200 it is difficult of get a ‘great’ fit. Valuing this caveat, it can be concluded that the measurement model adequately confirms the factors used and establishes the relevance and robustness of the questionnaire.

5.2 Descriptive statistics

Radar charts corresponding to 28 statements covering 12 indicators representing four dimensions presented in Figure 2 give a fairly straightforward visual comparison overview between the conventional and fair-trade farmers. The areas covered by the chart for individual groups reflect the level of farmer perceptions on Likert scale towards the covered aspects. The area can also be comprehended to be the reflection of combined performance on multiple variables by individual groups. The radar chart for individual statements clearly indicate that the conventional group is not better than the fair-trade group on any of the individual indicators as the two line of the radar chart did not cross each other at any point. However, it does not imply that there is a significant difference between the two groups on each indicator.

Figure 2 Radar chart – individual statements (see online version for colours)



Notes: Conv = conventional; FT = fair-trade; see Table 1 for codes used.

The t-test results for the test of equality of means between conventional and fair-trade farmers on all 12 indicators and four dimensions are presented in Table 5. Two tailed t-test value with zero p-value for all the indicators meaning that there is indeed a significant difference between all sustainability indicators and dimensions in both the groups.

Table 5 Descriptive statistics – sustainability indicators and dimensions

Dimension	*Indicators*	*Conventional*		*Fair-trade*		*t*	*Sig (two tailed)*
		Mean	*SD*	*Mean*	*SD*		
Economic	Viability	3.284	0.521	3.886	0.525	–8.841	0.000
	Vulnerability	2.500	0.710	2.979	0.642	–5.434	0.000
	Total	*2.892*	*0.55*	*3.432*	*0.50*	*–7.911*	*0.000*
Social	Knowledge	2.479	0.597	4.055	0.461	–22.697	0.000
	Quality of life	2.390	0.574	3.284	0.579	–11.910	0.000
	Food safety	2.530	0.560	4.453	0.434	–29.518	0.000
	Social participation	2.175	0.508	4.209	0.404	–34.062	0.000
	Total	*2.369*	*0.44*	*4.024*	*0.32*	*–33.341*	*0.000*
Environment	Input usage	2.309	0.663	4.144	0.704	–20.601	0.000
	Water	3.242	0.688	3.979	0.642	–8.513	0.000
	Soil	2.403	0.760	4.364	0.483	–23.656	0.000
	Total	*2.651*	*0.59*	*4.162*	*0.49*	*–21.426*	*0.000*
Governance	Traceability	2.314	0.656	4.038	0.520	–22.381	0.000
	Transparency	1.757	0.456	4.331	0.450	–43.629	0.000
	Support	1.856	0.422	4.252	0.375	–46.138	0.000
	Total	*1.925*	*0.36*	*4.231*	*0.33*	*–51.070*	*0.000*
Combined (average)		*2.459*	*0.39*	*3.962*	*0.31*	*–32.496*	*0.000*

5.3 Discriminant analysis

It is imperative to mention that in typical comparative sustainability assessment studies, two or more groups, despite possibly having significant difference on individual dimensions of sustainability, do not represent situations of no-sustainability versus sustainability. Rather they merely represent two distinct groups that are lower or higher on aspects of sustainability. In such case, if we develop a regression equation assuming sustainability as a dependent variable, with the four dimensions as independent variables, the output of regression equation will just be a number which will not describe the levels of no, low or high sustainability on its own. In such situations as per Poulsen and French (2004), Discriminant Analysis finds its relevance as it is a kind of reverse regression whereby a canonical function of multivariates can predict current and future group affiliations and also establish the most differentiating factors. Running a stepwise discriminant analysis at dimensions level provided in Tables 6–8.

Table 6 Tests of equality of group means (dimensions)

	Wilks' lambda	*F*	*df1*	*df2*	*Sig.*
Economic	0.789	62.58	1	234	0.000
Social	0.174	1,111.65	1	234	0.000
Environment	0.338	459.06	1	234	0.000
Governance	*0.082*	*2,608.15*	1	234	0.000

Table 7 Variables entered/removed for canonical discriminant function

Step	*Entered*	*Wilks' lambda*							
		Statistic	*df1*	*df2*	*df3*	*Exact F*			
						Statistic	*df1*	*df2*	*Sig.*
1	Governance	0.082	1	1	234	2,608.15	1	234	0.000
2	Economic	0.075	2	1	234	1,436.78	2	233	0.000
3	Social	0.066	3	1	234	1,099.86	3	232	0.000
4	Environment	0.064	4	1	234	840.04	4	231	0.000

Notes: At each step, the variable that minimises the overall Wilks' lambda is entered.
Maximum number of steps is 8.

Table 8 Eigenvalues

Function	*Eigenvalue*	*% of variance*	*Cumulative %*	*Canonical correlation*
1	14.546[a]	100.0	100.0	0.967

Note: [a]first 1 canonical discriminant functions were used in the analysis.

Table 9 Structure matrix – canonical function (dimensions)

Governance	*0.875*
Social	0.571
Environment	0.367
Economic	0.136

The above discriminant analysis provides two important highlights. First, the canonical correlation of 0.967 depicts a high correlation between the actual values and values predicted by canonical function. This helps deducing that the indicators used in the questionnaire provide a robust measure towards assessing the sustainability based on contribution of each dimension. Second, the lowest Wilk's statistic of 0.082 and highest F test score in equality of group means for all dimensions establishes governance to be the strongest dimension that differentiates the two groups, with social, environment and economic dimensions following it at much diluted level. In fact, inferring from the highest coefficient of 0.875 in the structure matrix, it can be argued that perhaps governance alone can reasonably discern amongst the level of sustainability and predict the group affiliations.

In fact, this is in line with the three circle within governance model suggested by Trudinger and Spitz (2008), although Sachs (2008) and FAO (2011) still emphasised on considering governance as the fourth dimension. Though the literature review established the need for studying all dimensions together to keep balanced approach in all dimensions as they may also have an influence on each other in specific ways in specific contexts, however, it is meaningful to contemplate as to what factors can provide a reasonable starting point towards inducing a change. The objective is not to establish any causal relationships but to discuss possible and immediate effects by and amongst latent constructs or dimensions based on logical and empirical suppositions.

Extending the analysis further to indictor (or sub-dimensional) levels provides the results of lowest Wilk's lambdas in the equality of group means and correspondingly highest coefficients in the structure matrix in support and transparency aspects (of the

Governance dimension) with traceability not getting that much strength as evident from Tables 10 and 11.

Table 10 Tests of equality of group means (indicators)

	Wilks' lambda	*F*	*df1*	*df2*	*Sig.*
Viability	0.750	78.165	1	234	0.000
Vulnerability	0.888	29.527	1	234	0.000
Knowledge	0.312	515.142	1	234	0.000
Quality of life	0.623	141.837	1	234	0.000
Food safety	0.212	871.290	1	234	0.000
Social participation	0.168	1,160.242	1	234	0.000
Inputs	0.355	424.388	1	234	0.000
Water	0.764	72.466	1	234	0.000
Soil	0.295	559.585	1	234	0.000
Traceability	0.318	500.890	1	234	0.000
Transparency	*0.109*	*1,903.451*	1	234	0.000
Support	*0.099*	*2,128.751*	1	234	0.000

Table 11 Structure matrix – canonical function (indicators)

Support	*0.751*
Transparency	*0.710*
Social	0.554
Food	0.480
Soil	0.385
Knowledge	0.369
Traceability	0.364
Inputs	0.335
Quality of life	0.194
Viability	0.144
Water	0.138
Vulnerability	0.088

In a broader temporal context, perhaps governance shall not be considered as a causal element, however, in a short-term it may provide genuine starting points or trigger points. Within governance the aspects of support and transparency with highest coefficients (0.751 and 0.710 respectively) in the structure matrix at indicator levels, provide a genuine base to plan the activities and actions towards improvement. This is in synergy with the expressions made by Pagell and Shevchenko (2014) to focus on identifying most positive components and creation of positive and regenerative effects in context of sustainability studies. This is also because, aspects of governance direct towards actions while the economic, social and environment aspects in general point towards the state, although their spill over effects on each other may be more complex and specific to contexts. This study in specific context of basmati farmers in Haryana, indicates towards governance and two (out of three) of its sub dimensions (indicators) as immensely significant in differentiating amongst systems on level of contribution towards sustainability.

6 Conclusions

There is a consensus among researchers that continued plight of our farmers can be addressed only if it is dealt on factors of sustainability such as economic, environment, social and governance. But in pursuit of finding or developing a better system than the current conventional one, the claims of fair-trade system that it addresses the problems of farmers and provide better contribution towards sustainability at grass-root level was required to be verified.

In this research article, authors have identified the indicators under each factor of sustainability through literature review. Based on the identified indicators on each factor, a questionnaire was developed and refined through inputs from academician and agri-business experts. Then primary data was collected through this questionnaire from the farmers following conventional system and well as farmers following alternative fair-trade system to sell their produce 'basmati rice'. Confirmatory factor analysis established the relevance of the indicators used and overall robustness of the questionnaire. This may further be corroborated through replication on larger sample sizes and for other agri-commodities. The results of study find that the average ratings provided by the farmers following fair-trade systems are significantly more on all 12 indicators and four dimensions of sustainability as compared to farmers following conventional system.

Through discriminant analysis, governance dimension emerged as the most distinguishing aspect that could define the conventional or fair-trade group affiliation. At indicator level, transparency and support aspects of governance led above all other indicators in differentiating the two groups. Though the previous literature points towards the need to address all dimensions together for a balanced effect in all dimensions and without any specific cause-effect relation, as over time they all influence each other. However, since governance dimension and its indicators 'transparency' and 'support' demonstrated maximum and substantial difference between conventional and fair-trade systems, it becomes obvious that they provide a good starting point to make changes to trigger a positive effect on other dimensions and the overall contribution towards sustainability. This was in line with expressions of Pagell and Shevchenko (2014) to focus on identifying most positive components and creation of positive and regenerative effects.

It is equally imperative to mention that the concept of sustainability is based on 'contribution' towards sustainability and not to define any process to be completely unsustainable or fully sustainable. Accordingly, though the analysis pointed towards difference between the conventional and fair-trade groups as the canonical regression of discriminant function provided robust results in predicting group membership through almost 97% canonical correlation and high eigenvalues, it is more meaningful not to see the studied groups of conventional and fair-trade farmers as simply 'un-sustainable' versus 'sustainable' respectively. Rather, they shall be perceived to make less sustainability contribution versus more sustainability contribution by virtue of their respective practices and mechanisms.

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