THE CONSTRUCT VALIDITY OF FARMER'S PERCEPTIONS OF AGRICULTURAL INFRASTRUCTURE AND DEVELOPMENT IN JAMMU AND KASHMIR: CONFIRMATORY FACTOR ANALYSIS APPROACH

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ABSTRACT

Agricultural infrastructure recognizes as critical for determination of success or failure of economic growth and development to reach the grass roots. The economic models and their application to rural and agricultural infrastructural development is useless unless farmer as a vital stakeholder is not reviewed. The study hence operationalizes the farmer's viewpoints of factors that shape and influence his life in more than one way. The research hence identifies the farmer and his perceptions as crucial to infrastructure development for agriculture. The research aims at development of common measurement model and instrument that can equally capture the unique attributes of infrastructure as influencing the agricultural outcomes in comprehensive manner.

Keywords: Convergent validity; Confirmatory factor analysis, Farmer's perceptions, Infrastructure, Agriculture, Jammu and Kashmir.

INTRODUCTION

Agriculture production boosting has largely been observed as reliant on the quality and composite nature of the infrastructure being available until grass roots levels. The literature (Binswanger, 1993) portrays a critical role of infrastructure in boosting agriculture production. A host of studies (Senyolo, 2009) , (Koshti, 2013), (Solouki, 2015) seem to correlate infrastructure availability, accessibility, reliability and quality; with sustainable development of agriculture. The studies (Tanko, 2019) on agricultural infrastructural indicators underline the critical role of physical, information, mobility mechanisms as shaping the development prospects. The agricultural infrastructure (Fosu, 1995) identifies as comprising the elements of irrigation and public access to water, transportation, storage services, commercial infrastructure, processing infrastructure, public services (Amir, 2020), agricultural research and extension services, communication and information services (Tanner, 2008), land conversion services (Koshti, 2013), credit and financial institutions (Goncalves, 2020), health and education services (Thippeswamy, 2013).

The studies (Edeme, 2020) reflect on the manifold definitions and roles of infrastructure in shaping the agricultural production. Infrastructure is regarded as the backbone that shapes and enhances the rate of factor mobility, factor usage as well as factor-based efficiency in agricultural perspective. Agriculture

infrastructure and production (Komarova, 2014) have been observed as bearing a direct and lateral impact on the production prospects and economic development scenario for the concerned region. Agriculture infrastructure indicators (Brooks, 2010) also speak about the infrastructure and its availability as shaping the boost in the agriculture production.

Challenges

The farmer's perceptions themselves are hard to quantify. The construct validation of farmer's perceptions of agricultural aspects and shaping of agricultural outcome; remains a haphazard research focus. The lack of common indices or indicators that could effectively capture famer's perceptions and enable better assessment of farmer's role in agricultural infrastructure assessment and infrastructural development; is lacking. A plethora of studies exists yet they have been from diverse perspectives like the government, expert point of view, producer's opinion yet few studies seem to incorporate the farmer's point of view. There is a requirement for state-bound analysis of the infrastructure indicators like roads, irrigation, electricity, transportation, education etc. in order to establish a benchmark for assessment and analysis of state's performance across infrastructural facilities in context of Jammu & Kashmir. The research is significant as this incorporates the infrastructure data so as to arrive at the common acceptable benchmark level for establishing inter-district comparison. The lack of common acceptable measure or scaling instrument remains the prime driver for the current research exercise.

Problem

The existing literature on subject with regard to Jammu and Kashmir context presents a non-convergent picture and calls for need for a composite and comprehensive approach towards deepening our understanding of the phenomenon in agricultural and rural perspective. The research gaps exist with regard to indices, or the aspects being considered for mapping or quantifying the infrastructure parameters. Despite the clarity with regard to broad classification of economic and social infrastructure, the convergence is missing. Studies on linking agricultural infrastructure with agriculture development are either based fully on secondary data or on primary sources of data yet none has experimented with combination of both as research needs to be rooted in realities and perceptions of actual infrastructure users. In conjugation less of he reviewed studies insist on fresh data and more of the reviewed literature seem to rely on data collected some ten years down the line. Such an approach might lead to conclusions that are not fresh in nature. The district bound variations would be there and localities' perceptions are central towards assessment of the accessibility, usability and affordability of the infrastructure. Yet few of the classified studies explore the subject to the grassroots level. The identification and respective grouping of agricultural development indicators like farmer's access to vital inputs, farmer's application of technologies for development, reduction of loses in agricultural practices, economic development, scope for improvement of infrastructures, agricultural mechanization, social improvement, market infrastructure access, land reform and yield management; is vital to study to come up with new ideas. The prominent research gaps (as mentioned in Table 1 seem to exist with regard to the manner in which the indicators have been clubbed or classified.

Table1
Summarizing the research gaps

	Type of research gap	Explanation
Missing Information	Research/Evidence/Knowledge Gaps	The research appears as scattered and points to lack of a common acceptable framework or indicator or conceptual approach to map the agriculture infrastructure.
	Synthesis/Unidentified Gaps	The gap was identified with regard to synthesis and approach to subject. Lesser studies have been worked with regard to complete range of infrastructural constituents
	Outcome uncertainty	The studies on subject matter are region and political system specific and conditions of peace or political conflict shape the relationship between agriculture infrastructure and expected outcomes.
	Absolute Evidence Gaps	The evidence gaps are prominent in terms of climatic conditions, soil conditions, water irrigation and agricultural practices
	Action-Knowledge Conflict Gap	The research gap seems to prevail with regard to action being undertaken on the agricultural and research knowledge
	Knowledge Void Gap	The knowledge gap is evident vis a vis the knowledge being accessed and incorporated for corrective action
Inadequate Information	Knowledge Gaps	There exists substantial knowledge gap with regard to climate as shaping the usage of infrastructure and implications for agriculture. None of the studies present a generalizable model or format that can be implemented equally across hot, arid, wet and cold conditions. The gap also seems to exist with regard to crop consideration, possibility of relationship across different forms of infrastructure and extent of convergence of outcomes
	Void Gaps	The gaps point towards non replication of outcomes being observed in one contextual setting
	Population Gaps	The gaps exist with regard to population being studied. Most of the secondary data based studies emphasize statistics yet other ones focus on a target segment like farmers, marketers, firms or government expenditure.
Insufficient Information	Evidence Gap	The research gap is evident with regard to regional and local evidence as well as evidence with regard to statistical validation and reliability assessment
	Methodological Gap	The review of literature projects the staring differences with regard to methods being adopted for research and data validation.
	Theoretical Gap	The theoretical gaps seem evident with regard to the aspects of theory generation, theory application and respective theory deduction.

Infrastructure availability, accessibility, respective affordability and level of infrastructure in agricultural perspective identifies as one of the major factors that could explain the regional balances and imbalances in the agricultural growth. This being the case, as we have already seen, our major aim here is to analyze the role of infrastructure in promoting agricultural development vis-à-vis the regional development. The obvious outcome as expected from this current research is to identify the factors or aspects that are operational in backward regions vis a vis the observed adequacy or inadequacy of the level of agricultural infrastructure, as well as to suggest policy measures to improve upon the performance of the regional economy. There is a requirement for state-bound analysis of the infrastructure indicators like roads, irrigation, electricity, transportation, education etc. in order to establish a benchmark for assessment and analysis of state's performance across infrastructural facilities in context of Jammu & Kashmir.

Defining and Measuring Farmer's Perceptions of Agriculture Infrastructure

Perceived improvements in infrastructure: The factor captures the perceived role of infrastructure and perceptions of improvements in current state of infrastructure as shaping the agricultural outcomes. The factor captures the opinions and ideas of farmers with regard to the improvements as happening in infrastructure, physical connectivity. The factor is being quantified with aid of statements related to construction and improvement of rural roads, construction of irrigation and drainage channels, presence of stores for the crop after harvest, presence of silos for crop after harvest, crop products packaging industries, crop products conversion industries, boosting rural handicraft, cold storage for crop preservation

Perceived agricultural mechanization: The factor explores the farmer's perceptions of agricultural mechanization as aiding agricultural development. The factor was worked with aid of supporting statements: application of machinery in cultivation and farm maintenance, production and improvement of modern agriculture technologies in crop production, leveling of farmlands by machinery, increase in cultivation areas by use of modern machinery, social security insurance of farmers and their families.

Perceived economic development: The factor represents the self-assessment of farmers with regard to economic development as taking place at their place. The factor was considered to explore the perception of farmers vis a vis the economic development that is happening at farmer's place. The factor was worked with sub scale statements: cutting of production costs, moving towards higher income cropping patterns, creation of vocation opportunities for learning and practice development, insurance of produced crops.

Perceived farmer's access to inputs: The factor represents the perceptions with regard to changes in access to agricultural inputs and technology for agriculture. The factor was considered on account of mapping the changes that are taking place with regard to farmer's access to critical inputs, essential ingredients, seeds, fertilizers and technology implements. The factor was operationalized with statements: access to quality and appropriate bred seeds, access to appropriate pesticides and fertilizers in production, access to bred livestock, farmer's access to loans and credit required for the production, farmer's access to modern irrigation methods, use of modern information systems and internet for managing crop and harvesting and marketing related issues, farmer's access to new and productive technologies,

improvement of vocational training and market exposures for farmers and development of new practices, supply of appropriate technologies to users.

Perceived reduction of losses: The factor explores the farmer's perceptions of reduction in agricultural loses in terms of statements being circulated. The factor was quantified with statements: reduction or stoppage of the destruction of natural resources by farmers, elimination or control of intermediaries or brokers in product purchase, sound use of water resources by farmers, application of micronutrient fertilizers in crop production, sound use of chemical fertilizers by farmers, reduction of crop losses at harvest time through application of harvest machinery, reduction of infestation of products to diseases, reduction of damages by pests to crops, appropriate use of manure for farm strengthening.

Perceived land reforms: The factor represents the farmer's perceptions with regard to changes in leveling the uncultivable land for agricultural usage, restoration of cultivable land, integration of cultivable lands, lesser role of hassles and brokers in land record management, diversified crop production by farmers.

Perceived improvement of marketing: The factor explores the farmer's perceptions of improvement in agricultural marketing as aiding agricultural development. The factor was worked with aid of supporting statements: establishment of cooperatives for the sale of crop product, ability to cope up with production challenges by farmers, improvement of farmer's technical skills, information dissemination and knowledge exchange platforms in rural areas, establishment of sales cooperatives, guaranteed purchase of production from farmers.

Perceived yield increase: The factor explores the farmer's perceptions of yield increase as shaping agricultural production enhancement. The factor seek to capture the farmer's self-assessment with regard to sub scale dimensions: emphasis on integrated crop harvesting, emphasis on increasing per hectare or per land holding yield, more creative and productive use of existing land, farm expansion and expanding the area under cultivation, focus on hybrid patterns of farming, incorporation of technical knowledge, information flows help me raise awareness about yield enhancement

Perceived increase in agricultural productivity: The factor represents the perceptions with regard to changes in productivity with regard to agriculture. The factor was operationalized with sub scale items: agricultural productivity has increased, share of agricultural income has risen, more yield from same inputs is possible, market access has improved, more options for selling final produce have opened up, better management of agricultural outcomes with post-harvest facilities, lesser crop spoilage occurs, crop preservation and processing has increased.

Social status: The factor captures the perceptions of farmers with regard to the social status-based changes that they have observed across time of research. The factor was measured with statements: more attention to small land holding farmers, respecting farmer's self-esteem in society by institutions and agencies, providing adequate incentives to farmers for increasing motivation to produce, higher purchase power for inputs and production resources by farmers, access to extension and agriculture experts.

Approach

Sampling: The research is being worked with the perceptions of the farmers vis a vis input availability, extent of improvement in transport and other infrastructure connectivity and perceptions of agricultural growth vis a vis the current infrastructural development in Jammu and Kashmir state. The primary data was collected from the selected households and household were selected through multi-stage sampling. At the first stage, the selected districts were grouped into two regions: one with potentially high agriculture infrastructure investment and other with low infrastructure investment. In the second stage from these two groups different towns or villages were selected and at last from the selected towns or villages, about 640 Households were selected. This identifies as ten times the number of statements being considered in scale for the purpose. The likert based measurement instrument was screened for validity and reliability across 100 respondents. The study relied on random sampling approach. The sample size was 640 which is ideally the ten times the number of sub scale statements (variables) chosen for quantification of the phenomenon. The figure of 640 is more than the minimum required threshold for the effective reliability and validity calculation of the measures. Accordingly, a number of actions were undertaken to ensure that at least fifty per cent responses are received. As far as the characteristics of the respondents contacted are concerned, the farmers and those engaged in agriculture as occupation were considered as prime participants. Of the 640-sample size, 438 responses were identified as valid, complete and actionable responses. The SPSS based reliability analysis on the 438 responses revealed these descriptive statistics. The loading item wise descriptive statistics yield that standard deviation is nominal and variance as exhibited is acceptable. For the assessment of reliability, research study incorporated the standard research tool of cronbach alpha in SPSS platform for reliability assessment to ascertain the "internal reliability and respective consistency" of the primary data hence collected via likert scale-based questionnaire. Then the research study operationalizes the "extractive factor analysis" for the assessment of dimensional validity of the data. The "dimensional validity analysis" is essential to reduce and segregate the representing sub scale items form the non-loading and non-representing sub scale items from across the respondent's viewpoint.

Internal Reliability Assessment: The internal reliability analysis is crucial for the ascertainment of the data based internal consistency. As advocated in the existing literature, cronbach alpha figures as the most prominent tool for the achievement of internal reliability assessment.

Dimensional Validity Assessment: This refers to the evaluation of the extent to which the dimensions undertaken and operationalized are actually quantifying a phenomenon or not. The "extractive factor analysis" was deemed essential to ascertain the dimensions that appropriately represent the factor in question. The loading dimensions are mentioned in the Table 2 below.

Table 2
ITEMS FOR EACH FACTOR

Factor	Sub scale Items	Source
Perceived improvements in infrastructure	IN1, IN2, IN3, IN5, IN6	(Solouki, 2015),
Perceived agricultural mechanization	AM1, AM2, AM6, AM7, AM8	(Solouki, 2015),
Perceived economic development	ED1, ED2, ED3, ED4, ED5	(Solouki, 2015),
Perceived reduction of losses	RL1, RL2, RL3, RL4, RL6, RL9	(Solouki, 2015), (Savari,

		2020)
Perceived farmer's access to inputs	FA1, FA3, FA4, FA5, FA7, FA8, FA9	(Solouki, 2015), (Senyolo, 2009)
Social status	SO1, SO2, SO4, SO5, SO6	(Solouki, 2015),
Perceived yield increase	YIN1, YIN2, YIN3, YIN4, YIN6, YIN7, YIN8, YIN9	(Solouki, 2015),
Perceived improvement of marketing	IMA1, IMA2, IMA5, IMA8, IMA9, IMA10, IMA11, IMA12	(Solouki, 2015),
Perceived increase in agricultural productivity	IAP1, IAP3, IAP4, IAP6, IAP7, IAP8	(Solouki, 2015),
Perceived land reforms	LR1, LR2, LR3, LR4, LR5	(Solouki, 2015),

Empirical Testing of Infrastructure Factors: Confirmatory Analysis

The confirmatory factor analysis forms the part of validation exercise as required before a likert scale based data. The scale based confirmatory factor analysis was undertaken as per scales devised earlier. The research relied on confirmatory factor analysis to ascertain the factor structure as identified in section above. The comprehensive application of latest statistical tools like IBM SPSS and AMOS for validity and reliability assessment is to be followed by application of AMOS for structural equation modeling. The rationale is to secure the achievement of research objectives and structural model and group wide difference establishment in empirical manner and context. The intention was to establish the linkages across "individual" farmer aspects, "contextual" influences and overall outcomes. The research process hence drives strength from the focus on mapping the cross factor relationships in empirical manner in order to ascertain the cross factor impact. The confirmatory factor analysis yielded the factor structures as validation models presented in sections below. The factor 'improvements in infrastructure" was represented by IN1, IN2, IN3, IN5, IN6; factor "agricultural mechanization" by AM1, AM2, AM6, AM7, AM8; factor "economic development" was represented by ED1, ED2, DE3, ED4 and ED5. The factor "reduction of losses" was represented by RL1, RL2, RL3, RL4, RL6, RL9; factor "farmer's access to inputs" was represented by FA1, FA3, FA4, FA5, FA7, FA8;factor "land reforms" by LR1,LR2, LR3, LR4, LR5; factor "yield increase" by YIN1, YIN2, YIN3, YIN4, YIN6, YIN7, YIN8. The factor "improvement in marketing" was represented by IMA1, IMA2, IMA5, IMA8, IMA9, IMA10, IMA11, IMA12 and factor "increase in agricultural productivity" by IAP1, IAP3, IAP4, IAP6, IAP7, IAP8. The respective Cronbach alpha measure for reliability was observed well within range 0.5 and 1 for 'farmer perceptions'. This shows 'improvements in infrastructure' with 0.905, 'agricultural mechanization' with 0.888, 'economic development' with 0.898, 'reduction in losses' with 0.883 and 'farmer's access to inputs' with 0.904 value as satisfactorily in range as acceptable. All the reported values hence confirm the significant reliability. The composite reliability in table below illustrates 'improvements in infrastructure' with 0.905, 'agricultural mechanization' with 0.889, 'economic development' with 0.899, 'reduction in losses' with 0.884 and 'farmer's access to inputs' with 0.891 value. All the reported values are well above .70 and confirm the significant composite reliability for factors concerned. The respective convergent validity in table below shows the factor loadings values varies maximum with item statement 'IN2' 0 .870 to minimum with item statement 'RL2' as 0.710. All factor loadings are good and above .70 or very close to that. Hence confirms the convergent validity. All reported AVEs value in Table 3 are more than 0.5 and are above MSV and ASV. Hence confirms discriminant validity also. CFA measure for farmer's perceptions signified good model fit indices with the values $\chi 2$ / df = 1.4, CFI = .976, GFI = .932, AGFI=.918, NFI = .931 and RMSEA= .03 respectively. The respective model fit indices point to

significant data-model fit. Hence CFA model of farmer's perceptions can further be tested for structural relationship. The Figure 1 (below) presents the five factor validation model for the farmer perceptions.

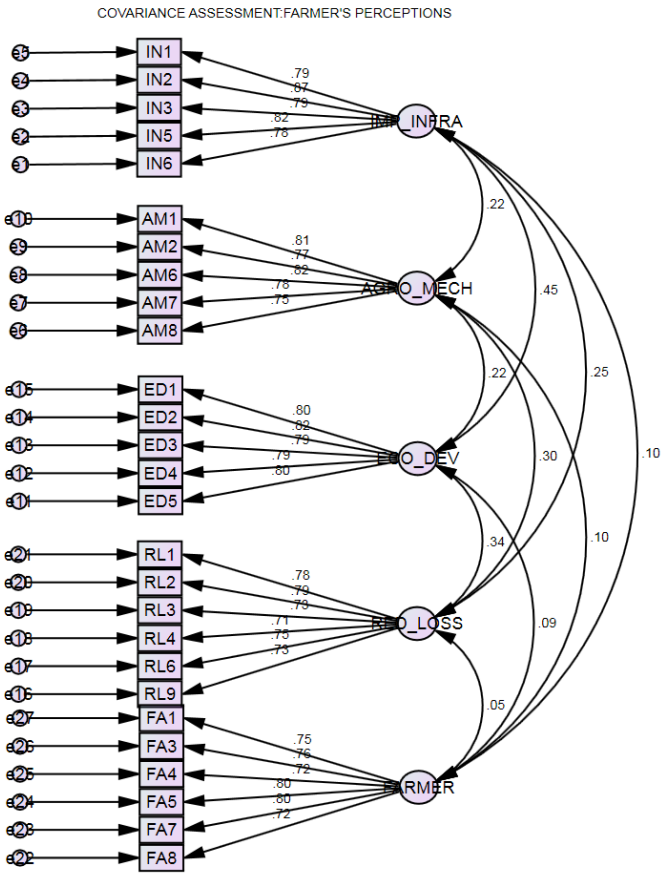

Figure1
CONVERGENT VALIDITY ASSESSMENT FOR FARMER'S PERCEPTIONS: FIVE FACTOR MODEL

Table 3
CONVERGENT VALIDITY MEASURES: FARMER'S PERCEPTIONS OF AGRICULTURAL INFRASTRUCTURE

	CR	AVE	MSV	ASV	CronBach Alpha	Loading statements
FARMER	0.891	0.577	0.010	0.008	0.904	7
IMP_INFRA	0.905	0.657	0.202	0.081	0.905	5
AGRO_MECH	0.889	0.616	0.092	0.050	0.888	5
ECO_DEV	0.899	0.639	0.202	0.093	0.898	5
RED_LOSS	0.884	0.560	0.113	0.068	0.883	6

Table 4 CORRELATION ASSESSMENT					
	FARMER	**IMP_INFRA**	**AGRO_MECH**	**ECO_DEV**	**RED_LOSS**
FARMER	0.759				
IMP_INFRA	0.101	0.810			
AGRO_MECH	0.097	0.219	0.785		
ECO_DEV	0.094	0.449	0.225	0.800	
RED_LOSS	0.048	0.254	0.303	0.336	0.748

The convergent validity assessment for farmer's perceptions revealed that the composite reliability (CR) for all the considered factors is within the satisfactory range of 0.7 to 0.99. The factors 'FARMER' representing farmer's access, 'IMP_INFRA' representing factor improvement in infrastructure, 'AGRO_MECH' representing agricultural mechanization, 'ECO_DEV' representing economic development, 'RED_LOSS' representing reduction in losses; all were observed in range of 0.8 to 0.99; that stands for satisfactory range. The respective average variance extracted (AVE)-an indicator of variance and overall item and scale convergent validity identifies as prevailing in safe range for data being assessed for research. The respective measures of MSV and ASV also signify the satisfactory convergent outcomes. Since this study is exploratory and scale items are a mixture of pre-validated sub scale items and self-devised, hence the further structural modeling can be undertaken. In similar manner, the CFA model validation for 'Perceptions of agricultural productivity' with the factors 'land reforms', 'increase in yield', 'improvement in marketing', 'and 'increase in agricultural productivity' was undertaken with aid of five, seven, six and seven indicators in Figure 2 below; a total of twenty 25 items were measured. The respective reliability measure (Cronbach alpha measure for reliability) was observed well within range .5 and 1 for 'farmer perceptions of agricultural production'. This shows 'social aspects' with 0.934, 'land reforms' with 0.895, 'increase in yield' with 0.910, 'improvement in marketing' with 0.921 and 'increase in agricultural productivity' with 0.896 value as satisfactorily in range as acceptable (illustrated in Table 3 above). All the reported values hence confirm the significant reliability. The composite reliability measures as illustrated in Table 3. The Table 4 illustrates 'social aspect' with 0.934, 'land reforms' with 0.896, 'increase in yield' with 0.899, 'improvement in marketing' with 0.898 and 'increase in agricultural productivity' with 0.897 values respectively. All the reported values are well above .70 and confirm the significant composite reliability for factors concerned. All factor loadings are good and above .70 or very close to that. Hence confirms the convergent validity. All reported AVEs value in Table 4 are more than 0.5 and are above MSV and ASV. Hence confirms discriminant validity also. CFA measure for farmer's perceptions of agricultural productivity signified good model fit indices with the values $\chi 2$ / df = 2.8, CFI =0.903, GFI = 0.942, AGFI=.908, NFI = 0.952 and RMSEA= 0.05. Hence CFA model of personal skills can further be tested for structural relationship. The Figure 2 (below) presents the five factor validation model for the outcomes vis a vis the farmer perceptions.

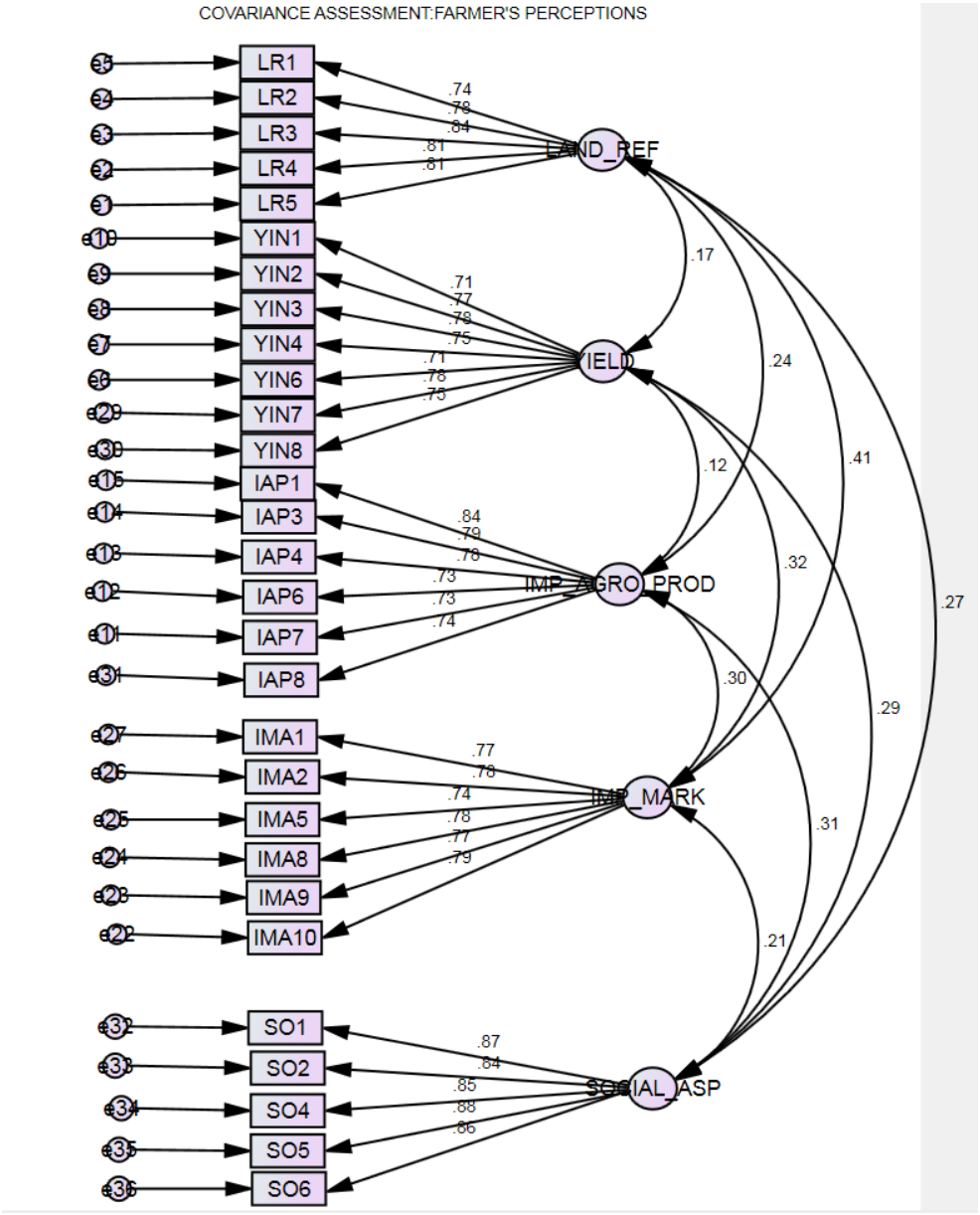

FIGURE 2
CONVERGENT VALIDITY ASSESSMENT FOR FARMER'S PERCEPTIONS OF AGRICULTURAL PRODUCTION: FIVE FACTOR MODEL

Source: AMOS

Table 5
CONVERGENT VALIDITY MEASURES: FARMER'S PERCEPTIONS OF AGRICULTURAL PRODUCTION

	CR	AVE	MSV	ASV	CronBach Alpha	Loading Statements

SOCIAL_ASP	0.934	0.739	0.097	0.075	0.934	5
LAND_REF	0.896	0.632	0.172	0.083	0.895	5
YIELD	0.899	0.560	0.105	0.058	0.910	8
IMP_AGRO_PROD	0.897	0.592	0.097	0.065	0.896	6
IMP_MARK	0.898	0.596	0.172	0.103	0.921	8

Table 6
CORRELATION ASSESSMENT

	SOCIAL _ASP	**LAND_ REF**	**YIELD**	**IMP_AGRO _PROD**	**IMP_ MARK**
SOCIAL_ASP	0.860				
LAND_REF	0.271	0.795			
YIELD	0.294	0.165	0.748		
IMP_AGRO_PROD	0.311	0.242	0.115	0.769	
IMP_MARK	0.209	0.415	0.324	0.302	0.772

Source: AMOS

The convergent validity assessment for farmer's perceptions revealed that the composite reliability (CR) for all the considered factors is within the satisfactory range of 0.7 to 0.99(as illustrated in Table 5). The factors 'IMP_MARK' representing improvements in marketing, 'LAND_REF' representing factor land reforms, 'YIELD' representing increase in yield, 'IMP_AGRO_PROD' representing increase in agricultural production; all were observed in range of 0.8 to 0.99; that stands for satisfactory range. The respective inter factor correlation was also observed to be significant (as mentioned in Table 6). The respective average variance extracted (AVE)-an indicator of variance and overall item and scale convergent validity identifies as prevailing in safe range for data being assessed for research.

DISCUSSION

The construct validity of farmer's perceptions of agricultural infrastructure and development in Jammu and Kashmir remains a determining step towards measure establishment. The five factor model establishes the standardized measure of farmer's perceptions of agriculture infrastructure as shaping marketing and yield as well as agricultural productivity. The study reflects on the need for standardized measure of farmer's role in infrastructure development across rural areas. The study yielded a common indicator of infrastructure development in agricultural perspective. The indices could possibly assist and equip the future studies on subject matter and even be extended to incorporate marketer's and government's perspective as well. The study could be beneficial in enriching the future researchers with regard to common measures of phenomenon.

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