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Impact of Knowledge and Infrastructure on Paddy Productivity

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Abstract

The Knowledge acquired through both formal and informal sources and infrastructure available with amicable accessibility provides major incentives to the farmers not only to improve their agricultural productivity but also the living standard and livelihoo d pattern. In this paper thus an attempt has been made to develop the Knowledge Index (considering both formal & informal sources of knowledge) and Infrastructural Index in order to observe the impact of these two indices on the agricultural productivity across the farm sizes and villages with varied irrigation status under study. A total sample size of 474 has been considered for the study. The analytical tool i.e **. PCA** has been used for the construction of Knowledge and Infrastructural indices. The Simple Linear regression (OLS) has been undertaken to observe the effect of knowledge index, infrastructural index and the interaction of the two indices on the productivity. A significant positive impact of knowledge index, infrastructural index and their interaction on productivity has been found.

Key Words: Principal Component Analysis (PCA), Knowledge Management, Knowledge Index, Infrastructural Index, Interaction Effect, Productivity.

Introduction:

The agricultural sector of India in general and that of Odisha state in particular has the greatest potentiality for improving rural livelihood and eradicating poverty through assimilation of the adoption of modern technology and management practices of agricultural knowledge backed by required infrastructure to improve the production and productivity in a sustainably cost-effective manner.

Knowledge Management can play an important role in improving agricultural productivity and addressing the problem of food insecurity across the farm sizes and regions of various states in our country. If managed properly, it enables dissemination of appropriate knowledge amongst various farm sizes including the focused group i.e. small farms through various knowledge intermediaries. The flow of knowledge and information to the small farms besides the other farm sizes not only minimize their risk and uncertainty faced from production to marketing of their produces but also broadly helps in improving the agricultural productivity. However appropriate and adequate mechanisms are required for generating, capturing and disseminating

knowledge and information through the use of effective processes and institutional arrangement so that effective agricultural knowledge management can be achieved for obtaining the targeted results.

The sources of agricultural knowledge include both exogenous or acquired (may be from the results of scientific research/trainings/other sources) and innate or indigenous knowledge. Besides others, as an exogenous sources of knowledge in the present day the Information and Communication Technology (ICT) can play a pivotal role in facilitating rapid, efficient and cost effective knowledge management so as to achieve the productivity enhancement of small farmers. However, the ICT application in India as well as in Odisha state is quite low in comparison to other developed nations of the world and developed states of India respectively even though the government has been taking measures to popularize the ICT application for disseminating of agricultural knowledge to the farmers. The technology related advice as well as market information on inputs and output through ICT such as electronic media/mobile phones/internet etc. should be popularized more to reach to the levels of small farmers.

Besides this the effect of formal education, informal education acquired by neighborhood effect or otherwise, training, experience and extension services etc. have important to add to the knowledge and management base of the farmers which can be reflected in terms of improvement in farm productivity.

The effect of knowledge acquired through various means and process/practice of Knowledge management through various techniques on efficient farm management and enhancement of farm productivity has been discussed in many ways by sever al experts with varied opinions with the ultimate conclusion of its positive effect on farm productivity. It is observed by a plethora of study (Birkhaeuser et al. 1991; T.W. Schultz,1964;Krishna Kumar, 1966; Welch,1978;Roling, 1992;AFAAS, 2011;Singh et.al, 1979, Sidhu, 1978, Chaudhri, 1979; Tilak, 1979; Ram,1980; Kaliranjan and Shand, 1984; Raja and Ramchandran,1990; Duraisamy, 1992; Narainmoorthyet al., 2000; Kashem, M.A. et al., 1992;Adhiguru, P. at el., 2009;Kinney, 1998;Nonanka and Takeuchi, 1995;Probst, *et al.,* 2000etc.) that knowledge and its management in farming by the farmers result in positive correlation with the adoption of modern technology in a cost-efficient manner for realizing higherproduction and productivity.

Infrastructure plays a strategic role in producing large multiplier effects in the growth of an agrarian economy.The importance and role of Physical Infrastructure like transport, power, irrigation, tractors, adoption of modern inputs, research, extension , access to institutional finance viz. agricultural credit cooperative societies/ Cooperative Banks /RRBs/ Commercial Banks, regulated and wholesale markets, access to fertilizer sales point and warehousing / storage etc. coupled with Social infrastructure like education, sanitization, dwelling status, livestock management

facilities etc. are the critical components affecting agricultural productivity significantly in Promoting Agricultural Development. A plethora of study (Andersen and Shimokawa, 2007;World Bank, 1997;. Biswanger et al., 1989;Fan et al.,1998;Fan et al. (2004)Bhalla and Singh,2001;Majumdar,2002;Thorat and Sirohi, 2002; A.Narayanamoorthy et al., 2006; Aschauer, 1989; Calderon and Chong, 2004 ; ADB et al., 2005; Ruttan, 2002; Antle, 1983; Dhawan, 1988; Vaidyanathan,1999, Barnes and Binswanger, 1986; Vaidyanathan et al., 1994; Ahmed and Donovan, 1992; ESCAP,2000; Van de Walle, 2002; Ramachandran and Swaminathan,2002;Ahmed and Hossain, 1990;Bhatia, 1999;Evenson and Gollin, 2003; Murgai et al., 2001; Hussain and Hanjra, 2003,2004; Ghosh, 2002, Gidwani,2002; Shah and Singh, 2004; Dhawan and Yadav, 1995; Ostrom et al., 1993;Wharton, 1967;Gilberto M. Llanto,2012; Fan, Hazell and Thorat, 2000;Mamatzakis, 2003;Craig et.al, 1997;Evenson and Quizon, 1991; Manalili and Gonzales, 2009; Nasir Nadeem et.al., 2011; Bloom et al., 2004; Ashok and Balasubramanian, 2006; Shakeri, 2004; Leinbach,1983; Gujrati, 2003 etc.) in this direction have been conducted to reveal the impact of infrastructure on agricultural productivity with varied perspectives.

Objectives of the Study:

The impact and importance of Knowledge and Infrastructure for the improvement of agricultural productivity in particular and development of agricultural sector in general reveals a positive result. However, the composition of knowledge and its management as well as that of Infrastructure while making their impact study by various experts differ by views, areas, situations and circumstances pertaining to agricultural productivity baring a few who have studied the composite impact using cross sectional data. Thus, an attempt has been made in this studyto develop a knowledge index and Infrastructural index based on certain specific parameters to analyze their individual and interactive impact on rice productivity across various farm sizes and agro-climatic zones. The following specific objectives are to:

a) Analyze the available and accessible sources of knowledge and Infrastructure across different farm sizes and areas with varied irrigation status
b) Construct the Knowledge Index and Infrastructure Index to identify the pace of development of farmers of various farm sizes and area with varied irrigation status,
c) Access the impact of Knowledge Index , Infrastructure Index and their interaction on agricultural Productivity (i.e. productivity of rice) across different farm sizes and areas with varied irrigation status

Data Base and Methodology

The data base of the study constitutes the primary data collected across various farm sizes classified on the basis of operational land holdings such as Small (upto5.00 acres), Medium (5.01 acres to 10 acres) and Large (10.01 acres and above) of three

villages with varied irrigation status(by canal irrigation status under Hirakud command area)viz. irrigated (VI), semi-irrigated(VII) and non-irrigated areas(VIII) located in three different blocks of Bargarh district of Odisha during the year 2017 - 18. Altogether 474 farm households have been considered for thestudy.In this study the farm size wise and area wise analysis has been made. The formal (i.e. year of education) and informal sources (the other variables) of knowledge based on certain specific parameters (as shown in the subsequent discussion) have been considered to construct an Index of Agricultural Knowledge (termed as Knowledge Index) by using PCA in order to assess the level of development of knowledge of the farmers on issues of agriculture in the area under study. Similarly, an Infrastructure Index has been constructed by using PCA based on certain specific parameters to assess the level development in level of available infrastructure across different farm sizes and villages under study. The Knowledge and Infrastructure being two of the important factors for improving and managing agricultural productivity, a Linear Regression analysis (OLS) has been used to observe the effect of Knowledge Index, Infrastructure Index and their interaction on Productivity of Rice across different farm sizes and villages under study. Further, significant difference of the regression lines across farm sizes and villages has also been made confirmed by Chow-Test.

The parameters considered for Knowledge Index and Infrastructure Index as well the analytical tools used for the purpose of this chapter are as follows.

The parameters considered for constructing Knowledge Index are: K_1= Number of Year of schooling, K_2= Number of Year of experience, K_3= Numbers of Training attended, K_4= Numbers of Extension contacts made, K_5= Numbers of Media (Electronic/Print) often used for Agricultural Information, K_6= Numbers of Meeting (of farmers or on farming) attended during the year.

The parameters considered for constructing Infrastructure Index are : I_1=Cropping Intensity, I_2= Percentage of Gross Irrigated area to Gross Cropped Area, I_3= Area Leased in as a percentage of Net Area Operated, I_4= Percentage of formal credit to Total credit, I_5= Percentage of production spent on electricity, I_6= Percentage of Production spent on transportation cost, I_7= Number of Phones (land and mobile phones) held by the household, I_8=Year of Education, I_9= Percentage of area under Pacca house to total area of the house, I_{10}= Number of latrine in the house, I_{11}= Average distance from hospital with specialist doctors, I_{12}= number of years of Membership in PACS, I_{13}= Percentage of Marketable Surplus sold to Regulated Market, I_{14} = Percentage of 0f Marketable Surplus kept in warehouse, I_{15}= Percentage of modern equipments/inputs to total equipments/inputs, I_{16}= Percentage of expenses on Machine labour to total expenses on labour (of all types such as human & bullock labour etc), I_{17}= Number of times visited to Veterinary hospital/center for livestock.

The Principal Component Analysis (PCA)has been applied as an analytical tool to construct the knowledge index and infrastructure index to examine the level of their development based on the above stated parameters.

PCA is a multivariate statistical technique used to reduce the number of variables in a data set into a smaller number of „dimensions". In mathematical terms, from an initial set of n correlated variables, PCA creates uncorrelated indices or components, where each component is a linear weighted combination of the initial variables. For example, from a set of variables X_1 through to Xn,

$$PC_1 = a_{11}X_1 + a_{12}X_2 + \cdots + a_{1n}X_n$$

$$PC_m = a_{m1}X_1 + a_{m2}X_2 + \cdots + a_{mn}X_n$$

where a_{mn} represents the weight for the mth principal component and the nth variable.

The advantage of such statistical weights (i.e. Factor Loading) lies in the fact that large variations in any one of the indicators do not undermine the contribution o f the other indicators and distort inter-farm comparisons. The corresponding weights are calculated for all the indicators during the year under. Based on the value of factor loading obtained from the PCA, the parameters are ranked and the significance of the parameters in terms of their importance compared to other factors under study for the said purpose have been identified.

By multiplying the individual weights (i.e. Factor Loadings) with individual indicators we find the index value. Based on these, weighted indices (by using PCA) of knowledge and infrastructure for all the samples under study are computed and presented according to their ranks.

Though the indices and their ranking speak eloquently about relative position of the farms in the developmental scale, it cannot indicate the particular stage of development in a particular farm size / village. Therefore, an attempt has been made to divide the farms into four groups, namely, Highly Developed, Developed, Developing, and Less Developed farms based on only the specific parameters considered for the purpose as indicated above. The classification of this type has been made on the basis of the following criteria (considering the mean and standard Deviation of Total Score) as follows.

Classifications	**Criteria**
Highly Developed	Total Score>Mean + SD
Developed	Mean ≤ Mean + SD
Developing	Mean ≤ Mean-SD
Less developed	0 ≤ Mean - SD

The Linear Regression model (OLS) has been used to assess the impact of knowledge index, infrastructure index and the interaction of these two indices on the rice (paddy)

productivity across different villages such as V-I, V-II and V-III and farm sizes such as Small, Medium and Big farms separately. The regression equation is follows.

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ui$$

Where α is the intercept and β_1 ….. β_3 are the partial regression coefficients

u_i is the stochastic disturbance terms

Y = Productivity of Rice (i.e. production per acre in Rupees) X_1 = Value of Knowledge index

X_2 = Value of Infrastructure Index

X_3 = Value of the product of Knowledge & Infrastructure Indices (Interaction)

The result of the OLS estimate of the multiple regression is recorded in table -7.

The regression results for the above stated function was worked out for various farm sizes (small, medium and large) and villages (V-I, V-II and V-III) and compared with the pooled data (All-V). To observe the behaviour of a particular size group and village to understand whether it is significantly different from other size groups and villages or not popularly used "Chow test" was undertaken and „F" value was found out from the test and the farm sizes and villages found significantly different from each other were considered for further analysis.

Given the assumptions of the Chow test procedure, it can be shown as follows:

$$F = \frac{S_6/K}{S_5/(N_1 + N_2 + N_3 - 3K)}$$

Follows the „F" distribution with df = (K, $N_1+N_2+N_3$-3K).

For instance, where, K = number of parameter estimated (i.e. 4) and N_1, N_2& N_3 are no. of observations of the various groups (small, medium and large farms respectively).

$S_6 = S_1 – S_5$, where S_1 = Residual sum of square (RSS) for pooled data, S_2, S_3 and S_4 are the RSS for small, medium and large groups respectively. df is degree of freedom

If the „F" computed from Chow test exceeds the critical F value at the choosen level of α, reject the hypotheses that the regressions of small, medium and large are the same, that is, reject the hypothesis that there exists significant difference i n the regression lines of different farm sizes.

In the same manner Chow test has been undertaken i.e. the „F" value based on Chow test has been calculated for each village (V-I, V-II and V-III) & compared with entire sample (pooled data) and the same manner the significance test is conducted.

Knowledge Index:- Indicators

In some of the studies the impact of education (formal education i.e. schooling) index and in some other studies the impact of informal education (i.e. learning occurred through experience and other sources of information) on agricultural productivity have been observed which often provides a partial information of the farmers" knowledge on agricultural productivity. Thus an attempt has been made in this study to construct a knowledge index by considering the indicators of both formal (K_1= Number of Year of schooling), and informal [K_2= Number of Year of experience, K_3= Numbers of Training attended, K_4= Numbers of Extension contacts made, K_5= Numbers of Media (Electronic/Print) often used for Agricultural Information, K_6= Numbers of Meeting (of farmers or on farming) attended during the year] education and information so as to observe the level of its development across the farm sizes and villages under study and subsequently the impact of the knowledge index constructed on the agricultural (paddy) productivity.

An overview of the parameters considered for construction of Knowledge index can be discussed with the help of the descriptive statistics depicted in the table - 1.4(across villages), 1.4(a) [across farm sizes] and 1.4(b) [across villages and farm sizes].

Education

It is observed from table-1.4that on an average in V-I the educational status of small and medium categories of farms is upper primary (class 7 th) whereas for big farm it is secondary (class 8th). So the educational status varies directly with farm size in V-I. The highest education irrespective of farm sizes found in VI is Graduation (Class 15 th) even though the percentage is higher for big farms followed by medium and small farms. Similarly the lowest education status i.e. Illiterate is also found in each categories of farm sizes in V-I even though the percentage of it is observed more for small farm size followed by Medium and big farms. Further, it is observed from the entire sample of V-I (irrespective of farm sizes) that on an average the education of most of the farmers is upper primary baring a few having higher education like graduation and some farmers are illiterate. The variation in the pattern of education across the farm sizes (Intra variation) and pooled data of V-I found is less as evident from the respective C.V. as shown in table-1. In V-II the average year of schooling (education) found for small farm is primary (class 4 th) whereas it is upper primary and secondary for medium and big farms. So the educational status varies dire ctly with farm size in V-II. The highest education is higher secondary (12 th) for Small and graduation (15th) for medium and big farms. Further, certain percentage of farms (where as observed higher percentage attributed to small farms followed by medium and big) are found illiterate in each of the categories of farm sizes in V -II. Further, it is observed from the entire sample of V-II (irrespective of farm sizes) that on an

average the education of most of the farmers is primary (up to class 5 th) baring a few having higher education like graduation and some farmers are illiterate. The variation in the pattern of education found across the farm sizes (i.e. intra variation) and pooled data of V-II is found as evident from the respective C.V. as shown in table-1. In VIII also the educational status varies directly with farm size. The average educational status found across the farm sizes and for the entire sample in V -III is primary level. The highest education levels found for small, medium and big are 12 th, 15th and 10th respectively with the least educational status is illiterate found in all categories of farms. The variation in the pattern of education across the farm sizes (Intra variation) and pooled data of V-III found is less as evident from the respective C.V. as shown in table-1.4.

The table-1.4(a) and 1.4 (b) derived from table-1.4 are showing the Inter-farm and Inter- Village variation. It is observed from table-1.4(a) that there exists an inter-variation in the level of educational status in each category of farm sizes belongs to three different villages (with varying irrigation and hence agricultural development status). For instance, the educational status of small farms of V-I is higher relatively to that of V-II and V-III. The educational status of Medium farms in V-II is found higher compared to that of V-I and V-III. There exists (on an average) a little variation between the level of education of the big farms of V-I and V-II but more variation with that of big farms of V-III. It is thus observed that the inter-farm variation in the educational level is more favourable for farms belong to V -I compared to V-II and V-III. Similarly, it is observed from table-1(b) that there exists inter-village variation where the average level of educational s tatus of farmers belongs to V-I found is comparatively higher than that of V-II and V-III. Further, table-1.4(b) reveals that the level of educational status (on an average) varies directly with the farm sizes.

It can thus be inferred from the intra and inter farm analysis of the average educational status of different farm sizes that there exists a direct relationship between the level of average educational status and farm sizes. Further, the average level of education in V-I found is relatively higher than that of V-II and V-III.

Experience

The average year of experience found for small farms is around 19 years and that of medium and big farms is around 23 years in V-I as shown in table-1.4. There are farmers having more than 50 years, more than 40 years and around 40 years of experience found in small, medium and big farm sizes respectively whereas the minimum experience is ranging from 3 to 7 years with big farms being the least in this range. However, the average experience in V-I found is 21 years with highest 53years and least 3 years for some farms in V-I. So experience varies directly with farm size in V-I. The average experience of the farmers is found around 16 years with farmers

having more experience belongs to small far size followed by big and medium farm sizes. Similarly, in V-III, the average experience of farmers is found around 17 years with farmers having more experience belongs to big farm size followed by small and medium farm sizes as shown in table-1.4. There exists intra-farm variation in each village as shown by their respective C.V.. It is observed from the table -1.4(a) which shows the inter-farm variation that the small and big farms of V-III are more experienced compared to that of V-I and V-II whereas the medium farms of V-I are more experienced compared to that of V-III and V-II. So there exists an inter farm variation which is also revealed by the C.V.as shown in table-1.4(a). Similarly, it is observed from table 6.5 (b) which shows inter-village variation that on an average the more experienced farmers belongs to V-I compared to that of V-III and V-II. Further, table-1.4 (b) shows that farmers belong to big farm size are more experienced followed by small and medium farm sizes.

It can thus be deduced from the analysis of the year of experience of the farmers in farming that there exists intra and inter variations across the farm sizes and villages. The famers belongs to big farm size and the farmers belongs to V -I (irrigated village) are found more experienced relative to the other categories of farmsand villages respectively in the area under study.

Training

The average number of training on farm and farming related activities attended (during a year) by the farmers of all size groups is more than two with a higher share of farmers belongs to small farm size in it followed by big and medium farm sizes in V-I. The average number of training attended by farmers in V-II found is around one irrespective of farm sizes. The average number of training attended by farmers in V -III found is less than for small and medium farm sizes whereas it is around one for farmers belong to big farm size. It is observed from the inter-farms comparison as shown in table-1.4(a) that the small, medium and big farm sizes belongs to V-I have attended more number of training compared to that of the farm sizes belongs to V-II and V-III. Similarly, from the inter-villages variation as shown in table-1.4(b) it is found that the higher number of training attended (on an average) by the farmers belongs to V-I than that of V-II and V-III. Further, it is also found that the farmers belongs to big farm size have attended more number of training followed by small and medium farm sizes.

It can thus be inferred that there exists an intra and inter variation in the num ber of training attended by the farmers across different farm sizes and villages under study. The number training programmes attended by farmers belongs to V-I (irrigated villages) relative to other villages (irrespective of farm sizes) and that of farms belongs to big farm size (irrespective of villages).

Extension Contacts

It is observed from table-1.4 that the average number of extension contacts made by the farmers in V-I is around three during a year. The number of extension contacts made by the farmers in V-I is showing a direct relationship with the farm sizes as highest number of contact during a year is made by big farms followed by the medium and small farms. This may be an indication of the less accessibility of small farms to the extension staffs and/or extension services provided at different levels. In V-II the average number of extension contact made is around one during a year. However on an average more than two times the extension contact made by the Medium farms followed by big and small farms in V-II as depicted in table-1.4. This also shows that the small farms may be less accessible to extension contact. In V -III the average number of extension contacts made by the farmers irrespective of their size groups is found less than one. This indicates that a few farmers from each of the farm sizes (within the few the contacts made by big farms is more compared to that of medium and small) made a few extension contacts. It implies that either the extension services are not properly available to the farmers or not properly accessibly by the farmers as the extension contacts made is quite negligible in V-III. The same pattern of intra and inter farms and inter villages variation is found as depicted in table-1.4(a) and (b) viz. the small farms are not properly accessible to extension contacts compared to other farm sizes and the farms of all sizes in V-I are relatively more accessible to extension contacts followed by V-II and V-III.

It can thus be deduced from the analysis made above that there exists almost a “direct relationship” between the extension contacts made by the farmers and the farm sizes. Further, it is found that the extension contacts made by the farms (all Sizes) in irrigated area (agriculturally developed) are more than that of non-irrigated area under study.

Media sources

The media (Electronic/Print) is one of the important sources of obtaining information regarding various aspects of agricultural development by the farmers. It is observed from the table-1.4 that irrespective of the villages under study the big farm size are using on an average two media (mostly Television and News Paper) followed by one media (either T.V. or News Paper) by some of medium and few of the small farms. Thus the number of media used as a source of information for agricultural development is directly related to farm sizes and the farmers of V-I (irrigated village) are using mostly two sources (TV & News paper) of media for information compared to farmers of V-II and V-III as shown in table-1.4(a) and (b).

Meetings

The meeting attended either as member of farmers" club or member of Primary Agricultural Cooperative Society (PACS) or member of JLG or otherwise during a year has been considered for the said purpose as this type of activi ties are also the major source of information for various agricultural operation. The average number of meetings attended by the farmers of V-I is found more than one during the year. However, the number of such meetings attended by the farmers under big f arm size is found more than two during the year followed by the medium and small farm sizes in V-I. The same pattern is found for farms sizes of V-II and V-III as shown in table-1.4. The numbers of meetings attended by the Medium and Big farmers of V-II is found higher than others as depicted in table-1.4(a). Further the number of meetings attended by the farmers of V-II is found higher followed by V-I and V-II and further a direct relationship between the numbers of meetings attended and farm sizes has bee n observed as shown in table-1.4(b).

Infrastructure Index: Indicators

In some of the studies the impact of physical infrastructure and in some other studies the impact of social infrastructure on agricultural productivity have been observed which often provides partial information on the strength of the farmers" infrastructu re affecting agricultural productivity. There are few studies which considered the indicators of both physical and social infrastructure for developing infrastructure index and to analyze its impact on agricultural productivity. Thus an attempt in the similar line has been made in this study to construct an infrastructure index by considering some of the indicators of both physical and social infrastructure of the farmers to assess its impact subsequently on agricultural productivity.

An overview of the parameters considered for construction of Infrastructure Index can be discussed with the help of the descriptive statistics depicted in the table - 1.5(across villages), 1.5(a) [across farm sizes] and 1.5 (b) [across villages and farm sizes].

Cropping Intensity : The average cropping intensity found for V-I, V-II and V-III are 171, 134 1nd 97 percent respectively and the cropping intensity in all the villages are found directly related to farm sizes as depicted in table-1.5. The copping intensity in V-I is found for all farm sizes is found higher followed by that of V-II and V-III and the cropping intensity of big farms is higher compared to other farm sizes as shown in table-1.5(a) and (b)

Gross Irrigated area to Gross Cropped Area : The percentage of Gross Irrigated area (GIA) to Gross Cropped Area (GCA) found on an average is 83.5 percent in V -I and it varies directly with the farm size in V-I as shown in table-1.5. Similarly, the

ratio of GIA to GCA found on an average in V-II is around 60 percent and the percentage share in this ratio is attributed more to medium farms followed by big and small farms in V-II. The ratio is quite negligible in V-III being non-irrigated.

Area Leased in to Net Area Operated: This ratio indicates the magnitude of tenancy prevailing across the farm sizes and villages. This ratio is found on anaverage around
20 percent each for Small farms as well as Big farms in V-I. In V-II it is on an average found around 30 percent each for medium and big farms. In V-III, it is found on an average around 20, 30 and 20 percent for small, medium and big farms respectively as shown in table-6.6.

Formal credit to Total credit: The percentage share of formal credit to total credit is found on an average around 40% in V-I and the share of formal credit total credit is found increases with the increase in farm sizes in V-I as depicted in table-1.5. Similarly, in V-II and V-III the percentage share of formal credit to total credit is found on an average around 27 and 13 percent respectively and in these villages (V-II and V-III) also the share of formal credit total credit is found increases with the increase in farm sizes as shown in table-6.6. The same is also reflected in table-1.5(a) and (b).

Expenses on Electricity: The percentage share of income from total production spent on electricity consumption for agricultural activities has been considered to observe the magnitude of electricity in agricultural operations. It is found quite negligible across the villages and farm sizes under study as shown in table 1.5, 1.5(a) and (b).

Expenses on transportation cost: The percentage share of income from total production spent on transportation for agricultural activities has been considered to observe the magnitude of transportation used for input-output transactions in agriculture. It is found quite negligible across the villages and farm size s under study as shown in table 1.5, 1.5 (a) and (b).

Telephone usage for Information: The number of telephones available to the farm households for personal use as well as for gathering information for agricultural information has also been considered as an infrastructure useful for the farmers to reduce their transaction cost. It is observed from the table-1.5 that in each of the villages (V-I, V-II and V-III) under study every farm households irrespective of farm sizes have possessed on an average one number of telephone (mainly mobile phone). However the some of the farm households belong to big farm sizes have more than one number of phones.

Education: It is observed from table-2 that on an average in V-I the educational status of small and medium categories of farms is upper primary (class 7 th) whereas for big farm it is secondary (class 8 th). So the educational status varies directly with farm size in V-I. In V-II the average year of schooling (education) found for small farm is primary (class 4th) whereas it is upper primary and secondary for medium and big farms. So the educational status varies directly with farm size in V -II. In VIII also the educational status varies directly with farm size. The average educational status found across the farm sizes and for the entire sample in V-III is primary level. It is observed from table-1.5 (a) and (b) that there exists a direct relationship between the level of educational status and farm sizes. Further, the average level of education in V-I found is relatively higher than that of V-II and V-III.

Pacca house to total house area: The condition of the residence of the farm household is one of the important infrastructural indicators which provide comfort to the farmers to undertake agricultural operations as well as to keep the agricultural produces safely. Thus the proportion of Pacca area (concrete house) to the total area of the house is considered as an indicator here. The percentage of pacca house to the total house area on an average is found around 70 percent in V-I and this proportion of pacca house is found increases with the increase in farm sizes. In V-II and V-III it is found as around 60 and 55 percent respectively and it also shows a direct relationship with farm sizes in these villages. So in V-I and for Big farms in all villages the pcca house is found higher compared to others.

Sanitary arrangement in the house: The sanitary arrangement made in the house (such as number of latrines) by the farm household is one of the important infrastructural indicators (in certain studies it is considered as physical and in some others as social infrastructure) which provide comfortable staying to the farmers and to undertake agricultural operations.

Distance to hospital (with specialist doctors): There are some hospitals with varied number of specialized department and specialist doctors are located in different parts of the district and nearby to the districts/blocks under study. It depends on the accessibility, need and affordability of the framers belongs to different farm sizes to avail the said facilities and as such health care is one of the important infrastructural indicators to help the farmers to maintain their productivity for undertaking agricultural operations. The average distance found from such hospital is around 18 k.m., 42 k.m. and 38 k.m. from V-I, V-II and V-III respectively as shown in table-1.5. However, different farmers belongs to different farm sizes are going to different hospitals based on their need and affordability and hence the average distance from such hospital for different farm sizes are different as depicted in table -1.5. The

average distance from hospital is found relatively higher for big farm size which indicates that they might have gone to hospital with greater specialization as it might have affordable to them compared to other farm sizes.

Membership in Primary Agricultural Cooperative Society (PACS): There are all most all farmers of all size groups are the members of the PACS. Some of them have taken membership since long (as PACS is very old rural institution) and some have taken membership since last one decade. So here it is considered that since how many years a farmer has been a member of PACS which indicate the magnitude of institutional support availed by the farmer concerned for agricultural operations. The average years of membership in PACS is found as 10, 6 and 5 years for V -I, V-II, and V-III respectively and the years of membership is found increasing with the increase in farm sizes (indicating big farms participation in farming and hence availing institutional benefits since long compared to other farm sizes) as shown in table-1.5.

Marketable Surplus sold to Regulated Market: The proportion of marketable surplus sold to regulated market reveals the accessibility of farmers to regulated market and strength of regulated market infrastructure to render its benefits to farmers. The average proportion of marketable surplus (of paddy) sold to regulated market is found as around 42, 32 and 16 percent in V-I, V-II, and V-III respectively and further this proportion is found increasing with the increase in farm size as shown in table-1.5.

Storage of Marketable Surplus warehouse: The proportion of marketable surplus kept in warehouse reveals the bargaining strength of farmers. The average proportion of marketable surplus (of paddy) stored at warehouse is found as around 10, 5 and 2 percent in V-I, V-II, and V-III respectively (indicates poor warehousing facility) and further this proportion is found increasing with the increase in farm size as shown in table-1.5.

Ratio of modern equipments to total equipments : The proportion of modern equipments hold by the farmers out of the total equipments available to them indicate their infrastructure holding strength to adopt the modern technology and adapt the technological change in farm operations. The average proportion of modern equipments hold by the farmers out of the total equipments available to them is found as around 26, 13 and 5 percent in V-I, V-II, and V-III respectively (indicates relatively more use of traditional methods of farming in less irrigated and non - irrigated area) and further this proportion is found increasing with th e increase in farm size as shown in table-1.5.

Ratio of expenses on Machine labour to total expenses on labour: The total expenses on labour consist of human labour, machine labour and bullock labour. The proportion of expenses on Machine labour to total expenses on labour indicates the level of mechanization in agricultural operations in the area under study. The average proportion of expenses on Machine labour to total expenses on labour made by the farmers is found as around 4.3, 2.5 and 1 percent in V-I, V-II, and V-III respectively (indicates less mechanization of farming practices) and further this proportion is found increasing with the increase in farm size as shown in table-1.5.

Frequency of Visit to Veterinary hospital/center for livestock: This indicates the availability of physical infrastructure to take care of the livestock of the farmers which has got much relevance in agricultural operations. The average number of times visited to Veterinary hospital / center for their livestock is found as 2, 4 and 1 time(s) in V-I, V-II, and V-III respectively (indicating relatively better facility in V-II than V-I and V-III) and further it is found increasing with the increase in farm size as shown in table-1.5.

Knowledge Index

The knowledge Index across different farm sizes and villages considered for the study has been constructed in order to assess the level of development in the knowledge based on certain specific parameters mentioned in the methodology and table - 1.6. The value of knowledge index has been estimated for each of the sample farms by taking the sum of the product of factor loading (derived from PCA) and the corresponding factors considered for the said purpose. The value of knowledge index has been estimated by using PCA separately for the farms under V-I, V-II and V-III. Similarly, another set of the value of knowledge index has been estimated by using PCA separately for farms under all small, all medium and all big farms (ie. Pooled small, medium and big of V-I, V-II and V-II in aggregation). The farmers/ farms are ranked based on index value and then classified into four categories by adopting the methods of classification (based on mean and standard deviation of index value) as mentioned in the methodology.

The Factor loadings of various factors and frequency distribution of farms across various farm sizes and villages under study falling under different categories of development of knowledge (base on knowledge index constructed for the said purpose) is made and represented in table-1.6,1.6(a), 1.6(b), 1.6(c) and 1.6(d).

Significant factors of Knowledge Index

The factor loadings of the factors (across villages and farm sizes) considered for constructing the knowledge Index are depicted in table-1.6. Based on the value of factor loadings in descending order mostly there are three factors such as $K_{1,}$ K_3 and

K_4 (both formal & informal education components) are found as Significant factors for Knowledge Index whereas K2 is found as least significant factor and the rests are moderately significant as shown in table 1.6(a).

Knowledge lndex across villages and Farm Sizes

It is observed from the table- 1.6 (b) that out of total farms in V-I, V-II and V-III 17, 17 and 15 percent are under highly developed category which indicates that the level of knowledge development on agricultural activities irrespective of irrigation status of the area under study is yet to reach its expected level. However, maximum percentage of the total farms in the respective villages (V-I, V-II and V-III) are found under developed category followed by developing and less developed category as depicted in the table. The same pattern of knowledge dissemination on agricultural activities is also observed in the entire area (All-V) under study. It indicates that there is possibility of enriching their knowledge with suitable management and policy oriented strategy by the government which may ultimately results in productivity improvement through effective management of input and output. Further, it is observed from the table that the same pattern of knowledge development is found while analyzing it for the small, medium and big farms of the entire area under study. The percentage of small farms under highly developed category is found lees than that of medium and big (even though the gap is around 3 to 5 percent). Thus a knowledge management strategy suited to all farm sizes with special importance to small farms is required to designed by the policy makers for the development agriculture irrespective of the differential level of agricultural development and irrigation status of the area under study in particular and district/state in general.

Descriptive Statistics of Index value

The descriptive statistics like mean, standard deviation and coefficient of variation for the total score obtained i.e. index value estimated across the villages and farm sizes under study are represented in table- 1.6(c) which shows the average score And variation in the series.

Knowledge Index across farm sizes

It is observed from table-1.6 (d) which represents knowledge level of different farm sizes in each of the villages that out of the total farms of all size grou ps in V-I under less developed category, the percentage of small, medium and big farms are found as 41, 33 and 26 percent respectively . Similarly, out of the total number of farms under less developed category, the percentage of small, medium and big farms are found as 86, 0 and 14 respectively in V-II. It is found in V-III that out of the total farms under less developed category the percentage of small, medium and big farms are found as 86, 11 and 4 respectively.

It is observed from the table that out of the total farms of all size groups in V-I under developing category, the percentage of small, medium and big farms are found as 28, 33 and 39 percent respectively. In V-II it is 71, 15 and 14 percent for small,medium and big farmsizes respectively. It is found in V-III that out of the total farms under developing category the percentage of small, medium and big farms are found as 51, 47 and 2 respectively

It is observed from the table that out of the total farms of all size groups in V -I under developed category, the percentage of small, medium and big farms are found as 53, 26 and 22 percent respectively. In V-II it is 65, 19 and 17 percent for small, medium and big farms respectively. It is found in V-III that out of the total farms under developed category the percentage of small, medium and big farms are found as 52, 37 and 11 respectively.

It is observed from the table that out of the total farms of all size groups in V -I under highly developed category, the percentage of small, medium and big far ms are found as 48, 15 and 37 percent respectively. In V-II it is 17, 35 and 48 percent for small, medium and big farmsizes respectively. It is found in V-III that out of the total farms under highly developed category the percentage of small, mediumandbig farms are found as 45, 50 and 5 percent respectively.

It can be deduced from the above analysis (made across the farm sizes in each of the villages) that in V-I the percentage of small farms found higher under developed, highly developed and less developed categories compared to other farm sizes where as the percentage of big farms compared to other farm sizes is found higher under developing category. In V-II it is observed that the percentage of Small farms compared to other farm sizes are found higher under less developed, developing and developed categories whereas the big farms are found higher under highly developed category. Further, in V-II it is found that no **(zero)** Medium farm are under the less developed category. In V-IIIalso it is observed that the percentage of Small farms compared to other farm sizes are found higher under less developed, developing and developed categories whereas the Medium farms are found higher under highly developed category. So in brief, Small farms in V-I, Big farms in V-II and Medium Farms in V-III are found under highly developed categories. Further, in V-II it is found that no (zero) Medium farm are under the less developed category

Infrastructure Index

The Infrastructure Index across different farm sizes and villages considered for the study has been constructed in order to assess the level of development in the infrastructure based on certain specific parameters mentioned in the methodology section and table-1.7. The value of infrastructure index has been estimated for each of the sample farms by taking the sum of the product of factor loading (derived from

PCA) and the corresponding factors considered for the said purpose. The value of infrastructure index has been estimated by using PCA separately for the far ms under V-I, V-II and V-III. Similarly, another set of the value of infrastructure index has been estimated by using PCA separately for farms under all small, all medium and all big farms (ie. Pooled small, medium and big of V-I, V-II and V-II in aggregation). The farmers/ farms are ranked based on index value and then classified into four categories by adopting the methods of classification (based on mean and standard deviation of index value) as mentioned in the methodology.

The factor loading of various factors and frequency distribution of farms across various farm sizes and villages under study falling under different categories of development of infrastructure (base on infrastructure index constructed for the said purpose) is made and represented in table-1.7, 1.7(a) ,1.7 (b), 1.7 (c) and 1.7(d).

Significant factors of Infrastructure Index

The factor loadings of the factors (across villages and farm sizes) considered for constructing the Infrastructure Index is depicted in table-1.7. Based on the value of factor loadings in descending order the factors can be categorized into three such as more significant, moderate and less significant as shown in table- 1.7(a).

Infrastructure lndex across villages and Farm Sizes

It is observed from the table-6 that out of total farms in V-I, V-II and V-III 18, 20 and 13 percent are respectively found under highly developed category which indicates that the level of infrastructure development in agricultural activities irrespective of irrigation status of the area under study is yet to reach its expected level with farms of non-irrigated area are lagging behind the irrigated area. Similarly, out of the total farms in V-I, V-II and V-III 28, 23 and 15 percent are found under developed category. There are 34, 41 and 71 percent out of the respective total of farms in V -I, V-II and V-III found under developing category. Similarly, out of the total farms in V-I, V-II and V-III 20, 16 and 1 percent respectively are found under less developed category as depicted in the table.

Further, out of the total small farms of the three villages in aggregation (All S) 16, 29, 32 and 26 percent farms respectively are under highly developed, developed, developing and less developed categories. Similarly, in case of medium farms (All M) 24,19,32 and 26 percent of farms are found under highly developed, developed, developing and less developed categories respectively. In case of big farms (All B) 17, 37, 27 and 19 percent of farms are found under highly developed, develo ped, developing and less developed categories respectively. In the entire area (All -V) under study 22,23, 34 and 22 percent of farms are found under highly developed, developed, developing and less developed categories respectively.

Hence, it can be deduced from this analysis that irrespective of the irrigation status in all the villages under study less than 50 percent of the farms are under highly developed and developed Clubbed together) categories where as more than 50 percent of the farms in these villages are under developing and less developed (clubbed together) categories in the level of development of infrastructure for agriculture and their socio-economic conditions. Similarly, except for Big farm size in all other farm sizes(Small and Medium) the percentage of farms under highly developed and developed categories are found less than 50 percent indicating that the level of infrastructure is yet to develop as expected which is required for improvement in farm productivity. To conclude, more than 50 percent of the farms are under less developed and developing categories in their infrastructural development. Thus, an appropriate policy for infrastructural development is required to be designed so as to boost the agricultural productivity and quality of life of the farmers.

Descriptive Statistics of Index value

The descriptive statistics like mean, standard deviation and coefficient of variation for the total score obtained i.e. index value estimated across the villages and farm sizes under study are represented in table-1.7(c) which shows the average score and variation in the series.

Infrastructure lndex across farm sizes

It is observed from table- **1.7** (d) which represents infrastructure level of different farm sizes in each of the villages that out of the total farms of all size groups in V-I under less developed category, the percentage of small, medium and big farms are found as 87, 13 and 0 percent respectively. Similarly, out of the total number of farms under less developed category, the percentage of small farms found as 100 percent both in V-II and V-III.

It is observed from the table that out of the total farms of all size groups in V -I under developing category, the percentage of small, medium and big farms are found as 47, 32 and 21 percent respectively. In V-II it is 72, 18 and 11 percent for small, medium and big farms respectively. It is found in V-III that out of the total farms under developing category the percentage of small, medium and big farms are found as 71, 18 and 1 respectively

It is observed from the table that out of the total farms of all size groups in V -I under developed category, the percentage of small, medium and big farms are found as 30, 32 and 38 percent respectively. In V-II it is 53, 9 and 38 percent for small, medium and big farms respectively. It is found in V-III that out of the total farms under developed category the percentage of small, medium and big farms are found as 32, 59 and 9 respectively.

It is observed from the table that out of the total farms of all size groups in V-I under highly developed category, the percentage of small, medium and big farms are found as 11, 26 and 63 percent respectively. In V-II it is 22, 39 and 39 percent for small, medium and big farms respectively. It is found in V-III that out of the total farms under highly developed category the percentage of small, medium and big farms are found as 11, 63 and 26 percent respectively.

It can be inferred from the intra- village analysis (made across the farm sizes in each of the villages) that in V-I the percentage of small farms are found higher under less developed category compared to other farm sizes (where it is zero for big farms) whereas in V-II and V-III 100 percentage of Small farms are found under less developed category. Similarly, in developing category the percentage of small farms (out of the total farm under this category) is found relatively higher in V -I, V-II and V-III. The percentage of big farms in V-I, small farms in V-II and medium farms in V-III is found higher compared to other farm sizes in the respective villages. The percentage of big farms in V-I, medium and big farms in V-II and medium farms in V- III is found higher under highly developed category. **So the small farms are found less developed in their infrastructural level in all the villages under study irrespective of irrigation status of the villages.**

Impact of Knowledge and Infrastructure Indices on Agricultural Productivity:

The Regression Model

The impact of knowledge index, infrastructure index and the interaction of these two indices on the rice (paddy) productivity have been assessed by the linear regression model (OLS) estimated for different villages such as V-I, V-II and V-III separately and also for Small, Medium and Big farms separately. The model specification and methodology (Chow test) to test the significance of the difference between/among the regression lines estimated separately for different villages and farms under study. It is observed from the table-1.8 which represents the Regression Result that the overall model is found significant as indicated by the significant value of F test and the model is also found best fit indicated by the value of R^2 depictedin the table. It is also found that there exists a significant difference between the regression lines estimated for the three villages and three categories of farms as indicated by the Chow test result as shown in the table. Thus, it is justified to undertake the analysis across the villages and farm sizes under study. Further, the problem of multicollinearity is not found in the model which is verified with the help of VIF (variance-inflating factor) as depicted in table-1.8(a).

Impact of Knowledge Index

The impact of knowledge index, infrastructure index and their interaction on the productivity of Rice (paddy) has been estimated by using the linear regression equation (OLS) and the result is depicted in table-1.8. It is observed from the table- that the knowledge index has a positive and significant impact on the agricultural (paddy) productivity in the entire area (All-V) under study as indicated by the coefficient i.e. 58.395 which is significant at 1% level of significance. It means an improvement in the level of knowledge on agricultural activities may l ead to an increase in productivity of Rice in the area under study. So the knowledge index and paddy productivity has a direct relationship the area under study (i.e. All -V). Similarly, the impact of knowledge index on Rice (paddy) productivity is found positive and significant in V-III (non-irrigated village) as indicated by the coefficient value i.e. 29.502 which is significant at 5% level of significance. It was not found significant in other two villages (V-I & V-II) under study. It indicates the development in the level of knowledge index will lead to increase in agricultural productivity in V-III (non-irrigated area). Further it may be suggested that the non- irrigated area areas are suffering from higher information asymmetry, lack of proper extension service, institutional support and other required training or knowledge development supports. So an improvement in knowledge index through suitable policy measures may increase the farm productivity many extent by using knowledge and know-how of advanced technology and .methodology of its management.

The analysis of various farm sizes reveals that the knowledge index has positive impact on rice productivity for all size groups of farms but it is found positive and significant for small and medium farm sizes in the area under study as indicated by their respective coefficient value i.e, 33.91 and 91.96 respectively (significant at 10% level of significance).Thus the development of knowledge index of these farm sizes will lead to the improvement in rice productivity in the area under study. Appropriate policy measures hence to be designed to improve the knowledge index of small and medium farms irrespective of irrigation status of the villages so as increase their agricultural activities as well as quality of l ife.

Impact of Infrastructure Index

The impact of Infrastructure Index on the productivity of rice (paddy) is found positive and significant at 1% level of significance for all three villages (V -I, V-II and V-III) under study as indicated by their coefficient vale such as 9.359, 8.132 and10.906 respectively. It is also found positive and significant for the entire sample (All-V) as indicated by the coefficient value i.e, 20.375 (significant at 1% level of significance). The he impact of Infrastructure Index on the productivity of rice (paddy) is found positive and significant at 1% level of significance for all three farm sizes (Small, Medium and Big) under study as indicated by their coefficient vale such

as 21.134, 24.146 and 17.202 respectively as shown in table-1.8. It can thus be inferred from this analysis irrespective of the level of development and irrigation status of the villages as well as various farm sizes under study the infrastructure index has a positive and significant impact indicating the fact that an improvement in the infrastructure index will lead to a significant improvement in rice (paddy) productivity in all the villages and for all categories of farms. Thus priority must be given by the policy makers to improve the level of infrastructure at least to a considerable level so as to enhance the agricultural productivity in a sustainable manner.

Impact of Interaction of Knowledge and Infrastructure Indices

The product of the knowledge index and infrastructure index is considered as interaction effect in this study to analyze the impact of this interaction of indices on rice productivity across villages and farm sizes under study. The variation in the level of knowledge index and infrastructure index found across the villages and farm sizes (as discussed in the preceding sections) may affect the result of the interaction value considered as independent variable in regression analysis to observe its impact on r ice productivity. It is observed from the table-1.8 that the impact of the interaction in the case of entire sample (All-V) is found negative and significant at 1% level of significance as indicated by its coefficient value i.e. -0.528. Similarly, it is also found negative and significant at 1% level of significance for V-III (non-irrigated village) as indicated by its coefficient value i.e. -1.014. Further, the impact interaction of indices on rice productivity is found negative and significant at 1% level of significance for Medium farm size as indicated by its coefficient value i.e. -0.984. This implies that an increase in the interaction variable may lead to decrease in rice productivity even though the impact of knowledge index and infrastructure index found positive on productivity. Thus it can be said that this result may be attributed to the disproportionate level of development in knowledge and infrastructure indices across the various villages and farm sizes under study. Thus to make the interactio n effect positive on productivity it can be suggested to bring an equitable and proportionate development in the level of knowledge and infrastructure indices across villages and farm sizes so as to reduce the disparities between these two indices in such a way that the level of development in these indices will be symmetrical so as to achieve the desired result

Conclusion

The knowledge management and infrastructural development are crucial amongst the factors affecting the agricultural productivity. In this context the Knowledge index and Infrastructure index have been developed to analyze their effect on productivity. It is found while constructing the knowledge index that out of the various components

considered for this index the factors such as Education (both formal & informal education), Training and Extension contacts of the farmers are found as most Significant factors whereas experience of farmers in farming is found as least significant factor. In the development scale of knowledge of farmers it is found that maximum percentage of the total farms in the respective villages (V-I, V-II and V-III) are found under developed category followed by developing and less developed category It is also found that Small farms in V-I, Big farms in V-II and Medium Farms in V-III are found under highly developed categories. Further, in V-II it is found that no (zero) Medium farm are under the less developed category. This indicates the knowledge gap across the villages and farms which need to be bridged in the entire area under study to the maximum possible extent through appropriate policy measures. It is observed while constructing the infrastructure index that out of the various components considered for this index the factors such as Credit from formal institutions, Regulated market for selling agricultural produces and Use of Modern agricultural implements are found as most Significant factors whereas Lease market and Health infrastructure are found as least significant factor. In the development scale of infrastructure of the farmers it is found that relatively the small farms are found less developed in their infrastructural level in all the villages under study irrespective of irrigation status of the villages. This indicates the infrastructure gap across farm sizes which need to be developed in the entire area under study to the maximum possible extent through appropriate policy measures.

It is observed while analyzing the effect of knowledge index , infrastructure index and their interaction on rice productivity that knowledge index has positive impact on rice productivity for all size groups of farms but it is found positive and significant for small and medium farm sizes in the area under study .Thus the development of knowledge index of these farm sizes through appropriate policy measures will lead to the improvement in rice productivity in the area under study. Similarly, infrastructure index has a positive and significant impact indicating the fact that an improvement in the infrastructure index will lead to a significant improvement in rice (paddy) productivity in all the villages and for all categories of farms under study. Thus priority must be given by the policy makers to improve the level of infrastructure at least to a considerable level so as to enhance the agricultural productivity in a sustainable manner. However, it is also observed that an increase in the interaction variable may lead to decrease in rice productivity even though the impact of knowledge index and infrastructure index found positive on productivity. Thus it can be said that this result may be attributed to the disproportionate level of development in knowledge and infrastructure indices across the various villages and farm sizes under study. Thus to make the interaction effect positive on productivity it can be suggested to bring an equitable and proportionate development in the level of knowledge and infrastructure indices across villages and farm sizes so as to reduce the

disparities between these two indices in such a way that the level of development in these indices will be symmetrical for achieving the desired goals.

Table- 1.4

Descriptive Statistics of the Parameters considered for constructing Knowledge Index (across different farm sizes of VI, VII & VIII)

	K1	K2	K3	K4	K5	K6
	VI					
	Small					
Mean	6.11	18.89	2.37	1.96	0.54	0.68
SD	3.82	11.51	1.67	1.79	0.50	0.66
CV	0.62	0.61	0.71	0.91	0.94	0.97
Max	15.00	53.00	7.00	6.00	1.00	3.00
Min	0.00	6.00	0.00	0.00	0.00	0.00
	Medium					
Mean	5.96	23.35	1.92	2.75	1.25	1.81
SD	4.10	11.01	1.72	1.92	0.71	1.24
CV	0.69	0.47	0.90	0.70	0.57	0.68
Max	15.00	47.00	7.00	7.00	3.00	5.00
Min	0.00	7.00	0.00	0.00	0.00	0.00
	Big					
Mean	7.82	23.05	2.11	3.54	1.54	2.36
SD	4.79	9.69	1.86	2.91	0.87	1.30
CV	0.61	0.42	0.88	0.82	0.57	0.55
Max	15.00	39.00	7.00	9.00	3.00	7.00
Min	0.00	3.00	0.00	0.00	1.00	0.00
	All					
Mean	6.57	21.31	2.17	2.64	1.02	1.47
SD	4.25	11.03	1.74	2.29	0.81	1.27
CV	0.65	0.52	0.80	0.87	0.80	0.86
Max	15.00	53.00	7.00	9.00	3.00	7.00
Min	0.00	3.00	0.00	0.00	0.00	0.00
	VII					
	Small					
Mean	3.38	17.49	0.94	0.80	0.02	1.24
SD	3.52	9.25	1.08	1.19	0.15	1.45
CV	1.04	0.53	1.14	1.48	6.52	1.16
Max	12.00	45.00	5.00	6.00	1.00	8.00
Min	0.00	5.00	0.00	0.00	0.00	0.00
	Medium					
Mean	6.58	11.33	0.83	2.08	1.33	1.29
SD	4.30	3.07	1.20	2.06	0.76	1.04
CV	0.65	0.27	1.44	0.99	0.57	0.81
Max	15.00	19.00	5.00	8.00	3.00	3.00
Min	0.00	8.00	0.00	0.00	1.00	0.00
	Big					

Mean	7.14	13.59	0.97	1.55	1.97	3.69
SD	3.97	6.37	1.24	1.53	0.78	3.30
CV	0.56	0.47	1.28	0.98	0.40	0.89
Max	15.00	29.00	4.00	6.00	3.00	11.00
Min	0.00	7.00	0.00	0.00	1.00	0.00
	All					
Mean	4.72	15.61	0.93	1.18	0.65	1.76
SD	4.11	8.29	1.13	1.52	0.96	2.16
CV	0.87	0.53	1.21	1.29	1.47	1.22
Max	15.00	45.00	5.00	8.00	3.00	11.00
Min	0.00	5.00	0.00	0.00	0.00	0.00
	VIII					
	Small					
Mean	3.15	19.20	0.32	0.27	0.02	1.00
SD	3.47	9.24	0.70	0.67	0.16	1.33
CV	1.10	0.48	2.21	2.49	6.36	1.33
Max	12.00	45	5.00	6.00	1.00	8.00
Min	0.00	5	0.00	0.00	0.00	0.00
	Medium					
Mean	3.30	11.98	0.42	0.38	1.21	1.49
SD	3.50	4.17	0.72	0.81	0.72	1.66
CV	1.06	0.35	1.73	2.16	0.59	1.11
Max	15.00	19	5.00	8.00	3.00	3.00
Min	0.00	8	0.00	0.00	1.00	0.00
	Big					
Mean	4.00	26.5	1.13	0.88	2.38	2.38
SD	3.70	9.78	1.36	0.64	0.92	3.07
CV	0.93	0.37	1.21	0.73	0.39	1.29
Max	10.00	42	3.00	3.00	3.00	9.00
Min	0.00	7	0.00	0.00	0.00	0.00
	All					
Mean	3.25	16.93	0.40	0.34	0.59	1.26
SD	3.47	8.77	0.77	0.73	0.87	1.62
CV	1.07	0.52	1.93	2.14	1.46	1.28
Max	15.00	29	4.00	6.00	3.00	11.00
Min	0.00	7	0.00	0.00	1.00	0.00

Table- 1.4 (a)

Descriptive Statistics of the Parameters considered for constructing Knowledge Index (across different farm sizes)

	K1	**K2**	**K3**	**K4**	**K5**	**K6**
Small	**Small VI**					
Mean	6.11	18.89	2.37	1.96	0.54	0.68
SD	3.82	11.51	1.67	1.79	0.50	0.66
CV	0.62	0.61	0.71	0.91	0.94	0.97

Max	15.00	53.00	7.00	6.00	1.00	3.00
Min	0.00	6.00	0.00	0.00	0.00	0.00
	Small VII					
Mean	3.38	17.49	0.94	0.80	0.02	1.24
SD	3.52	9.25	1.08	1.19	0.15	1.45
CV	1.04	0.53	1.14	1.48	6.52	1.16
Max	12.00	45.00	5.00	6.00	1.00	8.00
Min	0.00	5.00	0.00	0.00	0.00	0.00
	Small VIII					
Mean	3.15	19.20	0.32	0.27	0.02	1.00
SD	3.47	9.24	0.70	0.67	0.16	1.33
CV	1.10	0.48	2.21	2.49	6.36	1.33
Max	10.00	38.00	3.00	3.00	1.00	8.00
Min	0.00	7.00	0.00	0.00	0.00	0.00
	Alll small					
Mean	4.21	18.51	1.21	1.02	0.19	0.98
SD	3.83	10.04	1.49	1.48	0.40	1.22
CV	0.91	0.54	1.22	1.45	2.04	1.25
Max	15.00	53.00	7.00	6.00	1.00	8.00
Min	0.00	5.00	0.00	0.00	0.00	0.00
Medium	Medium VI					
Mean	5.96	23.35	1.92	2.75	1.25	1.81
SD	4.10	11.01	1.72	1.92	0.71	1.24
CV	0.69	0.47	0.90	0.70	0.57	0.68
Max	15.00	47.00	7.00	7.00	3.00	5.00
Min	0.00	7.00	0.00	0.00	0.00	0.00
	Medium VII					
Mean	6.58	11.33	0.83	2.08	1.33	1.29
SD	4.30	3.07	1.20	2.06	0.76	1.04
CV	0.65	0.27	1.44	0.99	0.57	0.81
Max	15.00	19.00	5.00	8.00	3.00	3.00
Min	0.00	8.00	0.00	0.00	1.00	0.00
	Medium VIII					
Mean	3.30	11.98	0.42	0.38	1.21	1.49
SD	3.50	4.17	0.72	0.81	0.72	1.66
CV	1.06	0.35	1.73	2.16	0.59	1.11
Max	10.00	29.00	3.00	3.00	3.00	6.00
Min	0.00	7.00	0.00	0.00	0.00	0.00
	All Medium					
Mean	4.98	16.44	1.10	1.65	1.25	1.58
SD	4.13	9.46	1.46	1.92	0.72	1.40
CV	0.83	0.58	1.33	1.16	0.58	0.89
Max	15.00	47	7.00	8.00	3.00	6.00
Min	0.00	7	0.00	0.00	0.00	0.00
VI	Big VI					
Mean	7.82	23.05	2.11	3.54	1.54	2.36
SD	4.79	9.69	1.86	2.91	0.87	1.30

CV	0.61	0.42	0.88	0.82	0.57	0.55
Max	15.00	39.00	7.00	9.00	3.00	7.00
Min	0.00	3.00	0.00	0.00	1.00	0.00
	Big VII					
Mean	7.14	13.59	0.97	1.55	1.97	3.69
SD	3.97	6.37	1.24	1.53	0.78	3.30
CV	0.56	0.47	1.28	0.98	0.40	0.89
Max	15.00	29.00	4.00	6.00	3.00	11.00
Min	0.00	7.00	0.00	0.00	1.00	0.00
	Big VIII					
Mean	4.00	26.50	1.13	0.88	2.38	2.38
SD	3.70	9.77	1.36	0.64	0.92	3.07
CV	0.93	0.37	1.21	0.73	0.39	1.29
Max	10.00	42.00	3.00	2.00	3.00	9.00
Min	0.00	17.00	0.00	0.00	1.00	0.00
	All Big					
Mean	7.28	20.40	1.67	2.69	1.74	2.77
SD	4.55	9.89	1.72	2.63	0.88	2.33
CV	0.62	0.49	1.03	0.98	0.51	0.84
Max	15.00	42	7.00	9.00	3.00	11.00
Min	0.00	3	0.00	0.00	1.00	0.00

Table- 1.4 (b)

Descriptive Statistics of the Parameters considered for constructing Knowledge Index (across different villages and farm sizes)

	K1	K2	K3	K4	K5	K6
	VI					
Mean	6.57	21.31	2.17	2.64	1.02	1.47
SD	4.25	11.03	1.74	2.29	0.81	1.27
CV	0.65	0.52	0.80	0.87	0.80	0.86
Max	15.00	53.00	7.00	9.00	3.00	7.00
Min	0.00	3.00	0.00	0.00	0.00	0.00
	VII					
Mean	4.72	15.61	0.93	1.18	0.65	1.76
SD	4.11	8.29	1.13	1.52	0.96	2.16
CV	0.87	0.53	1.21	1.29	1.47	1.22
Max	15.00	45	5.00	8.00	3.00	11.00
Min	0.00	5	0.00	0.00	0.00	0.00
	VIII					
Mean	3.25	16.93	0.40	0.34	0.59	1.26
SD	3.47	8.77	0.77	0.73	0.87	1.62
CV	1.07	0.52	1.93	2.14	1.46	1.28
Max	15.00	29	4.00	6.00	3.00	11.00
Min	0.00	7	0.00	0.00	1.00	0.00
	Small					

Mean	4.21	18.51	1.21	1.02	0.19	0.98
SD	3.83	10.04	1.49	1.48	0.40	1.22
CV	0.91	0.54	1.22	1.45	2.04	1.25
Max	15.00	53.00	7.00	6.00	1.00	8.00
Min	0.00	5.00	0.00	0.00	0.00	0.00
	Medium					
Mean	4.98	16.44	1.10	1.65	1.25	1.58
SD	4.13	9.46	1.46	1.92	0.72	1.40
CV	0.83	0.58	1.33	1.16	0.58	0.89
Max	15.00	47	7.00	8.00	3.00	6.00
Min	0.00	7	0.00	0.00	0.00	0.00
	Big					
Mean	7.28	20.40	1.67	2.69	1.74	2.77
SD	4.55	9.89	1.72	2.63	0.88	2.33
CV	0.62	0.49	1.03	0.98	0.51	0.84
Max	15.00	42	7.00	9.00	3.00	11.00
Min	0.00	3	0.00	0.00	1.00	0.00

Table-1.5
Descriptive Statistics of the Parameters considered for constructing Infrastructure Index
(across different farm sizes of VI, VII & VIII)

	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}	I_{11}	I_{12}	I_{13}	I_{14}	I_{15}	I_{16}	I_{17}
	VI																
	Small																
Mean	167	77	0.2	23	0.01	0.01	0.9	6	50	1	17	6	22	5	15	3	2
SD	27	21	0.3	40	0.003	0.004	0.7	4	19	1	12	8	34	11	20	4	1
CV	0.2	0.3	2.2	2	0.36	0.61	0.8	1	0.4	1	1	1	2	2	1	1	1
Max	200	100	1.0	100	0.02	0.02	3.0	15	100	2	40	27	100	35	74	14	7
Min	100	0	0	0	0.01	0	0	0	25	0	6	0	0	0	0	0	0
	Medium																
Mean	173	87	0.05	45	0.01	0.01	0.8	6	84	1	17	10	46	7	20	4	2
SD	25	12	0.2	45	0.004	0.004	0.5	4	17	1	12	11	40	14	16	3	1
CV	0.1	0.1	3.6	1	0.39	0.45	0.6	1	0.2	1	1	1	1	2	1	1	1
Max	200	100	0.7	100	0.02	0.02	2.0	15	100	2	40	33	100	39	75	9	6
Min	114	50	0	0	0.01	0	0	0	50	0	6	0	0	0	0	0	1
	Big																
Mean	175	90	0.2	60	0.01	0.01	1.1	8	88	1.1	22	17	68	21	48	7	3.0
SD	17	8	0.2	38	0.003	0.003	0.3	5	15	0.5	12	12	29	19	30	3	1.3
CV	0.1	0.1	1.0	1	0.24	0.25	0.3	1	0.2	0.4	1	1	0.4	1	1	0.4	0.4
Max	200	100	0.7	100	0.02	0.02	2.0	15	100	2.0	40	38	100	55	100	13	6.0
Min	131	67	0.0	0	0.01	0.01	1.0	0	50	0.0	6	0	0	0	13	2	1.0
	All																
Mean	171	83	0.1	39	0.01	0.01	1	7	70	1	18	10	42	10	26	4	2
SD	24	17	0.3	44	0.004	0.005	1	4	25	1	12	11	39	16	26	4	1
CV	0.1	0.2	1.9	1	0.38	0.53	1	1	0.4	1	1	1	1	2	1	1	1
Max	200	100	1.0	100	0.02	0.02	3	15	100	2	40	38	100	55	100	14	7
Min	100	0	0.0	0	0.01	0	0	0	25	0	6	0	0	0	0	0	0
	VII																

	Small																
Mean	132	53	0.0	20	0.02	0.01	0.9	3	44	0.1	39	5	18	1	5	1	3
SD	37	41	0.0	40	0.03	0.01	0.4	4	20	0.3	21	8	38	6	16	3	2
CV	0.3	1	0.0	2	1.15	1.22	0.5	1	0.4	2.5	1	2	2	5	3	2	1
Max	200	138	0.0	100	0.13	0.05	2.0	12	100	1.0	60	28	100	31	75	11	10
Min	54	0	0.0	0	0.01	0	0	0	10	0	12	0	0	0	0	0	0
	Medium																
Mean	141	76	0.3	35	0.01	0.01	0.8	7	79	0.8	50	5	48	7	25	5	5
SD	23	20	0.4	46	0.00	0.00	0.5	4	17	0.4	17	6	48	14	27	5	3
CV	0.2	0.3	1.3	1	0.41	0.51	0.6	1	0.2	0.5	0.3	1	1	2	1	1	0
Max	174	100	0.9	100	0.02	0.02	2.0	15	100	1.0	60	15	100	43	73	14	10
Min	76	32	0.0	0	0.01	0.00	0.0	0	45	0.0	12	0	0	0	0	0	0
	Big																
Mean	131	67	0.3	41	0.01	0.01	1.1	7.1	88	1.0	46	10	61	10	26	4	6
SD	23	25	0.3	45	0.00	0.004	0.3	4.0	14	0.4	17	6	40	15	28	4	2
CV	0.2	0.4	0.9	1	0.33	0.37	0.2	0.6	0.2	0.4	0.4	1	1	2	1	1	0.3
Max	170	108	0.8	100	0.02	0.02	2.0	15.0	100	2.0	60	20	100	37	100	13	10
Min	79	0	0.0	0	0.01	0.00	1.0	0.0	50	0.0	12	0	0	0	0	0	3
	All																
Mean	134	60	0.1	27	0.02	0.01	0.9	5	59	0.4	42	6	32	4	13	3	4
SD	32	36	0.2	43	0.02	0.01	0.4	4	27	1	20	8	44	11	23	4	3
CV	0.2	0.6	2.2	2	1.16	0.91	0.5	1	0.5	1	0.5	1	1	3	2	2	1
Max	200	138	0.9	100	0.13	0.05	2.0	15	100	2	60	28	100	43	100	14	10
Min	54	0	0.0	0	0.01	0.00	0.0	0	10	0	12	0	0	0	0	0	0
	VIII																
	Small																
Mean	99	0	0.2	10	0.01	0.003	1	3	38	0.1	40	4	2	0	1	1	1
SD	4	0	0.3	29	0.005	0.002	1	3	19	0.4	26	8	16	0	5	2	1
CV	0.04	0	1.8	3	0.43	0.62	1	1	1	2	1	2	6	0	6	2	1
Max	100	0	1.0	100	0.03	0.01	2	10	93	1	70	26	100	0	37	7	3
Min	88	0	0.0	0	0.01	0.00	0	0	3	0	12	0	0	0	0	0	0
	Medium																
Mean	95	0	0.3	14	0.01	0.01	0.9	3	77	1	35	4	28	5	7	0.1	1
SD	5	0	0.2	30	0.00	0.003	0.5	4	16	0	26	6	37	12	19	0.8	1
CV	0.05	0	0.8	2	0.30	0.47	0.5	1	0.2	1	1	1	1	2	3	5.5	1
Max	100	0	0.7	100	0.02	0.01	2.0	10	98	1	70	18	100	38	100	5.5	4
Min	86	0	0.0	0	0.01	0.00	0.0	0	43	0	12	0	0	0	0	0	0
	Big																
Mean	94	0	0.2	46	0.01	0.01	1.8	4	81	1	44	17	73	7	26	5	3
SD	3	0	0.3	50	0.003	0.004	0.5	4	12	1	26	11	33	14	26	2	2
CV	0.04	0	1.1	1	0.26	0.33	0.3	1	0.2	0.5	0.6	0.7	0.5	2.0	1.0	0.4	0.7
Max	100	0	0.6	100	0.02	0.01	2.0	10	100	2	70	26	100	36	66	6	5
Min	89	0	0	0	0	0	1.0	0	70	0	15	0	0	0	3	2	0
	All																
Mean	97	0	0.2	13	0.01	0.005	0.8	3.3	55	0.4	38	5	16	2	5	1	1
SD	4	0	0.3	32	0.004	0.003	0.6	3.5	26	0.5	26	8	32	8	15	2	1
CV	0.05	0	1.2	2	0.39	0.69	0.7	1.1	0	1.2	1	2	2	4	3	2	1
Max	100	0	1.0	100	0.03	0.01	2.0	10.0	100	2.0	70	26	100	38	100	7	5

Min	86	0	0	0	0.0	0.0	0.0	0.0	3	0.0	12	0	0	0	0	0	0

Table-1.5 (a)
Descriptive Statistics of the Parameters considered for constructing Infrastructure Index
(across different farm sizes)

	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}	I_{11}	I_{12}	I_{13}	I_{14}	I_{15}	I_{16}	I_{17}
	Small VI																
Mean	167	77	0.2	23	0	0	1	6	50	1	17	6	22	5	15	3	2
SD	27	21	0.3	40	0	0	1	4	19	1	12	8	34	11	20	4	1
CV	0.2	0.3	2	2	0	1	1	1	0	1	1	1	2	2	1	1	1
Max	200	100	1	100	0	0	3	15	100	2	40	27	100	35	74	14	7
Min	100	0	0	0	0	0	0	0	25	0	6	0	0	0	0	0	0
	Small VII																
Mean	132	53	0	20	0.02	0.01	1	3	44	0.1	39	5	18	1	5	1	3
SD	37	41	0	40	0.03	0.01	0.4	4	20	0.3	21	8	38	6	16	3	2
CV	0.3	1	0	2	1	1	1	1	0.4	2	1	2	2	5	3	2	1
Max	200	138	0	100	0.1	0.05	2	12	100	1	60	28	100	31	75	11	10
Min	54	0	0	0	0	0	0	0	10	0	12	0	0	0	0	0	0
	Small VIII																
Mean	99	0	0.2	10	0.01	0.003	1	3	38	0.1	40	4	2	0	1	1	1
SD	4	0	0.3	29	0.005	0.002	1	3	19	0.4	26	8	16	0	5	2	1
CV	0.04	0	2	3	0.4	1	1	1	1	2	1	2	6	0	6	2	1
Max	100	0	1	100	0.03	0.01	2	10	93	1	70	26	100	0	37	7	3
Min	88	0	0	0	0	0	0	0	3	0	12	0	0	0	0	0	0
	All Small																
Mean	133	44	0.1	18	0.01	0.01	1	4	44	0.3	32	5	14	2	7	2	2
SD	38	42	0.3	37	0.02	0.01	1	4	20	1	23	8	32	7	16	3	2
CV	0.3	1	3	2	1	1	1	1	0.5	2	1	2	2	4	2	2	1
Max	200	138	1	100	0.1	0.05	3	15	100	2	70	28	100	35	75	14	10
Min	54	0	0	0	0	0	0	0	3	0	6	0	0	0	0	0	0
	Medium VI																
Mean	173	87	0.0	45	0.01	0.01	1	6	84	1	17	10	46	7	20	4	2
SD	25	12	0.2	45	0.00	0.004	1	4	17	1	12	11	40	14	16	3	1
CV	0.1	0.1	4	1	0.4	0.45	1	1	0.2	1	1	1	1	2	1	1	1
Max	200	100	1	100	0.02	0.02	2	15	100	2	40	33	100	39	75	9	6
Min	114	50	0	0	0	0	0	0	50	0	6	0	0	0	0	0	1
	Medium VII																
Mean	138	82	0	42	0.01	0.01	1	8	80	1	48	6	64	5	33	7	4
SD	23	18	0	51	0.005	0.005	0	4	15	0	19	6	49	14	28	6	2
CV	0.2	0.2	0	1	0.4	0.46	0	0.4	0.2	0.3	0.4	1	1	3	1	1	1
Max	172	100	0	100	0.02	0.02	1	15	100	1	60	15	100	43	71	14	8
Min	76	40	0	0	0	0	1	0	50	0	14	0	0	0	0	0	0
	Medium VIII																
Mean	95	0	0.3	14	0.01	0.01	1	3	77	1	35	4	28	5	7	0.1	1
SD	5	0	0.2	30	0.003	0.003	0.5	4	16	0	26	6	37	12	19	1	1

CV	0.05	0	1	2	0.3	0.47	1	1	0.2	1	1	1	1	2	3	5	1
Max	100	0	1	100	0.02	0.01	2	10	98	1	70	18	100	38	100	5	4
Min	86	0	0	0	0	0	0	0	43	0	12	0	0	0	0	0	0
	All Medium																
Mean	135	49	0.2	30	0.01	0.01	1	5	80	1	30	7	39	6	16	3	2
SD	40	43	0.3	42	0.004	0.004	0.5	4	17	1	23	9	41	13	21	4	2
CV	0	1	1	1	0.4	1	1	1	0.2	1	1	1	1	2	1	1	1
Max	200	100	1	100	0.0	0	2	15	100	2	70	33	100	43	100	14	10
Min	76	0	0	0	0	0	0	0	43	0	6	0	0	0	0	0	0
	Big VI																
Mean	175	90	0.2	60	0.013	0.013	1	8	88	1	22	17	68	21	48	7	3
SD	17	8	0.2	38	0.003	0.003	0.3	5	15	0.5	12	12	29	19	30	3	1
CV	0.1	0.1	1	1	0.2	0.3	0.3	1	0.2	0.4	1	1	0.4	1	1	0.4	0.4
Max	200	100	1	100	0.02	0.02	2	15	100	2	40	38	100	55	100	13	6
Min	131	67	0	0	0	0	1	0	50	0	6	0	0	0	13	2	1
	Big VII																
Mean	131	67	0.3	41	0.013	0.012	1	7	88	1	46	10	61	10	26	4	6
SD	23	25	0.3	45	0.004	0.004	0.3	4	14	0	17	6	40	15	28	4	2
CV	0.2	0.4	1	1	0.3	0.4	0.2	1	0.2	0.4	0.4	1	1	2	1	1	0.3
Max	170	108	1	100	0.02	0.02	2	15	100	2	60	20	100	37	100	13	10
Min	79	0	0	0	0	0	1	0	50	0	12	0	0	0	0	0	3
	Big VIII																
Mean	94	0	0.2	46	0.01	0.01	2	4	81	1	44	17	73	7	26	5	3
SD	3	0	0.3	50	0.003	0.004	0.5	4	12	1	26	11	33	14	26	2	2
CV	0.04	0	1	1	0.3	0.3	0.3	1	0.2	1	1	1	0.5	2	1	0.4	1
Max	100	0	1	100	0.02	0.01	2	10	100	2	70	26	100	36	66	6	5
Min	89	0	0	0	0	0	1	0	70	0	15	0	0	0	3	2	0
	All Big																
Mean	154	75	0	53	0.01	0.01	1	7	87	1	31	15	66	16	39	6	4
SD	33	30	0	42	0.004	0.004	0.4	5	14	0.5	19	11	33	18	30	3	2
CV	0.2	0.4	1	1	0.3	0.3	0.3	1	0.2	0.4	1	1	0.5	1	1	1	1
Max	200	108	1	100	0.02	0.02	2	15	100	2	70	38	100	55	100	13	10
Min	79	0	0	0	0	0	1	0	50	0	6	0	0	0	0	0	0

Table-1.5 (b)
Descriptive Statistics of the Parameters considered for constructing Infrastructure Index
(across different Villages and farm sizes)

	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}	I_{11}	I_{12}	I_{13}	I_{14}	I_{15}	I_{16}	I_{17}
	VI																
Mean	171	83	0.1	39	0.01	0.01	1	7	70	1	18	10	42	10	26	4	2
SD	24	17	0.3	44	0.004	0.005	1	4	25	1	12	11	39	16	26	4	1
CV	0.1	0.2	2	1	0.4	1	1	1	0.4	1	1	1	1	2	1	1	1
Max	200	100	1	100	0.02	0.02	3	15	100	2	40	38	100	55	100	14	7
Min	100	0	0	0	0	0	0	0	25	0	6	0	0	0	0	0	0
	VII																
Mean	134	60	0.1	27	0.02	0.01	1	5	59	0.4	42	6	32	4	13	3	4

SD	32	36	0.2	43	0.02	0.01	0.4	4	27	1	20	8	44	11	23	4	3
CV	0.2	1	2	2	1	1	0.5	1	0.5	1	0.5	1	1	3	2	2	1
Max	200	138	1	100	0.13	0.05	2	15	100	2	60	28	100	43	100	14	10
Min	54	0	0	0	0	0	0	0	10	0	12	0	0	0	0	0	0
	VIII																
Mean	97	0	0.2	13	0.01	0.005	1	3	55	0.4	38	5	16	2	5	1	1
SD	4	0	0.3	32	0.004	0.003	1	3	26	1	26	8	32	8	15	2	1
CV	0.05	0	1	2	0.4	1	1	1	0.5	1	1	2	2	4	3	2	1
Max	100	0	1	100	0.03	0.01	2	10	100	2	70	26	100	38	100	7	5
Min	86	0	0	0	0	0	0	0	3	0	12	0	0	0	0	0	0
	Small																
Mean	133	44	0.1	18	0.01	0.01	1	4	44	0.3	32	5	14	2	7	2	2
SD	38	42	0.3	37	0.02	0.01	1	4	20	1	23	8	32	7	16	3	2
CV	0.3	1	3	2	1	1	1	1	0.5	2	1	2	2	4	2	2	1
Max	200	138	1	100	0.13	0.05	3	15	100	2	70	28	100	35	75	14	10
Min	54	0	0	0	0	0	0	0	3	0	6	0	0	0	0	0	0
	Medium																
Mean	135	49	0.2	30	0.01	0.01	1	5	80	1	30	7	39	6	16	3	2
SD	40	43	0.3	42	0.004	0.004	0.5	4	17	1	23	9	41	13	21	4	2
CV	0.3	1	1	1	0.37	1	1	1	0.2	1	1	1	1	2	1	1	1
Max	200	100	1	100	0.02	0.02	2	15	100	2	70	33	100	43	100	14	10
Min	76	0	0	0	0	0	0	0	43	0	6	0	0	0	0	0	0
	Big																
Mean	154	75	0.3	53	0.01	0.01	1	7	87	1	31	15	66	16	39	6	4
SD	33	30	0.3	42	0.004	0.004	0.4	5	14	0.5	19	11	33	18	30	3	2
CV	0.2	0.4	1	1	0.27	0.30	0.3	1	0.2	0.4	1	1	0	1	1	1	1
Max	200	108	1	100	0.02	0.02	2	15	100	2	70	38	100	55	100	13	10
Min	79	0	0	0	0	0	1	0	50	0	6	0	0	0	0	0	0

Table-1.6
Factor Loading (for Knowledge Index)

	All Villages/ Farms						
Parameters	V1	V2	V3	Small	Medium	Big	All V/ Farms
K_1= Number of Year of schooling	0.552	0.544	0.521	0.542	0.583	0.569	0.556
K_2= Number of Year of experience	-0.491	-0.369	-0.112	-0.356	-0.122	-0.425	-0.276
K_3= Numbers of Training attended	0.496	0.369	0.541	0.511	0.559	0.520	0.498
K_4= Numbers of Extension contacts made	0.444	0.503	0.568	0.516	0.564	0.468	0.517
K_5= Numbers of Media (Electronic/Print) often used for Agricultural Information	0.046	0.354	0.233	0.217	0.119	0.065	0.260
K_6= Numbers of Meeting (of farmers or on farming) attended during the year	0.097	0.232	0.214	0.076	0.028	0.044	0.178

Table: 1.6 (a)
Significant Importance of the selected Knowledge related parameters as per Factor Loading (across villages and Farm sizes)

Nature of Significance	V1	V2	V3	Small	Medium	Big	All V/F
More Significant	K_1, K_3, K_4	K_1, K_3, K_4	K_1, K_3, K_4	K_1, K_3, K_4	K_1, K_3, K_4	K_1, K_3, K_4	K_1, K_3, K_4
Moderate	K_5, K_6	K_5, K_6	K_5, K_6	K_5, K_6	K_5, K_6	K_5, K_6	K_5, K_6
Less Significant	K_2	K_2	K_2	K_2	K_2	K_2	K_2

Table-1.6 (b)
The Level of Agricultural Knowledge of the No. of farms across villages and Farm Sizes

	V1		V2		V3		All S		All M		All B		All V	
Knowledge Level	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Less Developed	39	20	21	15	28	20	49	19	15	12	17	18	80	17
Developing	46	24	41	29	47	33	66	26	56	43	28	30	145	31
Developed	74	39	54	39	46	32	99	39	32	25	31	33	170	36
Highly Developed	33	17	23	17	22	15	38	15	26	20	17	18	79	17
Total Sample	192	100	139	100	143	100	252	100	129	100	93	100	474	100

Table- 1.6 (c)
Mean, SD and CV of Index Value (Total Score) for Knowledge Index

	All Villages/ Farms						
Descriptive Statistics	V1	V2	V3	Small	Medium	Big	All V/F
Mean	-4.41	-1.61	0.62	-3.04	2.64	-2.16	-0.38
Standard Deviation (SD)	8.38	5.50	2.78	5.69	4.24	7.42	5.39
Coefficient of Variation (CV)	-1.90	-3.42	4.45	-1.87	1.61	-3.43	-14.21

Table-1.6 (d)
The Level of Agricultural Knowledge of the No. of farms across different Farm Sizes in each of the Villages

Knowledge Level	VI				VII				VIII			
	Small	Med	Big	Total	Small	Med	Big	Total	Small	Med	Big	Total

	Less Developed											
No.	16	13	10	39	18	0	3	21	24	3	1	28
%	41	33	26	100	86	0	14	100	86	11	4	100
	Developing											
No.	13	15	18	46	29	6	6	41	24	22	1	47
%	28	33	39	100	71	15	14	100	51	47	2	100
	Developed											
No.	39	19	16	74	35	10	9	54	24	17	5	46
%	53	26	22	100	65	19	17	100	52	37	11	100
	Highly Developed											
No.	16	5	12	33	4	8	11	23	10	11	1	22
%	48	15	37	100	17	35	48	100	45	50	5	100
	Total											
No.	84	52	56	192	86	24	29	139	82	53	8	143
%	44	27	29	100	62	17	21	100	57	37	6	100

Table-1.7
Factor Loading (for Infrastructure Index)

		All Villages/ Farms						
	Parameters	V1	V2	V3	Small	Medium	Big	All V/F
I_1	Cropping Intensity	0.2602	0.1702	-0.1457	0.3956	0.2785	0.2907	0.2958
I_2	% Gross Irrigated area to Gross Cropped Area	0.2858	0.247	0.223	0.387	0.2857	0.2402	0.3043
I_3	Area Leased in as % of Net area operated	-0.0830	0.2093	-0.0538	-0.1337	-0.2325	-0.0128	-0.0336
I_4	% formal credit to Total credit	0.3438	0.2841	0.3409	0.3391	0.3265	0.3442	0.3169
I_5	% of production spent on electricity	0.3599	-0.1802	0.1406	-0.1001	0.3413	0.3585	0.0183
I_6	% of Production spent on transportation cost	0.3725	0.0572	0.4234	0.0872	0.3748	0.3816	0.2768
I_7	No of Phones	0.1273	0.0906	0.1624	0.133	0.0621	-0.0019	0.1377
I_8	Year of Education	0.1080	0.2569	0.1761	0.2032	0.2213	0.131	0.2215
I_9	% of Pacca house	0.1725	0.3055	0.2858	0.081	0.1149	0.1076	0.2474
I_{10}	No of latrine	0.1008	0.2965	0.2763	0.0899	0.1404	0.0948	0.2318
I_{11}	Average distance from hospital with specialist doctors	0.0164	0.1282	0.0344	-0.1368	-0.0682	-0.1357	-0.0799
I_{12}	Membership of PACS	0.2699	0.2456	0.2855	0.2355	0.2636	0.2424	0.2638
I_{13}	% 0f Marketable Surplus sold to Regulated Market	0.3603	0.3327	0.4197	0.3454	0.3381	0.3365	0.337
I_{14}	% 0f Marketable Surplus kept in ware house	0.2582	0.2742	0.164	0.3105	0.1026	0.2967	0.2721

I_{15}	% of modern equipments to total equipments	0.2367	0.3274	0.3123	0.3244	0.2263	0.256	0.3078
I_{16}	% of expenses on Machine labour to total expenses on labour from all sources	0.2191	0.2698	0.1581	0.1851	0.2795	0.2752	0.2736
I_{17}	No. of times visited to veterinary Center	0.1261	0.2278	0.1921	0.2004	0.096	-0.087	0.1589

Table-1.7 (a)

Significant Importance of the selected infrastructure related parameters as per Factor Loading

(across villages and Farm sizes)

Nature of Significance	V1	V2	V3	Small	Medium	Big	All V/F
More Significant	I_4 ,I_5, I_6, I_{13}	I_9, I_{10}, I_{13}, I_{15}	I_4, I_6, I_{13}, I_{15}	I_1, I_4, I_{13}, I_{14}, I_{15}	I_4, I_5, I_6, I_{13}	I_4, I_5, I_6, I_{13}	I_1, I_2, I_4, I_{15},
Moderate	I_1, I_2 I_7, I_8, I_9 , I_{10} I_{12} I_{14}, I_{15}, I_{16}, I_{17}	I_1, I_2, I_3, I_4, I_8, I_{11}, I_{12}, I_{14}, I_{16}, I_{17}	I_2, I_5, I_7, I_8, I_9, I_{10}, I_{12}, I_{14}, I_{16}, I_{17}	I_2, I_7, I_8, I_{12}, I_{16}, I_{17}	I_1, I_2, I_8, I_9, I_{10}, I_{12}, I_{14}, I_{15}, I_{16}	I_1, I_2, I_8, I_9, I_{12}, I_{14}, I_{15}, I_{16},	I_6, I_7, I_8, I_9, I_{10}, I_{12}, I_{13}, I_{14}, I_{16}, I_{17}
Less Significant	I_3 ,I_{11}	I_5, I_6, I_7	I_1, I_3, I_{11}	I_3, I_5, I_6, I_9, I_{10}, I_{11},	I_3, I_7, I_{11}, I_{17}	I_3, I_7, I_{10}, I_{11}, I_{17}	I_3, I_5, I_{11}

Table-1.7 (b)

The Level of Agricultural. Infrastructure of the No. of farms across villages and Farm Sizes

Infrastructure Level	V1	%	V2	%	V3	%	All S	%	All M	%	All B	%	All V	%
Less Developed	38	20	22	16	1	1	31	12	33	26	18	19	103	22
Developing	66	34	57	41	101	71	107	42	41	32	25	27	161	34
Developed	53	28	32	23	22	15	73	29	24	19	34	37	108	23
Highly Developed	35	18	28	20	19	13	41	16	31	24	16	17	102	22
Total	192	100	139	100	143	100	252	100	129	100	93	100	474	100

Table-1.7 (c)

Mean, SD and CV of Index Value (Total Score) for Infrastructure Index

					All Villages/ Farms		
	V1	V2	V3	Small	Medium	Big	All V/F
Mean	123.18	89.17	18.31	85.45	89.81	129.42	99.58

	Standard Deviation (SD)	44.63	42.51	30.06	49.79	46.17	42.56	53.05
	C.V	0.36	0.48	1.64	0.58	0.51	0.33	0.53

Table-1.7 (d)
The Level of **Agricultural Infrastructure** of the No. of farms across different Farm Sizes in each of the Villages

Infrastructure Level	VI				VII				VIII			
	Small	Med	Big	Total	Small	Med	Big	Total	Small	Med	Big	Total
Less Developed	33	5	0	38	22	0	0	22	1	0	0	1
%	87	13	0	100	100	0	0	100	100	0	0	100
Developing	31	21	14	66	41	10	6	57	72	28	1	101
%	47	32	21	100	72	18	10	100	71	28	1	100
Developed	16	17	20	53	17	3	12	32	7	13	2	22
%	30	32	38	100	53	9	38	100	32	59	9	100
Highly Developed	4	9	22	35	6	11	11	28	2	12	5	19
%	11	26	63	100	22	39	39	100	11	63	26	100
Total	84	52	56	192	86	24	29	139	82	53	8	143
%	44	27	29	100	62	17	21	100	57	37	6	100

Table-1.8
Effect of Knowledge and Infrastructure Indices on Agricultural Productivity (Regression Results)

	Dependent variable= Productivity of Rice						
Regression Results	All V	V-I	V-II	V-III	Small	Medium	Big
Intercept	3880.64* (44.147)	6028.35* (55.522)	4943.32* (42.295)	4055.19* (100.453)	3762.34* (30.303)	3807.64* (21.105)	4516.18* (15.696)
Coefficient of Knowledge Index	58.395* (3.349)	-7.169 (-0.617)	3.208 (0.165)	29.502** (1.960)	33.913*** (1.788)	91.964*** (1.834)	38.707 (0.862)
Coefficient of Infrastructure Index	20.375* (26.541)	9.359* (11.668)	8.132* (7.247)	10.906* (7.523)	21.134* (18.805)	24.146* (11.951)	17.202* (8.377)
Coefficient of Interaction variable	-0.528* (-4.040)	0.00038 (0.0044)	-0.073 (-0.410)	-1.014* (-2.766)	-0.230 (-1.403)	-0.984** (-2.321)	-0.350 (-1.144)
R Square	0.629	0.472	0.301	0.340	0.655	0.589	0.485
No. of Observations	474	192	139	143	252	129	93
Residual sum of square (RSS)	331736125	36998963	37311501	23448070	159511416	89594299	56694448

***F** test value*	265.94*	55.98*	19.35*	23.89*	157.17*	59.72*	27.93*
Chow Test $F_{12, 462}$		**92.15**			**3.27**		

N.B. 1) Tabulated $F_{12, 462}$ = 2.18 at 1% level of significance

2) * at 1% , ** at 5% and *** at 10% level of significance

3) Bracket in the parenthesis are„t" value

Table- 1.8 (a)
VIF of independent variables of the regression model estimated across villages and farm sizes (VIF as a test for Multicollinearity)

Variables	All V	V-I	V-II	V-III	Small	Medium	Big
Knowledge Index	5.91	9.19	5.72	1.47	4.54	8.08	11.02
Infrastructure Index	1.11	1.24	1.14	1.60	1.22	1.55	1.10
Interaction variable	5.74	9.14	5.47	2.04	4.29	9.51	10.84
Mean VIF	4.25	6.53	4.11	1.70	3.35	6.38	7.65

NB. The multicollinearity problem is not visualized even though the mean VIF is found more than 2 as in many of the study of social sciences including economics it is considered up to 5 in some studies and 10 in some other studies.

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