

**Executive Summary of Ph. D study titled  
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Krishi Vigyan Kendra (KVK) is the strategic frontline extension institute established at district level under the Indian Council of Agricultural Research, New Delhi. Being an integral part of the National Agricultural Research System (NARS), KVK's bridge the gap between research system and clientele (farmers and mainstream extension agencies) through technology assessment and demonstrations, capacity building, and other extension activities. Considering their pivotal role of KVK's in the district agriculture information networks and the service it provides to the farming community, several studies have been conducted on KVK's, mainly on assessing impact of different activities of KVK. However, very few studies have comprehensively examined the KVK activities in holistic manner taking into account the 'process oriented assessment of KVK ecosystem'. Hence, the present research was taken up to analyse the effectiveness of KVK in an ecosystem perspective in Southern India with the following specific objectives:

1. To know the profile of selected Krishi Vigyan Kendras.
2. To analyze the ecosystem of Krishi Vigyan Kendras for functional effectiveness.
3. To analyze the ecosystem of Krishi Vigyan Kendras for functional convergence
4. To develop and standardize an ecosystem effectiveness index for functioning of KVKs.
5. To document the constraints and suggestions for effective functioning of KVKs.
6. To suggest the strategies to improve the ecosystem effectiveness of KVKs.

**Material and Methods**

The study adopted exploratory research design with case study approach, where the KVKs were considered as cases. 13 KVKs were sampled under ICAR-ATARI Zone (X and XI) covering Southern India. Stratified purposive sampling was adopted to select the ATARI zones and proportionate random sampling applied to sample the KVKs. The KVK staff (Senior Scientist and Head (n=13), Scientists (n=60)) and farmers (n=390) were selected. To understand the network of KVKs, we followed egocentric approach, where KVK was considered as central node. All the other extension agencies in contact of KVKs were listed and interviewed for their organizational contact. The primary data was collected from KVK staff, farmers and their network identified during the study using structured and semi-structured interviews.

Secondary data was collected from annual reports of KVK from the year 2011-12 to 2018-2019 and websites of ICAR-ATARI Zone X and XI and sampled KVKs. Being

exploratory in nature, the study had no pre-planned variables and the only dependant variable considered was KVK Ecosystem Effectiveness, which was measured by exploration of variables under formulated objectives.

### **Major analytical tools and techniques used in the study**

#### **Compound Annual Growth Rate (CAGR)**

It is used to discern the trend of KVK activities over a period of last eight years (2011-2012 to 2018-2019), and also to indicate the performance of the variable under consideration.

#### **Content analysis**

Content analysis was applied to understand the process of mandated activities (OFT, FLD) in a subjective yet scientific way for drawing valid and replicable inference from qualitative data of semi structured interviews. The scope of content analysis in this study was to identify the commonly practiced activities, actors, criteria involved in the process of OFT and FLD, emphasising the relationship between the content of texts and process involved in the mandated activities (OFT and FLD) of KVK. Based on the grounded scores, code co-occurrence coefficient results, the network of actors and the process of OFT and FLDs were mapped. The consistency in coding was assessed by intra-rater agreement (researcher perform coding twice for the same data at different interval), reliability was assessed using Cohen's Kappa with inter-rater agreement (coding done by different experts independently, in our case the members of advisory committee). The validity of data was assessed by getting the codes evaluated from the experts who had vast experience about KVK and data was mainly collected from the scientific staff, who were directly involved in the KVK activities.

#### **Non-parametric tests**

The perception of KVK staff towards internal working environments under different components like leadership, decision making, communication pattern, interpersonal relations, team work, job satisfaction, work time control, work-time variability, work schedule, health factors (fatigue recovery, sleep quality, enthusiasm problem) and work life balance of KVKs were measured using pre-validated and established scales. The data collected under this section were on ordinal scale, therefore different non parametric approaches were employed to test significance and draw meaningful inferences from the results. Accordingly, the 'Friedman test' was used to identify the presence of pattern in the ratings by the respondents. Further, 'Kendall's W' was used as a test of concordance/agreement. Only after confirming the presence

of a pattern in the ratings provided, the data was further analyzed for each components based on the statements through probability mean values.

### **Social Network Analysis (SNA)**

To measure and map the extension network of Krishi Vigyan Kendras' (KVKs), Social Network analysis was used within the frame work of 'ego centric networks'. In the first stage, the data from KVK was collected regarding all the organizations they regularly contact for extension purpose, frequency of interactions and trust they place on the organization. In the second stage, all the organizations which listed by the KVK's were contacted to enumerate a similar data. A combination of personal and telephonic interviews was used for the above purpose. The data was analyzed quantitatively to estimate the normalized network measures like density, path length and distance to draw inference about the convergence.

### **Meta-Analysis**

Meta-analysis was used to synthesise the 'effect size' of different technologies demonstrated under OFT and FLD. The effect size was calculated considering benefit cost (B: C) ratio as the outcome variable using published annual reports of past eight years. The purpose of doing this analysis was to show how effective the technologies assessed and demonstrated by KVK were in terms of B: C ratio of assessed/demonstrated technologies *vis a vis* check. Since each KVK assess and demonstrates (through OFT and FLD) many technologies across crops and livestock, we need a method to combine the results into single indicator and test for its significance (accounting for between study heterogeneity). So, in this study we use 'log odds ratio' and 'Cohen's D' as effect size indicators.

### **Index for KVK ecosystem effectiveness**

The index for the KVK ecosystem effectiveness was developed based on a total of 28 indicators identified in the study. The indicators identified were categorized in terms of input, process, output and outcome to measure the ecosystem effectiveness of KVK. The composite index developed through a combination of different methods *viz.*, normalisation (min-max), weighting (Budget allocation) and aggregation methods (additive). The study applied most widely used four normalization techniques *viz.*, min-max, z-score, ranking and proportionate methods; weighing methods like equal weights, budget allocation/expert opinion and principal component analysis methods and aggregation methods like additive and geometric methods to assess the robustness and sensitivity of the index. The spearman rank correlation was computed between indexes constructed through different methods *viz.*, different normalization techniques, normalization techniques v/s weighting methods, between different weighting

methods, between aggregation methods, aggregation methods v/s weighting methods. Further, the robustness based on the sensitivity analysis was assessed in terms of exclusion and inclusion of some indicators from the index. The robustness and sensitivity of index was interpreted based on the results of statistical significance and spearman rank correlation coefficient value. Based on the index scores, the indicators were ranked. Further, it was categorized in to low, moderate and high based on the average score and standard deviation of indicators to know the importance of indicators towards the effective functioning of KVK.

### **Rank Based Quotient (RBQ)**

Rank Based Quotient was used to quantify the constraints and suggestions using the data collected by preferentially ranking technique.

### **Major Findings of the Study**

#### **1) Profile of Selected Krishi Vigyan Kendras**

More than half of the sampled KVKs (53.85%) had experience of 8-26 years and about 46.15 per cent had vast experience of 27-45 years in serving the farming community as farm science centre in the district.

The sampled KVKs represented varied agro-climatic regions of Southern India. More than three fourth of studied KVKs were located within the distance of 2 km to 9 km from taluk headquarter and around 50 per cent (46.15%) of KVKs were located at a distance of 5 km to 20 km from district headquarter.

About 85.58 per cent of staff positions were filled out of which 14.42 per cent were temporary posts. The study also observed that 74.16 per cent staff working in KVKs were male indicating inequitable distribution in terms of gender.

Only fifty per cent of the sanctioned staff strength was filled in KVK managed under State Department of Agriculture (SDA), whereas, more than 80 per cent of sanctioned staff strength was filled in KVKs under other management types i.e., Non-Government Organisation (NGO) KVKs (97.92%), State Agriculture University (SAU) KVKs (85.71%), and Indian Council of Agricultural Research (ICAR) KVKs (84.37%). It was observed that only the SAU KVKs had temporary posts whereas other types of KVKs had cent per cent permanent posts.

Most of the KVKs had recommended acreage of land holding with the availability of medium level infrastructure facilities (infrastructure index score of 0.61 to 0.91). Notably, more than half of the sampled KVKs had no functional laboratory facilities like soil-water testing lab and home science lab.

The Compound Annual Growth Rate (CAGR) of sanctioned budget range from -1.43 to 20.46 per cent and that of expenditure range from -2.81 to 15.87 for sampled KVKs. The study also found the increase in the net balance of revolving fund generated by sampled KVKs from 4.31 per cent to 67.29 per cent for last eight years (2011-12 to 2018-19).

The sampled KVKs assessed 744 technologies over the 8 year period. The number of technologies assessed increased by 37.87 per cent from 2011-12 to 2018-19. More than three fourth (83.87%) of technologies assessed were in crops, with maximum OFTs in cereals and commercial crops with higher focus on varietal evaluation, and integrated pest management. The OFTs conducted in animal husbandry and fisheries was only 16.13 per cent, where most of them were on cattle and fisheries with thematic areas of production and management and evaluation of breeds.

The results of OFT under different management forms revealed that the NGO KVKs and SAU KVKs achieved the targets better when compared to KVKs under ICAR (86.00%) and SDA (87.00%). The effectiveness of OFTs were assessed using meta-analysis which revealed that the Benefit to Cost ratio (B: C ratio) of 86 per cent of technologies assessed by sampled KVKs was higher than the control/farmers practice in the district.

The sampled KVKs conducted 1,395 FLDs covering 18,197 farmers for last eight years (2011-12 to 2018-19). But, the number of FLDs decreased by 2.09 per cent and the farmers participation reduced by 7.52 per cent from 2011-12 to 2018-19. Most of the FLDs were conducted in the areas of vegetables and cereals with focus on integrated crop management, integrated pest management, and varietal evaluation. The FLDs conducted in animal husbandry and fisheries was found to be minimal and was observed to be conducted only on the thematic area of production and management.

The meta-analysis results of 988 technologies demonstrated by KVKs revealed that the technologies of KVKs had 100 per cent higher B: C ratio compared to the technologies practiced by farmers.

The respondent KVKs conducted a total of 12,487 training programmes with 4,33,703 participants. The Growth rate of training programmes of respondent KVKs from 2011-12 to 2018-2019 had decreased by 16.40 per cent and so the number of participants in the trainings by 11.08 per cent. More than half of the trainings (61.55%) were for farmers and farm women followed by 13.72 per cent for rural youths and 12.24 per cent were sponsored training programmes. The training programmes conducted for extension functionaries and vocational trainings were comparatively very minimal than other training programme types. It was observed that maximum on campus trainings were conducted than off campus trainings.

Participation of farmers and farm women was found to be more in off campus training than on campus trainings. Most of the trainings for farmers/farm women were conducted in the thematic areas of horticulture crops, crop production and home science/women empowerment. The rural youth were trained on small-scale enterprises. The extension functionaries were trained on home science/women empowerment and plant protection thematic areas. The sponsored trainings were more in the area of crop production and management and home science areas and most of the vocational trainings were conducted in the areas of income generating activities. The training targets were achieved by the sampled KVKs of all ownership types.

The KVKs had conducted 15,984 extension activities with 6,71,871 participants where 98 per cent were farmers and two per cent were extension functionaries. The results indicated that six out of every ten (60.33%) extension activities were in the form of advisory services. The number of extension activities of KVKs has increased by 45.65 per cent and the participation of targeted groups saw phenomenal increase of 479.84 per cent over a period from 2011-2012 to 2018-2019.

Considering the data from 2011-12 to 2018-19, it was observed that the literature developed by KVKs have reduced by 3.40 per cent, the soil and water samples tested by KVKs was reduced by 43.37 per cent. But, the advisory services has increased by 56.63 per cent with increased per cent of farmer's coverage from 1.84 per cent to 27.53 per cent. In addition, the sampled KVKs have generated a total revenue of Rs.358.92 lakhs by practicing income generating activities at KVKs.

## **2) The Ecosystem of Krishi Vigyan Kendras for functional effectiveness**

The functional effectiveness was analysed considering three aspects; a) the process of mandated activities (OFT, FLD, Training) b) internal working environment and c) farmers satisfaction towards the service of KVK.

More than half of the respondents followed the 'Source-Assessment' path (55.00%) and 'Source –Demonstration' path (51.67%) during technology passage in the KVK activities. The 'Source-Assessment-Source' path was less followed emphasising that the feedback about the technology assessed was not frequently provided to the source of technology.

The results revealed that the technology was most probably selected based on 'need of the farmers', 'thrust area' and 'location and crop technology'. The farmers were mostly selected based on farmer's interest, farmer's ability and nature of a farmer. The land was probably selected based on facilities available in land, accessibility to field and field health.

Each scientists assessed an average of 3 OFTs per year with 4-9 trials per OFT with the involvement of two KVK staff. It was observed that the OFT process had five major steps *viz.*, Diagnosing the situation, Planning, Conducting OFT, Assessment and Dissemination, where the assessment and dissemination stage was found to be least practiced during the process of OFT. The diagnosis of problem frequently conducted by informed farm survey and interviews with local officer/opinion leaders followed by the planning stage where frequently they list the identified problems, rank them and prioritize to select more severe problem experienced by farmers in the district. But, there was limited practice of communicating the feedback to the researchers and follow-up of OFTs after conduct was observed from the study. Most of the scientists opined that the successful OFTs will be taken forward to FLD but the study found that the further feed forward mechanism was limited during the process.

The study identified the different roles performed by different actors in the process of OFT like: research institutes of SAUs/National research institutes involved as source of technology/inputs and ground level extension functionaries like line department/ATMA, NGOs (if any operating in the district) involved in identification of farmers, village selection etc., But, more involvement of farmers was observed in all the stages except in assessment stage and involvement of line department was observed limited during diagnosis stage.

The study revealed that each scientist conducted 3 to 6 FLDs on an average per year in the farmer's field along with support of 1 to 2 KVK staff during the FLD process. The process of FLD involved planning, implementation and follow-up phase, where the results revealed that the implementation and planning phase was frequently followed by the Scientists but the follow-up phase was rarely followed. The study revealed that only 26.67 per cent expressed that they practice follow-up of FLD technologies.

The study also found the roles of probable actors involved in the process of FLD like the involvement of line department, farmer groups, NGOs were found to be at the grass root level to implement and plan the FLD, whereas the role of SAU, ICAR-ATARI, Research institutes back stop the KVK staff with needed inputs and guidance for successful conducting of FLD. But, the average results revealed that only farmer's found to be frequently in all the stages along with KVK staff during the FLD process.

The scientists conduct an average of 15 trainings at KVKs, where more than three fourth of trainings were knowledge oriented and only 16.16 per cent were skill oriented trainings. The vocational trainings conducted were very minimal (4.60 per cent).

The process of training was analysed considering Pre-training, Training and Post-training phase. The average results of training process revealed that the scientists frequently

design the training programme and make training arrangements under pre-training phase followed by implementation of training programme under training phase. The follow-up activity under post-training period was certainly not followed by majority of respondents. During the training process, the scientists frequently seek support from line department, seek technical support from national institute and involve local non officials in inauguration of training programmes. The study also found that the line department and farmers frequently involved in training need assessment activity and the farmers had their involvement implementation of training activity.

The sampled KVKs had average internal working environment index score of 86.24 indicating fairly good internal working environment status without major complications for its effective functioning. Around 90 per cent respondents expressed that they were highly satisfied with their job, inter-personal relations with colleagues, decision making and team works at KVKs inspite of comparatively lower per cent of work life balance. The working environment results under leadership revealed that there was supportive attitude of superiors towards subordinates but majority of the respondents disagreed about the delegation of work, consideration of subordinates ideas and suggestions, space to express their work problems, transparency in KVK activities and actions. The results also revealed that there was limited role in decision making related to major activities of KVKs. The results indicated that staff perceive that most of activities were based on specific instructions and the scientists will have more communication with farmers and relevant literatures were made available for effective functioning of KVK. The inter-personal relations and team-work were observed to be fairly good and most of the scientists expressed that they were highly satisfied with their job, with fast fatigue recovery from their work back home with fairly good sleep and enthusiasm for the next day.

More than half of the farmer's (59.74%) visited KVK occasionally and their visit was mainly for on campus advisory service (37.18%) and training programmes (34.62%). Most of the farmers (59.74%) rely on mobile advisory service of KVK instead of personal visit.

The farmers had medium level of satisfaction towards the services provided by KVK based on aggregate result of relevancy, quality, usefulness, and customer service dimensions. More than 50 per cent of farmers expressed a high level of satisfaction towards the customer services provided by KVKs and medium level of satisfaction towards relevancy (61.79%), quality (57.18%) and usefulness (69.49%) of KVK services for farmers.



### **3) The Ecosystem of Krishi Vigyan Kendras for functional convergence**

The functional convergence of KVKs analysed using Social Network Analysis (SNA) for the networks identified under sampled KVKs. The results of global measures of sampled KVKs revealed that all KVKs are well connected with minimum number of nodes of 17 to maximum of 35, where the edges of networks were between 62 and 147, having average weighted degree of 34.25 to 46.00. In addition the average path length (minimum path length of 1.69, maximum path length of 2.17), network diameter of 3 to 5 and graph density of 0.12 to 0.28 was found among the sampled KVKs. The results of normalized local measure provided information on centrality measures of KVK, which play a crucial role in convergence. KVK 8 and KVK 9 had highest weighted degree and KVK 4 and KVK 5 has lowest weighted degree where KVK 4 has lowest closeness centrality and betweenness centrality and highest clustering value, indicating the small world network. The results revealed that the most of the sampled KVKs occupied central position in the district along with SDA and ATMA. The status of KVK relation with other extension functionaries in the district found to be good and satisfactory with equal per cent of 43 per cent.

### **4) Development and standardization of an index for measuring ecosystem effectiveness of KVKs**

The ecosystem effectiveness index was developed and standardized based on the 28 indicators identified under the study. Results revealed that staff strength, infrastructure facility, number of FLDs conducted by KVK and clientele satisfaction indicators ranked in top four having high importance in the effective functioning of KVK among the 28 indicators. Based on the conceptual model, the 28 indicators were reduced to 16 main factors which were classified under inputs, process, output and outcome indicators.

The average results of classification indicated that Input indicators had higher influence on the effective functioning of KVK with average index score of 0.07 followed by the process indicators (0.06), outcome indicators (0.05) and the output of KVK (0.04). The sensitivity and robustness of index was tested by calculating and comparing the index by using different normalization methods and aggregation methods

Based on the index, it was revealed that about 76.92 per cent of sampled KVKs had moderate ecosystem effectiveness followed by low (15.12%) and high (07.69%). Under different management types, the NGO KVKs had moderate (66.67%) to high (33.33%) ecosystem effectiveness, where the KVKs under other ownership types had low and moderate ecosystem effectiveness.

The study identified few successful interventions practiced by sampled KVKs like ‘e-saayam’ of KVK Jammikunta of Telangana, ‘Agri-clinic and Agri-pharmacy’ from KVK Suttur of Karnataka, ‘FPOs’ started with the facilitation of KVK Kannur from Kerala, ‘Innovative Farmers Group’ formed by KVK Palem of Telangana, ‘Public Private Partnership’ of KVK Amadalavalasa of Andhra Pradesh with Reddy labs, Reliance foundation and an NGO to disseminate effective information to farmers, were in the areas of information and communication technology, establishment of new infrastructure units, collective action approach, public private partnership and concept of parallel extension functionaries.

### **5) Constraints and suggestions for effective functioning of KVKs**

The major constraints for effective functioning of KVKs were limited opportunities for career (74.12%), overload of unavoidable works other than mandated activities (67.84%), inadequate infrastructure facility (66.95%), limited critical inputs (65.83%), sparse technologies specific to field situation (75.93%), insubstantial technical know-how (54.90%), difficult to mobilize farmers (78.92%), difficult to select farmers and farmers’ fields (75.00%), were the major ones.

The major suggestions obtained were capacity building of staff (74.90%), due consideration for career development of KVK staff by ICAR and concerned host organizations (wherever applicable) (67.45%), establishment of research and document wing at KVK (76.08%), Provision of one cargo vehicle, two office vehicles in working condition (74.90%), accommodation of list of technologies generated by research institutes/SAUs under a common platform along with their website (72.30%), restricting the KVK scientists to perform only mandated activities (71.68%), subject wise budget allocation and others (68.85%), under the human resource development, infrastructure development, technological and administrative suggestion categories for effective functioning of KVKs.

### **6) Strategies to improve the ecosystem effectiveness of KVKs**

Based on the results, the following major strategies are recommended from the study:-

- Monthly monitoring and evaluation of mandated activities of each KVK Scientist at field level by host organization, SAU, ICAR representatives recommended to address the delineation in the procedure of technology assessment, demonstration and capacity building of KVKs.
- Regular follow-up and feedback activity is recommended for KVK staff in the mandated activities by adopting post survey techniques, convergence with

educational institutes (SAUs) in project mode for effective technology development & refinement.

- Mapping the network of extension functionaries using network analysis for better convergence in extension efforts in the district involving KVK Staff, Farmers/farmer groups, Line department, NGOs, Private institutes and other concerned actors.
- It is recommended to conduct evidence based analysis and impact analysis in project mode by ICAR-ATARI/SAUs/Host organization/ collaboration with an independent researcher to measure the effectiveness of technologies transferred by KVKs.
- Monthly subject wise Research-Technology interface via e-platforms is recommended between KVK Scientific staff and Researchers from concerned National institutes/SAUs to bridge the gap between the researchers and KVK staff.
- It is recommended for regular recruitment and engaging contractual staff by KVKs to fill the vacancy, provision of special budget for laboratory services, direct payment to the KVKs for effective utilization of budget.

## **IMPLICATIONS OF THE STUDY**

The major implications based on the findings of the study are as follows:

- In the study an index has been developed using 28 different indicators considering different aspects of KVK ecosystem. The robustness and sensitivity of the index was tested with established methods.

A similar index can be constructed for all the KVK's as a diagnostic tool. The index can indicate which KVKs effectiveness can be improved and also indicates which factors are acting as impediments.

- Also, the study has mapped the process of mandated activities (OFT/FLD and training) of KVK, which highlight deviation from recommended sequence of activities.

These maps can be useful tools for policy makers to reorient KVK activities for more effectiveness, similarly, the roles of different actors in mandated activities are also mapped, which can be leveraged to enhance the participation of farmers, extension functionaries and other stake holders in KVK activities. This would greatly augment image-building of KVK in the district.

- The network map of extension functionaries in the district, using the approach of Social Network Analysis indicates the information flow and convergence. Actors at the center of the network are more influential and involving them in KVK activities will help in spreading the information to large number of farmers. Several other network metrics like centrality measures, path length, graph density and others can be used to measure and analyse the convergence.
- The study also highlighted the delineation in the technology application chain in the mandated activities of KVK like OFT, FLD and training, where policy makers can take possible actions like imposing regular monitoring and evaluation activities at field level by Key officers of SAUs, ICAR-ATARI, Host organization (or) revising the guidelines and standard operating procedures for conducting mandated activities considering the status of KVKs for enhancing functional and convergence effectiveness of KVKs.
- Further, the study has identified and ranked the perceived constraints and suggestions for improved effectiveness in functioning of KVK. Such information is vital for reorienting the KVK activities for effective functioning.