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A Scale to Measure the Livelihood Security of Farmers in Kolar from Koramangala-Challagatta Valley (K.C. Valley) Project of Karnataka

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

An attempt was made in the present study to develop a standardized scale to analyses the livelihood security of farmers in Kolar district after the implementation of K.C. Valley project where sewage treated water is supplied from Bangalore is filling the tanks of Kolar district. The livelihood security scale consists of seven dimensions *viz.,* food security, economic security, health security, social security, ecological security, psychological security and physical security and the scale was considered highly reliable and valid. The livelihood scale consists of 47 statements were administered to 32 farmers of Malur taluk during 2020-2021. It is found that farmers have been spread over better to average (69.45 %) level of livelihood category followed by poor livelihood category (30.55 %).

Keywords: Livelihood security; K. C. valley; Kolar; food security; economic security; health security; social security; ecological security; psychological security and physical security.

1. INTRODUCTION

Kolar is known as the land of silk and milk and livelihoods here are strongly linked with the natural environment. Agriculture and its allied sectors such as horticulture, livestock rearing and sericulture are the major livelihood activities in the district. However, Kolar typically receives

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743 mm rainfall annually with 80.00% received from June to September (Southwest monsoon) and 20.00 % from October-November (Northeast monsoon). Rainfall is characterized by uneven distribution, unpredictability, and dry spells.

Kolar faces severe water quantity and quality issues over the years. Groundwater across the district is classified as overexploited and several areas have high fluoride content which leads to health issues. Overall, borewell success rates have decreased from 83.00 per cent in 2009, to 66.00 per cent in 2015. Successful borewells are also failing: 33.00 per cent of successfully dug bore wells in 2014-15.00 and 9.00 per cent of borewells dug in 2015-16 have stopped functioning. Ground water level of Kolar District plummeted by 64.97 per cent from 14.06 meters below ground level in 2018 to 4.93 meters below ground level in 2019. Since the 33.23 per cent surge in 2016, ground water level sank by 69.07 per cent in 2019.

Considering the significance of waste water and problems of Kolar district, Government of Karnataka had taken an initiative to implement Koramangala-Challaghatta Valley Project (K.C. Valley Project) which is considered to be a unique project in the country. The scheme envisages filling of tanks in Kolar and Chikkaballapur districts with treated sewage water from Bengaluru. The K.C. Valley Project was initiated during November 2016 to supply treated sewage water to a total of 126 irrigation tanks situated in different clusters of Kolar and Chikkaballapur districts in a phased manner. Bengaluru Metropolitan and Karnataka state government authorities have been grappling with the ever growing sewage problems. The K.C. Valley Project thus has been designed to attain win to win benefits to address the ever growing problem of Bangalore city's drain and sewage water problems on one hand and on the other to rejuvenate the steadily declining groundwater table in the surroundings of the irrigation tanks in kolar district.

K.C. Valley project renews a hope among the farming community in effective utilization of waste water in securing better livelihood opportunities of the area. After the implantation of K.C. Valley project major changes were occurred in livelihood status of farmers and are presented in this paper.

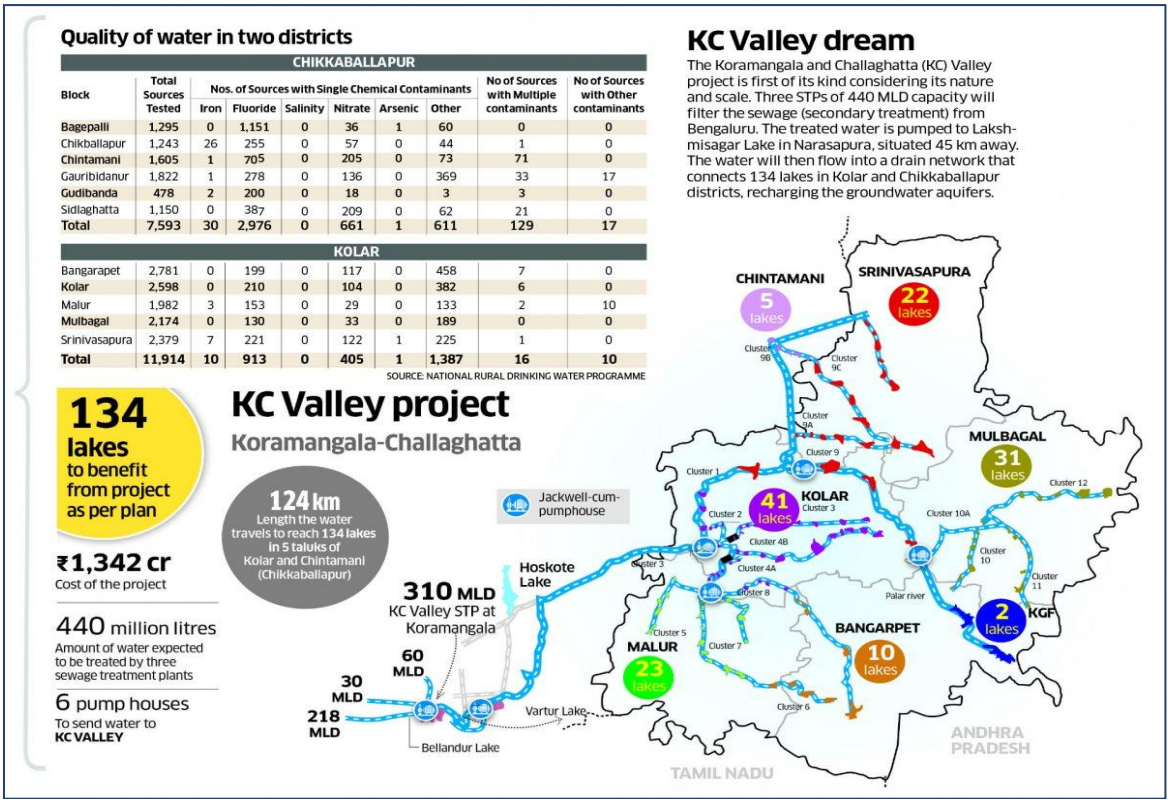

Fig. 1. Map showing the details of K.C. Valley project
Source: https://www.deccanherald.com

Ellis [1] suggests a definition of livelihood as follows. “A livelihood comprises the assets (natural, physical, human, financial and social capital), the activities and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household”. Livelihoods essentially revolve around resources (such as land, crops, seed, labour, knowledge, cattle, money, social relationships and so on) but these resources cannot be disconnected from the issues and problems of access and changing political, economic and socio-cultural circumstances.

Assessing vulnerability / security of livelihoods at household level is the central point of poverty reduction strategies [2]. The indicators proposed for assessing vulnerability of household include:

- Physical assets: A household‘s physical assets- those that can be sold compensate for temporary loss of income-are a measure of its capacity to self-insure.
- Human Capital: Household with limited education tends to be more subjected to income fluctuations and less able to manage risk.
- Income diversification: In rural settings analysis might look at non-farm income, which tends to fluctuate less than farm income, provides a measure of protection against weather related risks.
- Links to community network: Family based networks, occupation based groups or associations to which a household belongs to. This is called social capital of the households.

The components of secure livelihoods vary from five to nine in the literature. Most recent works on the issue focus on the economy, food, education, health, habitat, and participation with characteristic interrelationships [3-5].

Akudugu [6] revealed that the immediate and direct impact of irrigation on livelihoods farmers in the community were involved in irrigated agriculture, the average farm income would have been about GHS 1881.80 (USD 493.91) and this was found to be significant at 1%. With the presence of irrigation facilities across the communities, the average farm income is about GHS 2717.62 (USD 713.29) and this was found to be statistically significant at 1%. The implication of these findings is that irrigation brings about an increase in income levels and this is consistent with the empirical literature. Also indicated that results show that almost twice (85%) the proportion of non-irrigators had alternative livelihood activities compared to irrigators (45%). The majority (52%) of the non-irrigators reported experiencing food shortages compared to only a few (9%) irrigators who experienced food shortages and this is understandable because irrigators have a longer supply of food from their farms compared to non-irrigators.

Assefa *et al.,* [7] capture the impact of irrigation on farmers livelihood, the total income of the household was used in the endogenous switching regression model. The model result shows that the positive and significant impact of irrigation schemes had increased users total income by 7829 ETB (8.5%), as compared to non-users. This shows how significant the role of a small-scale irrigation scheme in improving the livelihood condition of farmers in the study area.

2. METHODOLOGY

The present study was carried out during 2021-2022 for developing a standardize scale to analyse the livelihood security of farmers in K. C. Valley area. To develop and standardize the scale thirty-two farmers who are utilizing water from the K. C. Valley project were interviewed in non-sampling area i.e., Malur Taluk of kolar district. Data was collected through personal interview method and responses were recorded and analyzed. The developed scale was used to measure the livelihood security of farmers in Kolar and Srinivaspura taluks of Kolar District.

The present study was purposively carried out in Kolar district of Karnataka State. Kolar and Srinivas Pura taluk were selected purposively for the study as the numbers of tanks filled were more in these two taluks. The ex-post facto design was used as the research design. Random sampling design was employed for the selection of respondents. The primary data were collected from 180 farm households, consisting of 90 farm households in Kolar taluk and 90 from Srinivaspura taluk. From each taluk, 30 marginal, 30 small and 30 big farmers were selected. The data were collected from the respondents through personal interview method using pre-tested and well-structured schedules. The responses were scored, based on the cumulated score, the respondents were categorized into poor, average and better level of livelihood security based on mean and standard deviation as a measure of check.

2.1 Development of Scale to Measure the Livelihood Security of Farmers

Livelihood security is operationally defined as "capabilities, assets including both material and social resources and activities required for a means of livelihood earned under K.C. Valley Project".

2.1.1 Identification of dimensions

Seven major dimensions related to livelihood security of farmers were identified based on review of literature and discussion with the experts with agricultural extension and allied sciences. The dimensions identified were food security, economic security, health security, social security, ecological security, psychological security and physical security. Both positive as well as negative statements pertaining to the psychological object were included.

2.1.2 Collection and editing of items

A tentative list of 110 items pertaining to livelihood security of farmers was collected. The items developed were edited as per the 14 criteria enunciated by Thurstone and Chave [8] and Edwards [9]. As a consequence, 70 statements of livelihood security were retained for further analysis.

Table 1. Statements to measure the impact of K.C. Valley project on livelihood security status of farmers

I	Food security	MR	R	UD	NR
1.	Use of water from KC valley project helps in securing daily requirement throughout the year				
2.	Use of treated water for irrigation helps in growing the diversified nutrient rich crops				
3.	Diversification of crops due to K. C. Valley project helps to meet the nutrient requirement of the household				
4.	Balanced food available to my family members				
5.	Clean water is available for cooking purpose				
6.	Average Number of meals is consumed by my family members				
7.	I will produce the major portion of food items on my own in farm				
8.	Whether any of the family members are suffering from mal nutrition				
II	**Economic security**				
1.	Availability of irrigation facilities helps in effective utilization of all the resources				
2.	Cost of irrigation has been reduced after the implementation of project				
3.	Diversification of crops through use of treated water resulted in higher cost benefit ratio				
4.	Cost of production has been decreased by utilization of treated water from project				
5.	Dependency on single crop has been reduced by practicing IFS through assured irrigation from K.C Valley project				
6.	Increased in the annual income of the family due to K.C. Valley project				
7.	Cost of digging bore well has been reduced for the project implementation				
8.	All the family members are engaged in farming as well as earning after the implementation of project				
9.	I started practicing more than one enterprise by utilization of treated water				
10.	Project helped in generation of employment opportunity throughout the year				
11.	I didn't sold any assets to meet the household expenditure after the project implementation				
12.	Area under cultivation has been increased after the implementation of project				

I	Food security	MR	R	UD	NR
13.	Assured irrigation from K.C. valley project provides security against risk and uncertainties of farm yields				
14.	Growing of high value crops is possible through irrigation with K.C Valley water which adds to more income				
15.	Livestock holding has been increased through generation of pasture added to total earnings of the family				
16.	I started availing credit from the banks after the implementation of project				
17.	I started savings of the earnings which act as a means of better livelihood				
18.	Failed bore wells have been recovered after the implementation of project				
19.	I am repaying the loans regularly and I'm not a defaulter				
20.	I have insured all crops grown in the field against natural calamities				
III	**Health security**				
1.	More incidence of diseases at household , village and community level after implementation of project				
2.	I was sick for many number of days after the implementation of project				
3.	I was frequently visiting to the hospital after the implementation of the project				
4.	I didn't find any harmful effect on health after consumption of food grown through treated water				
5.	Health of all the family members are in good condition				
6.	Health insurance for my family members is done				
7.	I have spent maximum amount of earnings for hospital expenses after the project implementation				
8.	I have own mode of transportation to avail medical facilities during emergency				
IV	**Social security**				
1.	I have become an member of cooperative society after the implementation of project				
2.	I started interacting with progressive/ innovative farmers often after getting water from project				
3.	I started participated in krishimelas, exhibitions and campaigns et., to acquire information about new technologies suitable for irrigated conditions				
4.	I got good recognition in society after growing diversified crops through assured irrigation				
5.	Growing of diversified crops improves the Cosmopolite characters of farmers				
6.	Project implementation has ensured good linkage with the extension agencies				
7.	I have acquired awareness about ones right to utilize public resources through project implementation				
8.	Villagers are maintain harmonious relationship after the implementation of project				
9.	Conflicts among farmers over utilization of treated water in the fields				
10.	After implementation of KC valley project I'm utilizing the benefits from the Govt. Schemes				
V	**Ecological security**				
1.	I feel treated water smells and it is not hygienic				
2.	Treated water is releasing the effluents / heavy metals causing soil pollution				

I	Food security	MR	R	UD	NR
3.	Treated water for irrigation helped in effective utilization of water along with other factors of production				
4.	Treating the waste helps in reducing inland water pollution				
5.	I feel treated water is destroying the soil structure in long run				
6.	Irrigation with treated water is providing favorable environment for crop growth				
7.	Application of treated water is compatible with the natural, physical , chemical and biological processes that occur on and in the soil				
8.	Groundwater level has been increased after the implementation of the project				
VI	**Psychological security**				
1.	After implementation of project my knowledge and skills of farming has been increased				
2.	Assured irrigation provided confidence in trying out the innovative ideas in my farm				
3.	Positive attitude to take risk has been increased				
4.	Project helped in reducing the mental stress				
5.	Assured irrigation has increased confidence of availing credit from and repaying loans to the banks				
VII	**Physical security**				
1.	Electricity facility is available in village to access the irrigation facility				
2.	Good linkages of road from villages to the nearby cities/town has been provided after the implementation of project				
3.	Project implementation has helped to possess a own new house				
4.	I have purchased new vehicle for transporting the produce				
5.	I have purchased new machinery and implements for farming				
6.	I expanded my livestock numbers in a desired way				
7.	I purchased new mobiles for telecommunications				
8.	My land holding has been increased				
9.	Possess a new bore well at low cost after the implantation of project				
10.	I have purchased two wheeler/four wheeler after the project implementation				
11.	I am sending my children for higher studies				

MR- Much Relevant; R- Relevant; UD- Undecided; NR- Not relevant

2.2 Relevancy Analysis

The proforma containing 70 items measuring livelihood security were given to 150 judges by means of google forms and handed over personally in the field of agricultural extension, agronomy, soil science and economics to critically evaluate the relevancy of each item in five-point continuum *viz.,* Most Relevant (MR), Relevant (R), Less Relevant (LR) and Not Relevant (NR) and the responses were assigned the score of 4, 3, 2 and 1 respectively. The judges were also requested to make necessary modifications and additions or deletion of statements if they desire so. A total of 110 judges who returned the questionnaire duly completed were considered for further processing. From the data gathered, “Relevancy Percentage” “Relevancy Weightage” and “Mean Relevancy Score” were worked out for all the 70 livelihood statements. Using these criteria individual statements were screened for relevancy using the below mentioned formulae.

$$\text{Relevancy Weightage of } i^{th} \text{ indicator } (RW_i) = \frac{(MR\times4)+(R\times3)+(LR\times2)+(NR\times1)}{Maximum\ possible\ score}$$

Relevancy Percentage of i^{th} indicator (RP_i) = $\frac{(MR\times4)+(R\times3)+(LR\times2)+(NR\times1)}{Maximum\ possible\ score} \times 100$

Mean Relevancy Score of i^{th} indicator (MRS_i) = $\frac{(MR\times4)+(R\times3)+(LR\times2)+(NR\times1)}{Number\ of\ judges\ responded}$

Table 2. Relevancy percentage and Mean relevancy scores of livelihood security items

I	Food security	RP	MRS
1.	Use of water from KC valley project helps in securing daily requirement throughout the year	83.586	3.343
2.	Use of treated water for irrigation helps in growing the diversified nutrient rich crops	80.556	3.222
3.	Diversification of crops due to K.C. Valley project helps to meet the nutrient requirement of the household	79.293	3.172
4.	Balanced food available to my family members	76.263	3.051
5.	Clean water is available for cooking purpose	75.000	3.000
6.	Average Number of meals is consumed by my family members	74.747	2.990
7.	I will produce the major portion of food items on my own in farm	77.778	3.111
8.	Family members are suffering from mal nutrition	66.919	2.677
II	**Economic security**		
1.	Availability of irrigation facilities helps in effective utilization of all the resources	84.091	3.364
2.	Cost of irrigation has been reduced after the implementation of project	85.101	3.404
3.	Diversification of crops through use of treated water resulted in higher cost benefit ratio	83.333	3.333
4.	Cost of production has been decreased by utilization of treated water from project	78.535	3.141
5.	Dependency on single crop has been reduced by practicing IFS through assured irrigation from K.C Valley project	80.808	3.232
6.	Increasing in the annual income of the family due to K.C. Valley project	83.333	3.333
7.	Cost of digging bore well has been reduced because of the project implementation	81.313	3.253
8.	All the family members are engaged in farming as well as earning after the implementation of project	80.808	3.232
9.	I started practicing more than one enterprise by utilization of treated water	79.040	3.162
10.	Project helped in generation of employment opportunity throughout the year	80.051	3.202
11.	I didn't sold any assets to meet the household expenditure after the project implementation	76.010	3.040
12.	Area under cultivation has been increased after the implementation of project	85.101	3.404
13.	Assured irrigation from K.C. valley project provides security against risk and uncertainties of farm yields	83.586	3.343
14.	Growing of high value crops is possible through irrigation with K.C Valley water which adds to more income	83.081	3.323
15.	Livestock holding has been increased through generation of pasture added to total earnings of the family	81.818	3.273
16.	I started availing credit from the banks after the implementation of project	75.000	3.000
17.	I started savings of the earnings which act as a means of better livelihood	80.556	3.222
18.	Failed bore wells have been recovered after the implementation of project	79.545	3.182
19.	I am repaying the loans regularly and I'm not a defaulter	76.263	3.051
20.	I have insured all crops grown in the field against natural calamities	76.768	3.071

I	Food security	RP	MRS
III	**Health security**		
1.	More incidence of diseases at household , village and community level after implementation of project	77.778	3.111
2.	I was sick for many number of days after the implementation of project	68.434	2.737
3.	I was frequently visiting to the hospital after the implementation of the project	68.434	2.737
4.	I didn't find any harmful effect on health after consumption of food grown throughout treated water	77.020	3.081
5.	Health of all the family members are in good condition	79.545	3.182
6.	Health insurance for my family members is done	73.990	2.960
7.	I have spent maximum amount of earnings for hospital expenses after the project implementation	68.687	2.747
8.	I have own mode of transportation to avail medical facilities during emergency	69.697	2.788
IV	**Social security**		
1.	I have become a member of cooperative society after the implementation of project	77.525	3.101
2.	I started interacting with progressive/ innovative farmers often after getting water from project	78.535	3.141
3.	I started participating in krishimelas, exhibitions and campaigns et., to acquire information about new technologies suitable for irrigated conditions	82.576	3.303
4.	I got good recognition in society after growing diversified crops through assured irrigation	81.818	3.273
5.	Growing of diversified crops improves the cosmopolite characters of farmers	79.545	3.182
6.	Project implementation has ensured good linkage with the extension agencies	82.576	3.303
7.	Villagers are maintaining harmonious relationship after the implementation of project	78.788	3.152
8.	Conflicts among farmers over utilization of treated water in the fields	74.747	2.990
9.	After implementation of KC valley project I'm utilizing the benefits from the Govt. Schemes	80.051	3.202
V	**Ecological security**		
1.	Treated water smells and it is not hygienic	75.758	3.030
2.	Treated water releasing the effluents / heavy metals is causing soil pollution	74.495	2.980
3.	Treated water for irrigation helped me in effective utilization of water along with other factors of production	80.556	3.222
4.	Treating the waste water helps in reducing inland water pollution	79.040	3.162
5.	I feel treated water is destroying the soil structure in long run	70.455	2.818
6.	Irrigation with treated water is providing favorable environment for crop growth	79.798	3.192
7.	Application of treated water is compatible with the natural, physical , chemical and biological processes that occur on and in the soil	76.768	3.071
8.	Groundwater level has been increased after the implementation of the project	80.303	3.212
VI	**Psychological security**		
1.	After implementation of project my knowledge and skills of farming has been increased	82.323	3.293
2.	Assured irrigation provided confidence in trying out the innovative ideas in my farm	82.323	3.293
3.	Positive attitude to take risk has been increased	82.323	3.293
4.	Project helped in reducing the mental stress	76.768	3.071
5.	Assured irrigation has increased confidence of availing credit from and repaying loans to the banks	81.313	3.253

I	Food security	RP	MRS
VII	**Physical security**		
1.	Electricity facility is available in village to access the irrigation facility	80.051	3.202
2.	Good linkages of road from villages to the nearby cities/town has been provided after the implementation of project	78.788	3.152
3.	Project implementation has helped to possess an own house	68.939	2.758
4.	I have purchased vehicle for transporting the produce	73.990	2.960
5.	I have purchased machinery and implements for farming	78.283	3.131
6.	I expanded my livestock numbers in a desired way	80.303	3.212
7.	I purchased new mobiles for telecommunications	77.020	3.081
8.	My land holding has been increased	75.505	3.020
9.	Possess a new bore well at low cost after the implantation of project	76.010	3.040
10.	I have purchased two wheeler/four wheeler after the project implementation	71.212	2.848
11.	Iam sending my children for higher studies	79.293	3.172

RP- Relevancy Percentage; MRS – Mean Relevancy Score

Individual items were screened based on these calculated values. Accordingly, items having relevancy percentage of more than 85 per cent and mean relevancy score more than or equal to 3.00 were included for further analysis. Thus, a total of 62 statements out of 70 were considered for item analysis.

2.3 Item Analysis

For item analysis, 32 respondents were selected from the non-sample area and the respondents were asked to indicate their response in each of the items in their respective scoring pattern. Based on the total scores obtained, the respondents were arranged in descending order. The top 25 per cent of the respondents with their total scores were considered as high group and the bottom 25 per cent as low group. These two groups provide criterion groups in terms of evaluating the individual statements suggested by Edwards [9]. 't' value was calculated for each of the statement by using the above mentioned formula:

$$t = \frac{\bar{X}_H - \bar{X}_L}{\sqrt{\frac{\sum X_H^2 - \frac{(\sum X_H)^2}{n} \times \sum X_L^2 - \frac{(\sum X_L)^2}{n}}{n(n-1)}}}$$

Where,

$\bar{X}_H$= The mean score on given statement of the high group

$\bar{X}_L$ = The mean score on given statement of the low group

$\sum X^2_H$= Sum of squares of the individual score on a given statement for high group

$\sum X^2_L$ = Sum of squares of the individual score on a given statement for low group

n = Number of respondents in each group

$\sum$ = Summation

t = the extent to which a given statement differentiates between the high and low groups.

After computing the 't' value for all the 62 livelihood statements, only those with 't' value equal and greater than 2.145 were finally selected for inclusion in the scale. Out of 62 livelihood statements 47 statements were significant at 5 per cent.

2.3.1 Reliability of the scale

The value of correlation coefficient for scale to measure the livelihood security was 0.88 and this was further corrected by using Spearman Brown formula to obtain the reliability coefficient of the whole set. The 'r' value of the scale was 0.93, which was found significant at one per cent level indicating the high reliability of the scale. It was concluded that the scale constructed was reliable.

a) Half test reliability formula

$$r_{1/2} = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{\sqrt{(N\Sigma X^2 - (\Sigma X)^2)\,(N\Sigma Y^2 - (\Sigma Y)^2)}}$$

Where,

ΣX= Sum of the scores of the odd number items

ΣY = Sum of the scores of the even number items

ΣX^2= Sum of the squares of the odd number items

ΣY^2 = Sum of the squares of the even number items

b) Whole test reliability formula

$$r_{11}= \frac{2\times r1/2}{1+r1/2}$$

Where, $r1_{/2}$= Half test reliability

2.3.2 Validity

$$\text{Validity}=\sqrt{r_{11}}$$

The data was subjected to statistical validity, which was found to be 0.93 for the scale to measure the livelihood security of farmers which is greater than the standard requirement of 0.70. Hence, the validity coefficient was also found to be appropriate and suitable for the tool developed.

2.3.3 Administration of the scale

The final scale consists of 47 statements for measuring the livelihood security of farmers. The response will be collected on a Likerts scale consists of five-point continuum, *viz.,* Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree with an assigned score of 5,4,3,2 and 1 for positive statements and reverse scoring for negative statements respectively.

Table 3. Scale to analyze the Livelihood security of farmers in K. C. Valley Project area

Sl. No	Statements	SA	A	UD	DA	SDA
I	**Food security**					
9.	Use of treated water for irrigation helps in growing the diversified nutrient rich crops					
10.	Diversification of crops due to K. C. Valley project helps to meet the nutrient requirement of the household					
11.	Balanced food available to my family members					
12.	Clean water is available for cooking purpose					
13.	I will produce the major portion of food items on my own in farm					
II	**Economic security**					
21.	Availability of irrigation facilities helps in effective utilization of all the resources					
22.	Diversification of crops through use of treated water resulted in higher cost benefit ratio					
23.	Dependency on single crop has been reduced by practicing IFS through assured irrigation from K.C Valley project					
24.	Cost of digging bore well has been reduced because of the project implementation					
25.	All the family members are engaged in farming as well as earning after the implementation of project					
26.	I started practicing more than one enterprise by utilization of treated water					
27.	Project helped in generation of employment opportunity throughout the year					
28.	I didn't sold any assets to meet the household expenditure after the project implementation					
29.	Area under cultivation has been increased after the implementation of project					
30.	Assured irrigation from K.C. valley project provides security against risk and uncertainties of farm yields					
31.	Livestock holding has been increased through generation of pasture added to total earnings of the family					
32.	I started availing credit from the banks after the implementation of project					
33.	I started savings of the earnings which act as a means					

Sl. No	Statements	SA	A	UD	DA	SDA
	of better livelihood					
34.	Failed bore wells have been recovered after the implementation of project					
35.	I am repaying the loans regularly and I'm not a defaulter					
36.	I have insured all crops grown in the field against natural calamities					
III	**Health security**					
9.	More incidence of diseases at household , village and community level after implementation of project					
10.	Health of all the family members are in good condition					
11.	Health insurance for my family members is done					
IV	**Social security**					
10.	I have become a member of cooperative society after the implementation of project					
11.	I started interacting with progressive/ innovative farmers often after getting water from project					
12.	I started participating in krishimelas, exhibitions and campaigns et., to acquire information about new technologies suitable for irrigated conditions					
13.	Growing of diversified crops improves the cosmopolite characters of farmers					
14.	Villagers are maintaining harmonious relationship after the implementation of project					
15.	There are no conflicts among farmers over utilization of treated water in the fields					
16.	After implementation of KC valley project, I'm utilizing the benefits from the Govt. Schemes					
V	**Ecological security**					
9.	Treated water releasing the effluents / heavy metals is causing soil pollution					
10.	I feel treated water is destroying the soil structure in long run					
11.	Irrigation with treated water is providing favourable environment for crop growth					
12.	Application of treated water is compatible with the natural, physical , chemical and biological processes that occur on and in the soil					
VI	**Psychological security**					
6.	After implementation of project, my knowledge and skills of farming has been increased					
7.	Assured irrigation provided confidence in trying out the innovative ideas in my farm					
8.	Positive attitude to take risk has been increased					
9.	Project helped in reducing the mental stress					
10.	Assured irrigation has increased confidence of availing credit from and repaying loans to the banks					
VII	**Physical security**					
12.	Project implementation has helped to possess a own house					
13.	I have purchased vehicle for transporting the produce					
14.	I have purchased machinery and implements for farming					
15.	I expanded my livestock numbers in a desired way					

Sl. No	Statements	SA	A	UD	DA	SDA
16.	I purchased new mobiles for telecommunications					
17.	Possess a new bore well at low cost after the implementation of the project					
18.	I have purchased two wheeler/four wheeler after the project implementation					

SA- Strongly Agree, A-Agree, UD-undecided, DA-Disagree, SD-Strongly Disagree

Table 4. Livelihood security of farmers in Kolar district of Karnataka

Sl. No.	Steps	Livelihood security of farmers	
		Statements considered	Statement retained
1	Collection of items	110	110
2	Editing of items	110	70
3	Relevancy analysis	70	62
4	Item analysis	62	47
5	Standardization of scale	47	47
6	Administration of scale	47	47

Based on the livelihood score, respondents were classified into poor, average and better levels of livelihood security category using mean and SD.

3. RESULTS AND DISCUSSION

Table 5. Overall Livelihood security of farmers in K.C. Valley project area

n=180

Livelihood level	Category	Marginal farmers (n_1=60)		Small farmers (n_2=60)		Large farmers (n_3=60)		Total (n=180)	
Mean = 152.83 SD = 3.44		F	%	F	%	F	%	F	%
	Poor (<149.38)	15	25.00	24	40.00	25	41.67	15	25.00
	Average (149.38 – 156.27)	19	31.67	15	25.00	17	28.33	19	31.67
	Better (> 156.27)	26	43.33	21	35.00	18	30.00	26	43.33

F- Frequency, % - percentage

3.1 Overall Livelihood Security of Farmers in K.C. Valley Project Area

The examination of the Table 5 and Fig 2 revealed that, in case of marginal farmers more than two fifth (43.33 %) of the farmers belonged to better level of livelihood security, which is followed by 31.67 per cent and one fourth of the marginal farmers belonged to average and poor level livelihood security respectively. This may be due to extent of availability of assured irrigation facilities through increased groundwater after the implementation of K.C. Valley project in their farm, farmers started cultivating the crops all-round the year and this thing has contributed in enhancing the income level of farmers as well as increased employment opportunities throughout the year.

The results from the Table 5 and Fig 2 with respect to small farmers, three fifth (60.00 %) of the farmers belonged to average and better level of livelihood category followed by poor livelihood (40.00 %) category respectively. Small farmers have better utilized the available resources like both the material (land and water) and social resources (money, information and services) in order to achieve the better livelihood strategies. Changing from the mono cropping to vegetable-based cropping system has increased the potential demand for marketing of crops to enhance their income might have contributed to generate better livelihood in the project region.

In case of big farmers, slightly more than two fifth (41.67 %) of the farmers belonged to poor livelihood category followed by 30.00 per cent

and 28.33 per cent belonged to better and average livelihood category. It gives a clear picture that, Majority of (58.33 %) of the big farmer's belonged to better to average level of livelihood category. This indicates that farmers might have better accessed to livelihood assets after the implementation of K.C. valley project, many of the farmers depends directly or indirectly on peasant agriculture and the project has been significantly contributed to production of food crops as well as livestock which helped in securing better to average livelihood category.

Overall it is evident from the Table 5 and Fig 2 that, farmers have been spread over better to average (69.45 %) level of livelihood category followed by poor livelihood category (30.55 %). K. C. Valley had helped in increasing ground water table which in turn helped in cultivating the crops all-round the year by better utilization of all the scarce resources. This has contributed in enhancing the income as well as in income generation. Thus, farmers have secured better livelihood strategies by better utilization of livelihood assets. This may be probable reason for better to average level of livelihood security.

3.2 Different Livelihood Component Wise Distribution Farmers in the K.C Valley Project Area

Farmers are distributed into different categories based on components of livelihood security *viz,* food security, economic security, health security, social security, ecological security, psychological security and physical security and results are depicted in Table 6 and are discussed in the following paragraphs.

Results in the Table 6 and Fig 3 indicates that majority (65.00 %) of the farmers belonged to better to average level of food security followed by poor level (35.00 %) of food security respectively. Obviously, irrigation is key to increasing food production and farm income and improves resilience against weather variability. Farmers might have consistent access to enough food to lead a healthy and active life after the implementation of project by growing the crops all-round the year may be the probable reason for that. This result was in accordance with the results of [10] who found that maximum number of farmers (i.e. 45.34 per cent) had medium level of food security.

It is tangible from the Table 6 and Fig 3 that three fourth (75.00 %) of the farmers belonged to average to better level of economic security followed by one fourth (25.00 %) of them belonged to poor level of economic security. The probable reason might be that treated water Irrigation has enhanced both the productivity and profitability of the agricultural crops in the K.C. Valley project area. Water available has reduced the cost on irrigation and helps in getting higher returns.

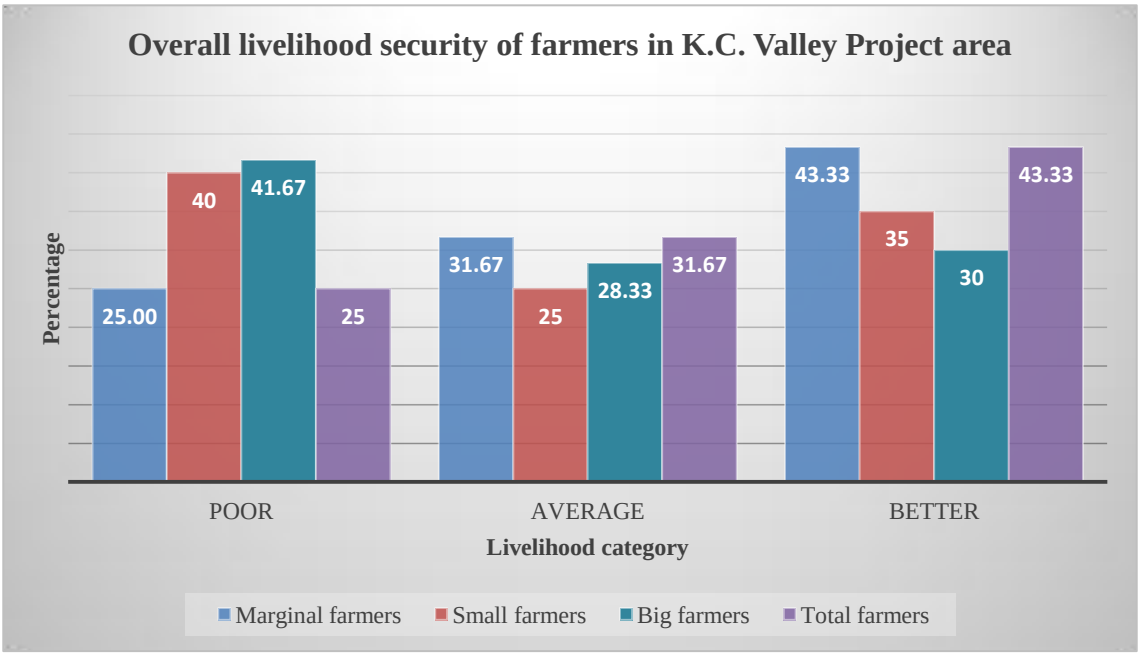

Fig. 2. Overall livelihood security of farmers in K.C. Valley Project area

Table 6. Different livelihood component wise distribution of farmers in K. C. Valley project area n=180

Sl. No	Livelihood components	Categories	Frequency	%
1	Food security	Poor (<15.27)	63	35.00
	Mean = 16.77	Average (15.27-18.26)	53	29.44
	SD = 2.99	Better (>18.26)	64	35.56
2	Economic security	Poor (< 58.80)	45	25.00
	Mean = 60.35	Average (58.80-61.89)	72	40.00
	SD = 3.08	Better (>61.89)	63	35.00
3	Health security	Poor (< 9.48)	58	32.22
	Mean = 10.01	Average (9.48-10.51)	68	37.78
	SD = 1.03	Better (> 10.51)	54	30.00
4	Social security	Poor (< 23.28)	34	18.89
	Mean = 24.90	Average (23.28-26.51)	107	59.44
	SD = 1.61	Better (> 26.51)	39	21.67
5	Ecological security	Poor (<12.28)	74	41.11
	Mean = 12.84	Average (12.28-13.40)	49	27.22
	SD = 1.12	Better (> 13.40)	57	31.67
6	Psychological security	Poor (< 20.12)	61	33.89
	Mean = 20.99	Average (20.12-21.86)	33	18.33
	SD = 1.73	Better (> 21.86)	86	47.78
7	Physical security	Poor (<22.20)	19	31.67
	Mean = 23.66	Average (22.20-25.12)	21	35.00
	SD = 2.91	Better (>25.12)	20	33.33

F- Frequency, % - percentage

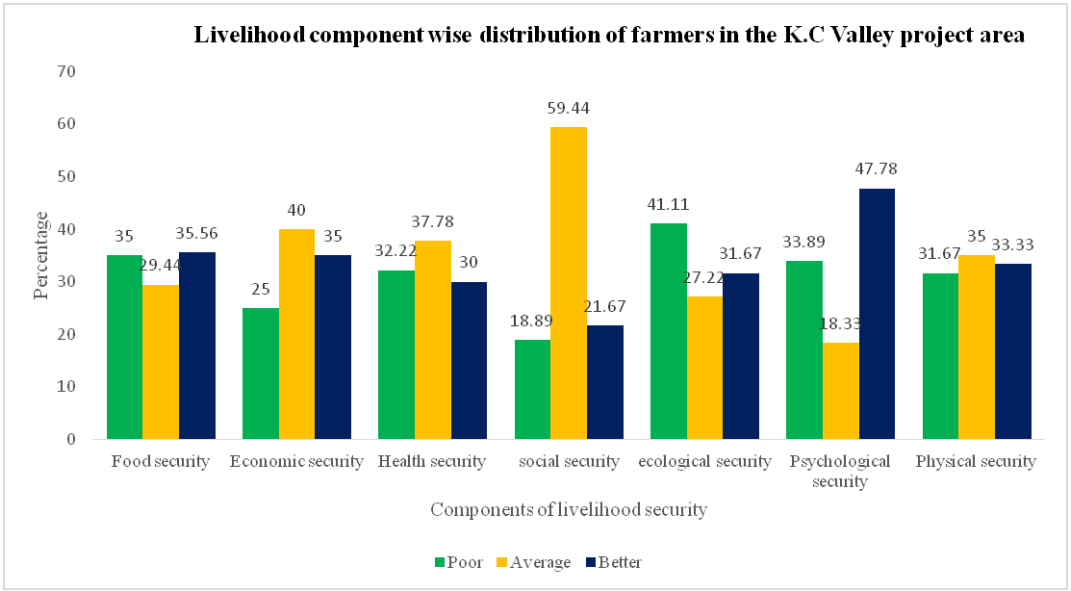

Fig. 3. Livelihood component wise distribution farmers in the K.C Valley project area

A close perusal of Table 6 and Fig 3 indicates that 37.78 per cent of the farmers belonged to average level of health security, less than one third of them belonged to poor level (32.22 %) health security and 30.00 percent of the farmers had better health security. The probable reason for the above trend may be, increased water facilities might have enhanced the food security which in turn helped in accruing healthy life. But in long turn treated water might have negative impact on health; this may be the probable reason for that.

The data presented in the Table 6 and Fig 3 depicted that, majority of the farmers in the K. C. Valley project area belonged to average level (59.44 %) of social security followed by 21.67 per cent and 18.89 per cent belonged to better and

poor social security category respectively. The probable reason might be that, farmers might have increased participation in cooperative societies; frequently they were contacting input dealers for seeds, pesticides fertilizers, involved in social activities after the implementation of project [11,12].

It can be found out from the Table 6 and Fig 3 that two fifth (41.11 %) of the farmers belonged to poor ecological security followed by better (31.67 %) and average (21.67 %) ecological security respectively. Farmers might have thought that the use of treated water may affect the health as well as environment Conventional wastewater treatment plants (WWTPs) clean wastewater and minimize water pollution; but, while doing so, they also contribute to air pollution and associated emissions.

It is evident from the Table 6 and Fig 3 that nearly half (47.78 %) of the farmers belonged to better psychological security followed by poor (33.89 %) and average (18.33 %) psychological category respectively. Increased irrigation facilities help to safeguard domestic food security and strengthen farmers' ability to recover from shocks and adapt to a changing environment like droughts.

A close look at the Table 6 and Fig 3 reveals that, more than one third (35.00 %) of the farmers belonged to average level of physical security and one third (33.33 %) of them belonged to better physical security followed by poor level (31.67 %) of physical security. Farmers have purchased the own vehicles, farm implements and other domestic purpose physical implements this might be the reason for better physical security.

4. CONCLUSION

Kolar is a drought prone area and ground water level is depleting over the years. A farmer used to spend huge amount to sink a borewell with the hope of finding water. Often, the water used to dry up very soon and he would be left with a huge debt to repay. This K.C. Valley project emulated across the Kolar to solve the problem of dry borewells and poor groundwater level. Farmers are availed irrigation facilities all-round the year due to K.C. Valley project which enabled them to cultivate more crops even in the small area, resource poor farmers working as laborers due to drought conditions and borewell failure are also started cultivating crops on their own field as a result there livelihood security level also been increased due to availability of water.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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