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Technological interventions and livelihood security of small holders in maize based farming system of Kashmir Valley

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Abstract
Considering the importance of maize cultivation in the agricultural economy of the state, an attempt was made to analyze the impact of improved maize varieties on farm household income and livelihood security of maize growers in Kashmir Valley. The results revealed that although the adoption of improved varieties increase cost of maize cultivation but these varieties improved yield levels that resulted in the significant decline in its cost of production. It was observed that the adopter farms have relatively better endowments of physical, economic, social, human and natural capital and their livelihood was more secure compared to non-adopters. The regression estimates ascertained significant role of different capital endowments and technology adoption in livelihood security of maize growers. A number of policy options emerge out of the findings of this study.

Keywords: Maize, small farmers, improved varieties, adoption, livelihood security, Kashmir

Introduction

India is the 6th largest producer of maize in the world, contributing about 2 per cent to the global maize production of 855.72 Mt (USDA-FAS, 2013) [26]. In India, maize is grown under resource poor conditions as a rainfed crop. Maize constitutes about 9 per cent of the total volume of cereals produced in the country and is the third most important food-grain after rice and wheat. As reported by DMR, 2012 [6] and Chaudhary *et al*., 2012 [5], the consumption pattern for maize in India at present includes poultry feed- 52 per cent, human food- 24 per cent, animal feed- 11 per cent and industrial processing- 11-12 per cent. Maize has been included in the National Food Security Mission, in addition to the existing thrust on wheat, rice and pulses. However, in recent years, as a result of the commercial orientation and rising demand for maize in its end uses, maize production scenario has undergone myriad changes. The overall yield has also shown an increasing trend, particularly after 2000-01, on account of recent adoption of Rabi (winter) and spring maize and introduction of hybrid (including single cross hybrid) maize (DMR, 2013) [8]. Besides, the state government also promotes composite seeds through State Seed Corporation and the promising varieties are generally procured from the private sector (Sood, 2011) [25]. A regional shift in production has been observed from north to south; Bihar, Uttar Pradesh and Madhya Pradesh were the major maize producing states in 1990s, but during the past two decades, southern states, especially Andhra Pradesh and Karnataka, have become the major maize-producing states (Gulati and Dixon, 2008) [15].

According to an estimate by KPMG (2013), India may require 44.44 Mt of maize by the year 2022, of which 22.9 Mt will be for poultry feed and 7.5 Mt each will be demanded by starch and cattle & other feed sectors. To meet the given demand, the scale of maize production needs to be increased for successful industrialization and markets with effective distribution system need to be developed to handle the grain produced. If maize supply is to keep pace with projected growth in demand, domestic production will have to increase significantly. Production increases in maize can be achieved through expansion in area planted, yield gains, or some combination of two. Diminishing availability of arable land rules out the possibility of further expansion of area planted; suggesting that future production growth will depend mainly on yield gains made possible by spread of productivity enhancing technologies. One of the important sources, of potential productivity gains is the improved germplasm contained in maize varieties. Producing higher maize yields on existing cultivated land is, therefore, the surest way of generating the extra maize grain required to feed the nation.

Although the technological breakthrough as such in Indian agriculture is no longer a new phenomenon, yet it has got a significant relevance particularly for the regions which are on way towards agricultural development.

Indian Himalayas are fragile ecosystem falling under such conditions of agricultural backwardness have yet to get benefit from agricultural innovations. Among Himalayan states, the Jammu & Kashmir is one of the traditional maize growing states, in the country and its productivity when compared to other maize growing states is very low. Enhancement in maize productivity is crucial for improving the livelihoods of smallholder farmers in the state. SKUAST-K has developed or refined number of technologies for development of maize sector of the state and Kashmir Division in particular. The maize production in Kashmir is generally taken up under scantly irrigation facilities. Earlier maize was cultivated as a fodder crops though this crop as a source of grains has been recognized after the technological breakthrough in seed technology and their dissemination in different agro-climatic locations. The various seed technologies including maize composites and hybrids have performed better at the field, however, a comprehensive study of performance of these technologies as well as the interactions between level of adoption and economic gains is necessary to get an integrated view. In this backdrop, the present study has analyzed the livelihood of farming households in relationship with the extent of adoption of improved maize seed technology in the Kashmir valley and has identified the factors associated with its adoption.

Methodology

Choice of maize technology: SKUAST-Kashmir has developed technologies to improve yield levels of maize by many folds of which two improved maize varieties were selected for the preset investigation viz Maize Composite-8 and Maize Composite-15. Besides, scientific recommendations like the method and quantity of inputs use, plant to plant and row to row distances, etc were considered for evaluation in relationship with livelihood security in MFS.

Data: The proposed study was based upon secondary and primary data. The secondary data was collected from various published and unpublished records of different Directorates/offices of Government of Jammu & Kashmir. The selected varieties of maize were evaluated in maize based farming system (MFS) of Kashmir, J&K. Multi-stage sampling technique was employed for the selection of blocks, villages and cultivators. In first stage of sampling, Kupwara district as representative of MFS was selected purposively on the basis of dominant cropping pattern. From selected district, Drugmulla CD block was randomly selected considering major proportion of area under respective farming system. In the final stage an appropriate sample of respondents were randomly selected from a selected village. The primary data was collected in the year 2016-17 and 2017-18.

Method of processing and analyzing: The CARE framework considers livelihoods in terms of access to five types of capital or assets including human, economic, social, natural and physical capital. Household-level quantitative data was used to analyze the asset-base of households in relationship with the adoption of improved maize varieties and use of other critical inputs as envisaged in scientific recommendations. We have analyzed the effect of adoption on productivity, profitability of maize farming, and rural household incomes. We measure the outcomes induced by the productivity growth in maize cultivation with the adoption of selected S&T interventions. Household level HLS indices will then be constructed following Hahn *et al*. (2009) [16] procedures. Indicators were identified and it is assumed that each indictor has equal weight to the overall HLS index. The indicators were then standardized following the procedure adopted in measuring Human Development Indices. For example, a standardized indicator j of a household is given by:

Indj = ($indicator_j$ – min_j)/ (max_j – min_j) for desired variable, more value of which may have desired impact

Indj = (max_j – $indicator_j$)/ (max_j – min_j) for undesirable variable, more value of which may have unfavourable impact.

Where minimum and maximum values of the indicators are from the same type of sample within which the household belongs. Once each indicator representing a particular livelihood security domain was standardized, then the relevant household livelihood security index for the particular domain was constructed by averaging the standardized indicators to construct household level security index (HLS). Then the composite overall Livelihood Security (LS) index for the region was constructed by summing up the HLS for each indicator.

Livelihood security function: In order to quantify the determinants of livelihood security, the cause and effect of relationship was estimated employing following function:

LSI = f(ESI, SSI, NSI, HSI, EDSI, HLSI, PHSI, TAI, FML, AGE, U)

Where,

LSI	=	Livelihood security index
ESI	=	Economic security index
SSI	=	Social security index
NSI	=	Natural security index
HSI	=	Human security index
EDSI	=	Educational security index
HLSI	=	Health security index
PHSI	=	Physical security index
TAI	=	Technology adoption index
FML	=	Average family size (No.)
AGE	=	Age of family head (years)
U	=	Random term

Various indices have been exogenized in the function to ascertain their relative role in the function. Average family size and dependency ratio have been included in the structural form of the model because these variables exhibited burden of a family and could have negative influence on livelihood security. Besides more number of exogeneous variables were attempted in the model, however, only those variables that gave best fit to the estimates were kept in its final form.

Technology adoption index: To study the level of adoption of technology and other associated management practices technological adoption index will be worked out by using the following formula:

Technology adoption index (TAI) = (1/n)* $(\sum_{i=1}^{n} A_i/R_i)$* 100

Where,

i = i^{th} technology (i ranges from 1 to n)

A = Actual level of technology use

R = Recommended level of technology use

The selected sample respondents were categorized on the basis of level of technology adoption and corresponding livelihood security will be examined to ascertain the influence of agricultural S&T intervention towards livelihood security.

Results & Discussion

Traits of selected S&T interventions in Maize

The maize growing area of Kashmir generally lies at higher altitudes and this crop is raised under rainfed conditions. Within the major maize growing district viz Kupwara, the selected study area provides a niche for the cultivation of maize. The S&T interventions in the form of composite varieties have performed better under given ecology of the study area and have given a commercial orientation to this crop. The specific features of selected varieties have been detailed in the ensuing section (Table 1).

Table 1: Morphological traits of selected S&T interventions in maize

Morphological character	Maize composite-8 (C-8)	Maize composite-15 (C-15)
Leaf angel between blade and stem	Small	Small
Leaf altitude of blade	Straight	Straight
Anthocyanin colouration of brace	Absent	Absent
Time of authesis	Medium	Early
Anthocyanin coloration of base of glumes	Absent	Absent
Anthocanin coloration of anthers	Absent	Absent
Density of spikiest	Sparse	Sparse
Angle between main axis and lateral branches	Wide	Wide
Tassel altitude of lateral branches	Curved	Wide
Time of silk emergence	Medium	Medium
Anothocyanin coloration of silk	Absent	absent
Anothocyanin coloration of sheeth	Absent	Absent
Tassel length of main axis above lowest side branch	Medium	medium
Plant lenght	Long	medium
Ear placement	Medium	medium
Width of leaf blade	Narrow	medium
Far length without husk	Long	Long
Ear diameter	Large	Large
Ear shape	Conical	Conical
Grains rows per ear	Many	Many
Type of grain	Dent	Dent
Colour of top of the grain	White	Yellow with cap
Colour of glumes of cob	White	White
Kernel row arrangement	Straight	Straight
Kernel shape	Indented	Indented
1000 kernel weight (gm)	264	210
Maturity days	135-156	130-135
Seed rate (Kg/ha)	30	30
Suitability	Lower as well as higher belts of Kashmir and Jammu, altitude tolerance of 1700-2100 m amsl	Higher elevations in temperate zone, altitude tolerance of 1700-2100m amsl
Silent features	Early maturing, cold tolerant	Early maturing
Yield	50-55	45-50

Descriptive statistics

The average family size, the family structure and the sex ratio under Maize dominated farming system (MFS) in the state presented in the Table 2 revealed that the average size of family was 7.1 within non-adopter families and 7.7 within adopter families. Another important aspect of farm families is gender; sex ratio for adopter and non-adopter families has been estimated to ascertain the number of females in a family in relation with male members. The ratio was seen to be favourable among adopters; explaining that these families have more availability of female labour. Illiteracy was little higher among adopters compared to non-adopters indicating that there may be some other pulling factor responsible for encouraging adoption of S&T intervention in the study area. The illiteracy among females was more compared to their male counterparts. Occupational pattern revealed that a good proportion of members belong to dependant category including children of 0-5 years of age, students and old age members or the members which are not working owing to ailment or will. It was observed that major proportion of the total working members were practising agriculture as main occupation in the study area though their proportion was higher among non-adopters. The average size of holding was around one hectare in all the category of farm household though it was more among non-adopters (24 kanal). The proportion of land holding available for cultivation was relatively higher at adopter farms which is in contradiction to the fact that the higher proportion of cultivated area with assured irrigation facilities is available with non-adopters. On an average, the maize crop collectively accounted for major proportion of total cropped area though its proportion was relatively higher at non-adopter. Intercropping with non-bearing fruits and cultivation of other crops was visible at farms that resulted in cropping intensity >100 per cent though the intensity was more at adopter which could be influence to a good extent by relatively higher farm returns.

Table 2: Family structure in maize based farming system

S. No.	Particulars		Adopters	Non-adopters
1.	Family (no.)	Male	4.0	3.8
		Female	3.7	3.4
		Total	7.7	7.1
		Sex Ratio	939	894
2.	Illiteracy (%)	Male	30.2	29.0
		Female	32.9	32.0
3.	Farming as main occupation (%)	Male	43.5	54.5
		Female	54.4	54.9
4.	Dependent family members (%)	Male	17.1	16.8
		Female	39.7	39.7
5.	Net sown area (NSA) (kanal)		19.2	21.4
6.	Average holding size (kanal)		21.5	24.5
7.	NSA as % of average holding		89.12	87.23
8.	Cropped area (kanal)		20.3	22.6
9.	Maize area (% of cropped area)		38.8	47.85
10.	Cropping intensity (%)		106.0	105.6
11.	Healthy family members (%)		80.0	79.7
12.	Membership in producers' org. (%)		8.0	4.0
13.	Membership in civil societies (%)		8.0	4.0
14.	Participation in ext. activities (%)		38.0	31.9
15.	Capital formation (Rs in lakhs)		0.95	0.82
16.	Annual expenditure(Rs in lakhs)		0.54	0.45

As far as the health status is concerned, sickness is significantly higher among non-adopters (Table 2) and in all farm households the deficiency diseases were the major reasons for their sickness. Members of farm families in both categories of farmers were seen to have less social links. Among adopters 8 per cent were part of producer organization and figures for this association is half of adopters. In same manner the participation in civil societies was more among adopters. Moreover as high as 38 per cent adopters have participated in extension programmes. The study of capital formation at the farms indicated higher capital stock generation at adopter farms (Rs 0.95 lakh/farm) compared to non-adopters (Rs 0.82 lakh/farm). It could be inferred from higher capital accumulation at farms' of adopters that the higher profitability of maize production technologies at their farms have improved the asset position which help to generate capital stock at their farms that was observed to have significant impact on improvement of gross farm returns in mountain regions. The adopters of technology owing to better returns have better affordability and access to various necessitates including food. The expenditure pattern says that in absolute terms higher amount was spent by adopter households though the difference was not too wide.

Economies associated with technological interventions in maize

Adopters have allotted major proportion of the total area under maize towards selected maize varieties and the area under land races or obsolete technologies at their farms was meagre. However non-adopters have allotted major area towards land races of maize; though they have taken up maize varieties in question on experimental basis on a small piece of land as reflected in Table 3. The knowledge sharing on comparative returns from S&T interventions and scientific practices recommended for maize with farmers and to other stakeholders would definitely help in the prompt diffusion of these technologies in the domain area to achieve better returns from the maize crop in the state.

Table 3: Variety-wise distribution of maize area under maize based farming system

S. No.	Variety	Adopters		Non- adopters	
		Area	%	Area	%
1	Improved/composite	7.82	99.12	0.28	2.72
2	Local	0.07	0.88	9.95	97.28
3	Total	7.89	100.0	10.23	100.0

The economics and resource use patterns in the maize production for adopters and non-adopters in the study area of Kashmir have been presented in Table 4 & 5. Maize was grown traditionally for fodder before various technological interventions were introduced in its farming. The non-adopters deviate from scientific recommendations and apply more or less input than recommendations. In case of cultivation of maize composite-8 (C-8), it could be seen from table that both category of farmers have sown more seed though the gap was wider for non-adopters. The non-adopters applied more urea and gave least attention towards intercultural operations like weeding and earthing. Similar is the case of other inputs and the gap between adopters and non-adopters appears prominent. Survey results show that maize cultivation is a less labour intensive crop than maize and labour charges comprises more than half the total cost of maize cultivation for both adopters and non-adopters. Non-adopters required 71 mandays labour as against 81 mandays labour at adopter farms and in this way more labour are required to operate C-8 variety as per recommendations. Level of machine power and animal power use was found different in across sampled farmers, however, there in not much difference between adopters and non-adopters in machine and animal power use within the region. Maize farmers also commonly applied farmyard manure and its availability and use varied from one household to another, depending mainly on the number of farm animals reared at home. As such, there is enough scope for raising nutrient use across the study area to increase maize production in the state. Though the cost of cultivation goes up for adoption of input technologies but, the cost of production went down by more than Rs 200/qt. Application of inputs as close as possible to recommendations has enhanced yield levels at adopter farms compared to non-adopters that has resulted to higher net returns and per rupee return to variables costs.

Table 4: Economic feasibility of Maize composite-8 variety of (Rs/ha)

Particulars	Adopters		Non-adopters	
	Qty	Amount	Qty	Amount
Seed (Kg)	30.7	552	28.5	513
Seed treatment (gm)	90.0	31	30.5	26.4
Urea(kg)	92.0	644	83.3	583
DAp (kg)	42.5	638	21.2	318
MoP(kg)	22.0	154	4.6	32.5
FYM (qt)	13.5	2228	13.8	2269
Chemicals	1.0	3236	0.0	2800
Human labour(md)	81.2	24360	70.62	21186
Bullock pair (hrs)	8.2	1025	10.9	1363
Machine (hrs)	12.5	3750	10.6	3186
Interest on working capital		3662		3228
Total variable cost		40278		35506
Yield (Qt/ha)		58.9		32.0
VC of production (Rs/qt)		684		1110
Gross return (Rs/ha)		82460		44800
RFFR (Rs/ha)		42182		9294
PRRVC		2.05		1.26

PRRVC = Per rupee return over variable costs, RFFR = Return to farm fixed resources, VC = Variable costs

The resource use pattern in the maize composite-15 (C-15) production for adopters and control variety for non-adopters in the study area has been presented in Table 5. C-15 has been developed at SKUAST-Kashmir to give commercial orientation to the maize cultivation. It could be seen from table that both category of farmers have sown more seed though the gap was wider for non-adopters. Raising maize composite-15 as per scientific recommendations is cost intensive but the per rupee return to variable costs is more than land races cultivated by non-adopters. Moreover C-15 has better yield when it is raised with set of recommendations than its traditional management as evident from Table 5.

Table 5: Economic feasibility of maize composite-15 variety of maize (Rs/ha)

Particulars	Adopters		Non-adopters	
	Qty.	Value	Qty.	Value
Seed (Kg)	30	540.0	29	513.1
seed treatment gm	85	30.6	30.5	26.4
N(kg)	91.5	640.5	83	583.2
p (kg)	42.5	637.5	21	318.2
K(kg)	22	154.0	4.6	32.5
FYM (qt)	15.5	2557.5	14	2269.1
Chemicals	1.15	4600.0	0	2800.5
Human labour(md)	79	23700.0	71	21186.0
Bullock pair (hrs)	2.2	275.0	11	1362.8
Machine (hrs)	13.5	4050.0	11	3186.0
Interest on working capital		3718.5	0	3227.8
Total variable cost		40903.6	0	35505.6
Yield	60.2			32.0
VC of production (Rs/qt)	679.462			1109.5
Gross return (Rs/ha)		84280.0		44800.0
RFFR (Rs/ha)		43376.4		9294.4
PRRVC		2.06		1.26

PRRVC = Per rupee return over variable costs, RFFR = Return to farm fixed resources, VC = Variable costs

Farmers under the valley condition raise maize traditional land races like Red maize and white maize and other unidentified races. SKUAST-K with its KVK and Seed Division laid OFTs/FLDs and conducted awareness programmes to disseminate these varieties in their target areas. These varieties have been taken up by receptive farming community and same scenario, as for earlier discussed maize variety technologies for other ecologies, was observed in the study area. Adopter farm category was applying inputs and performs intercultural operations more or less as per scientific recommendations and the technological gaps were narrow for this farm category. On the other hand technological gaps were very wide at non-adopter farms. It could be inferred that cultivation of maize varieties with scientific packages is capital intensive than traditional varieties and it is difficult to manage large area under them until the farmers are supplemented from external sources.

The economics and resource use patterns in the maize production for adopters and non-adopters of maize seed technology in the study area of Kashmir have been presented in Table 6. Maize was grown traditionally for fodder before various technological interventions were introduced in its farming. Besides raising local unidentified land races, the non-adopters divert from scientific recommendations and apply more or less input than recommendations. In majority of the cases farmers were seen to sow more seed than scientific recommended with consideration of poor germination or loss of planting material. The non- adopters applied urea and gave least attention towards intercultural operations like weeding and earthing. Similar is the case of other inputs and the gap between adopters and non-adopters of improved/high yielding varieties appears prominent. Survey results have shown that labour charges accounts for about half the total cost in maize cultivation for both improved/high yielding and local varieties. Level of machine and animal power use was found different in across various regions, however, there in not much difference in the use of mechanical labour between improved and obsolete varieties. The variable cost of production was found higher at the farms improved/high yielding varieties were raised compared to local varieties or land races. Though the cost of cultivation goes up for adoption of maize technology but the cost of production reduced by more than Rs 200/q for cultivation of C-15 maize variety. The variable cost associated with production of per quintal of maize was over Rs 200/q for all other considered improved varieties. Application of inputs as close as possible to recommendations has enhanced yield levels at adopter farms compared to local races that resulted in higher net returns and per rupee return to variables costs. The higher gross returns from considered varieties resulted in higher returns to farm fixed resources though it was observed yet more for C-15 maize variety followed by C-8. Cultivation of improved varieties of maize is cost intensive but the per rupee return to variable costs is more than control land races. All the improved varieties of maize released for different location were found to have realized economies in terms of return to fixed resources, cost of production and per rupee returns.

Table 6: Returns from maize varieties at adopters and non-adopters farms (qt/ha)

Particulars	Adopters	Non-adopters
Maize composite-8 (c-8)		
Variable costs	40278	35506
Gross return	82460	44800
VCP	684	1110
RFFR	42182	9294
PRRVC	2.05	1.26
Maize composite-15 (C-15)		
Variable costs	43904	35506
Gross return	84280	44800
VCP	679	1110
Net return	43376	9294
RFFR	2.06	1.26

RFFR = Return to farm fixed resources (000'Rs/ha), VCP = Variable cost of production (Rs/ha) & PRRVC = Per rupee return over variable costs)

The additional cost on cultivation of improved maize with scientific recommendations is expected to benefit adopters in the form of higher productivity. In line with our expectation, the increase in cost of cultivation due to the adoption of maize composites is associated with higher yield gains. Based upon the value, bi-products (fodder) from maize varieties were converted to grain yield equivalent and presented in Table 7 which revealed that the cultivation of improved maize have given substantially higher yields than local cultivars. The realized yield levels from improved varieties are comparable to global yield average.

Table 7: Yield levels of maize varieties at adopters and non-adopters farms (qt/ha)

Particulars	Adopters	Non adopters	Gain
Maize composite-8 (c-8)			
Grain	49.78	17.88	31.90
Fodder (grain equivalent)	9.12	14.82	-5.00
Total	58.9	32.0	26.90
Maize composite-15 (C-15)			
Grain	51.42	17.88	33.54
Fodder (grain equivalent)	8.78	14.82	-5.34
Total	60.20	32.0	28.20

Clearly, adoption of improved maize varieties could potentially increase maize yields during the kharif season in the state. It was observed that these varieties outperform local cultivars in selected areas of Kashmir. The scenario indicated that although the adoption of improved maize technology and complimentary inputs raised the cost of cultivation but also benefits farmers in terms of improved productivity that ultimately resulted in low cost produce. The comparative statement of cost and returns from selection varieties indicating the possibility of doubling farmers income. The dissemination of maize technologies developed by SKUAST-K needs an efficient take off to accomplish this mission in the mandated area of the university.

Indexing livelihood security

The security index for each of the capital was calculated using the standardized values; standardization was done using their ward level maximum and minimum values. The figures of these indices revealed that the two category of farmers turned different with respect to the economic capital. Economic security index is statistically different and low for non-adopters which imply that adopters are economically more secure than their counterpart. It could be seen from the Table 8 that economic capital has higher index values for adopters (0.6311) and relatively lower for non-adopters. The various component measure of human security as indicated by the index was more for the adopter than non-adopters. The incidence of sickness, less education and more number of dependant members at farms of non-adopters resulted in lower index for this capital and made them insecure compared to adopters. Aggregate index of the indicators used to measure security in natural capital lower among non-adopters. All the indicators have average value among different capital items considered in the CARE framework. The indicators perused for social security indicated same index value for both farm categories. Famers and their family members were found to be either part of producer organization or part of civil societies. Physical capital security has the higher values for adopters (Table 8). Overall livelihood security index comprises five major livelihood security domains: Security in economic capital, physical capital, human capital, social capital and natural capital. On an average, overall security is higher for adopters of improved maize technologies compared to non-adopters (Table 9).

Table 8: Livelihood and capital Indices adopters and less adopters farms

Particulars	Adopter	Non-adopters
Human Capital	0.4791	0.3723
Natural Capital	0.4948	0.4411
Physical Capital	0.5512	0.4201
Economic Capital	0.6311	0.3129
Social Capital	0.4214	0.4215
Livelihood security	0.5155	0.3936

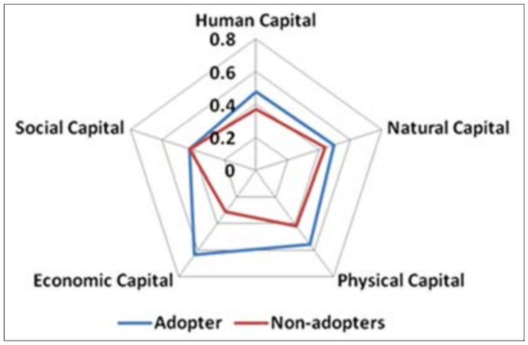

Fig 1: Livelihood security on CARE web

Determinants of livelihood security

In order to capture the impact of security of five kind of capital, livelihood security index was endogenized with seven security variables, technology adoption index (TAI), family size and age of family head (Table 9). The household which have higher level of family size or dependency ratio, their demand for basic needs is also higher. We would expect that this variables to affect livelihood security negatively, other things being equal. However for this analysis regression coefficient for family size turned positive and statistically insignificant which could be due to less family size in the study area. Expectedly all security variables affect overall livelihood security positively. Education security and health security were put as separate exogenous variable to capture their direct impact and their coefficient is indicative of their significant positive role in securing rural livelihood. The overall model appeared statistically significant explaining over 93 per cent of the variation in livelihood security.

Table 9: Estimates of log-linear livelihood function

Variable	Coeff.	Stand. error
Constant	-0.328	
ESI	0.091*	0.022
SSI	0.257*	0.042
NSI	0.05*	0.012
HIS	0.024*	0.008
EDSI	0.014*	0.005
HLSI	0.210*	0.039
PHSI	0.184*	0.058
TAI	0.009	0.021
FML	0.040*	0.02
Adj. R^2	0.8286	
Fcal	21.48	

*indicates significance at 0.05 or better probability level

Conclusion & policy suggestions

Considering the importance of maize cultivation in the agricultural economy of the state, this crop needs due attention of institutions and extentionists. In this backdrop, an attempt was made analyze the impact of improved maize varieties on farm household income and livelihood security of farmers in maize based farming system in Kashmir Valley. The results revealed that although the adopters of improved varieties possess small land holding compared to non-adopters but the cropping was little more intensified at their farms. The figures for participation in social organizations and extension programmes were relatively more for adopter farms. In same fashion these farms has more accumulation of capital and more expenditure. It was observed that the adoption of improved maize varieties increase cost of maize cultivation but owing to yield gains the cost of production showed a significant decline. Not only this have the adopter farms had relatively better endowments of livelihood capital and livelihood of adopter households was more secure compared to non-adopters. Based upon findings, this study concludes with following policy suggestion:

The participatory crop improvement programme find its important role in the development of maize crop in the valley. There is a need to strengthen the Seed Village Scheme to develop informal seed production chain.

Extension agencies should be consistent with their responsibilities of replacing unidentified/ deteriorated genetic material and dissemination of variable seed and input technologies. There is a need to impart professionalism among farming community by way of capacity development programmes. There is a need to develop capacities among different stakeholders involved with the maize cultivation of the valley. The initiatives taken up by SKUAST-K towards R&D efforts for strengthening of maize economy has to be vigorously carried forth.

There is a need to encourage scientific cultivation and management of value chain of maize. In this process the role location specific mechanization find a significant role.

Low gestation micro-irrigation schemes should be launched to ensure supply of irrigation water to the maize growing areas so that application of critical inputs as per scientific package may be encouraged.

Concerted efforts are to be made to regulate marketing of maize in the valley. Encouragement of value addition and supply chain management of maize is a need of the hour. Development of essential marketing infrastructure in public-private partnership mode should be taken up around production centres.

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References

1. Binswanger H. The Economics of Tractors in South Asia: An Analytical Review. Agricultural Development Council and the International Crops Research Institute for the Semi-arid Tropics (ICRISAT), New York, 1978.
2. Byerlee D. Technical change, productivity, and sustainability in irrigated cropping systems of South Asia: Emerging issues in the post-Green Revolution era. Journal of International Development. 1992; 4:477-496.

3. CARE. Measuring Livelihood Impacts: A Review of Livelihoods Indicators. Livelihood Monitoring Unit (LMU) Rural Livelihoods Program CARE Bangladesh, Prepared by TANGO International, Inc, 2004.
4. Chambers R, Conway G. Sustainable rural livelihoods: practical concepts for the 21st century. IDS Discussion Paper 296. IDS, Brighton, 1991.
5. Chaudhary DP, Kumar A, Sapna Mandhania S, Srivastava P, Kumar RS. Maize as fodder–An Alternative Approach. Directorate of Maize Research, New Delhi, 2012, 32p.
6. DMR. A Compendium of Hybrids and Composites of Maize (1993-2012), Technical Bulletin No. 2012/5, Directorate of Maize Research, New Delhi, 2012a.
7. DMR. Maize Production Technologies in India. Directorate of Maize Research, New Delhi. Food and Agriculture Organization, Rome, 2012b, 99p.
8. DMR. Project Director Review- 2013, Directorate of Maize Research, New Delhi, 2013.
9. FAO. Food Outlook–Biannual Report on G l o b a l F o o d M a r k e t s. A v a i l a b l e a t, 2013a. http://www.fao.org /docrep /018 /al999e/al999e. pdf (verified on 18.07.2013).
10. FAO. GIEWS Food Price Database, 2013b. Available at http://www.fao.org/giews/ pricetool/ (verified on 18.07.2013).
11. FAO. Trade and Markets: International commodity prices, 2013c. Available at http://www. fao.org/economic/est/statistical-data/estcpd/en/ (verified on 16.07.2013).
12. Frankenberger T, Drinkwater M, Maxwell D. Operationalizing household livelihood security: A holistic approach for addressing poverty and vulnerability Program Document, CARE USA, 2000.
13. Frankenberger, Timothy R, Luther Kristina. Household livelihood security assessments: A toolkit for practitioners. Prepared for the PHLS Unit of CARE by: TANGO International Inc., Tucson, Arizona, 2002.
14. GoI. Manual of Good Agricultural Marketing Practices for Maize. Directorate of Marketing & Inspection, Ministry of Agriculture, Government of India, Nagpur, 2008.
15. Gulati A, Dixon J. Maize in Asia: Changing Markets and Incentives, Academic Foundation, New Delhi, 2008.
16. Hahn MB, Riederer AM, Foster SO. The Livelihood Vulnerability Index: A pragmatic approach to assessing risks from climate variability and change-A case study in Mozambique. Global Environmental Change. 2009; 19(1):74-88.
17. Hussein K. Livelihoods Approaches Compared: A Multi-Agency Review of current Practice, Department for International Development and ODI, UK, 2002.
18. ICAR. Handbook of Agriculture, Indian Council of Agricultural Research, New Delhi, 2006, 872-886.
19. ISAAA. Global demand for maize in 2020 to increase by 45%: Potential role of BT maize, 2003. A v a i l a b l e a t h t t p: / / www.isaaa.org/kc/Publications /pdfs/ksheets/ (verified on 31.07.2013).
20. Jansen HGP, Walker TS, Barker R. Adoption ceilings and modern coarse cereal cultivars in India. American Journal of Agricultural Economics. 1990; 72:653-663.
21. KPMG. Processed Food and Agribusiness Opportunities for Investment in India. A knowledge Paper, KPMG, India, 2007.
22. Lindenberg M. Measuring household livelihood security at the family and community level in the developing world, World Development, 2002; 30(2):301-318.
23. Ramasamy C, Paramisivam P, Otsuka K. Modern seed-fertilizer technology and adoption of labour saving technologies in rice production: The Tamil Nadu case. Indian Journal of Agricultural Economics. 1992; 47:35-47.
24. Sen AK. Poverty and famines, Oxford, UK, Clanderon, 1981.
25. Sood J. Chhattisgarh will not allow GM crops. Down to Earth Magazine, 2011.
26. USDA-FAS. Corn Area, Yield and Production, 2013. Available at www.fas.usda.gov /psdonline/ (verified on 08.07.2013).