

Technology Application for Sustainable Environment Management in Disadvantageous Terrains: Shifting Thrust of Public Agricultural Extension System in North Eastern Region of India

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Abstract

The North Eastern region of India is generally featured by enormous biodiversity, forest cover and clean environment. But, in the recent past the region has encountered numerous environment related issues, mainly due to encroachment, deforestation and indiscriminate *jhuming*. To contain the degraded environment a centrally planned and strategic change in farm practices considering natural resource management, recycling and environmental protection had been increasingly felt essential. The present study aimed at finding out whether the public agricultural extension system in the region while applying technologies in the farmers' fields for transfer and wider dissemination, had been taking into due consideration the environmental issues or not, and if so, then what was the pattern of shift. A technology application index (TAI), comprising of six different indicators, was developed for the same purpose and the required data were extracted from relevant secondary sources. The findings of the study indicate that there has been a visible shift in thrust in agricultural technology application from field crop production oriented technologies to resource management and horticultural production technologies. Although a shift in relative thrust has been observed in technologies related to small scale enterprises, some more emphasis is required to integrate the small scale enterprises to farm based livelihood options, exploiting natural resources in a sustainable manner and following scientific soil health management practices.

Highlights

- Development of a holistic measure- Technology Application Index (TAI) to understand the pattern of shift in technology application by the KVKs in North East Region.
- An observed shift in technology application by the KVKs in compliance with environmental issues.

Keywords: Environmental degradation, technology application, Krishi Vigyan Kendra, public extension, north east India

In the grim context of climate change, environment friendly practices in all spheres of life have become the major thrust all over the world for environmental protection, sustainable future and quality of life (Joseph 2013). The North Eastern region of India, although is highly rich in biodiversity, having enormous forest cover and natural resources, has countered numerous environment related issues in the recent past. The age old practice of Jhum cultivation in the region is believed to have damaged the environment to a very high extent

in the region (Choudhury and Sundriyal 2003; Rathore *et al.* 2010). Besides, increasing population pressure, demand for food and unemployment resulting in encroachment, conversion of forest land for agricultural purposes and increased rate of deforestation have added to the menace of environmental degradation in the region. The region is considered to be a 'backward enclave' of a progressive economy and suffers from numerous shortcomings in different forms, like disadvantageous topography, fragility of ecology,

remoteness, poor road connectivity, trifling rate of infrastructure development, extremism etc. The economy of the region is primarily agrarian based, majority of the farmers are small to marginal having poor access to modern farm resources and high apathy towards use of chemical farm inputs. Use of chemical fertilizers in the region is as low as 51.73 Kg/ha which is far below the national average of 128.34 Kg/ha (GOI, 2013). Agriculture provides livelihood support to more than 70 percent of the North Eastern population. In spite of covering 7.9% of the country's total geographical area, the region produces only 1.5 percent of the country's total food grain and continues to be a net importer of food grains even for its own consumption. The region has ever been in high need of improved agricultural technologies, maintaining a balance between input intensiveness and output.

The public agricultural extension system, mainly governed by Krishi Vigyan Kendras (KVKs) has played the pivotal role in application and dissemination of improved agricultural technologies throughout the region since the late seventies, in spite of the fact that the extreme level of remoteness of a vast stretch of the region has always acted as a hindering factor in effective communication and mass outreach. The KVKs assess, refine and apply technologies in the farmers' fields through a well thought out mechanism comprising of on-farm testing, frontline demonstration, capacity building of targeted beneficiaries, extension activities and production and distribution of critical inputs like

seeds, planning materials, livestock strains, fish fingerlings etc.

Environment has increasingly become a buzz word in scientific discussions today. The ever increasing concern over environmental degradation throughout the globe, even not sparing the most environmentally pure regions, like the North Eastern region of India, has left us with none other than the single option of sustainable environment management. The fragility of ecology as exists in the region makes it too vulnerable to the climate change impacts, hence necessitates faster diffusion of natural resource management technologies related to conservation agriculture, afforestation, rain water harvesting and efficient use of farm inputs to mitigate the negative consequences of climate change in the region (Das *et al.* 2009). The purpose of the present study was to find out whether the process of technology application as followed by the KVKs in the region was in compliance with mitigation measures of environmental degradation or not, showing any shift in thrust and thereby the success derived by the *Kendras* as the major driver of the Public Agricultural Extension System in the region.

Materials and methods

The present study followed an ex-post facto research design and considered time series data (2009-10 to 2013-14) pertaining to technology application by all the then established 75 KVKs across the eight North Eastern

Table 1. Indicators of TAI and their operationalization

Sl. No.	TAI Indicator	Indicator code	Operationalization
1	Technology module	TECHMO	Number of technology modules undertaken for popularization by each KVK in a particular year under different thematic areas.
2	On farm trial	OFTRI	Number of trials conducted for assessment and refinement of technological modules to identify the location specificity of farming technologies under various farming systems of North East region.
3	Frontline demonstration	DEMO	Number of demonstrations conducted with already assessed technology modules for establishing potential of demonstrated enterprises including crop and livestock in the farmers' fields.
4	Area coverage	HACOV	Total area covered (in ha.) under demonstrations as mentioned.
5	Capacity Development	CAPADEV	Number of training courses including awareness programmes organized under different technological modules to for upgrading knowledge and enhancing skills.
6	Beneficiary coverage	BENCOV	Number of farmers, farm women, rural youth, field level extension functionaries and civil society personnel covered under different programmes.



states. The first KVK in the region was established in Kolasib district of Mizoram in 1979. Up to the eighth five year plan there were only 13 KVKs in the entire North Eastern region. The KVK network in the region started rapidly expanding only after the ninth five year plan. Until the implementation of the tenth five year plan, there were only 15 KVKs in the region. In the tenth plan 54 new KVKs were established in the region. During the eleventh plan there was addition of 5 new KVKs and in the twelfth plan 4 new KVKs were established. At present there is a total of 78 KVKs in the region- 15 in Arunachal Pradesh, 28 in Assam, 9 both in Manipur and Nagaland, 5 in Meghalaya, 8 in Mizoram, and 4 each in Sikkim and Tripura (ZPD-III Annual Report, 2015).

The study was mainly based upon analysis of secondary data, extracted from different relevant sources like, agricultural census, 2011 of Govt. of India, Annual Reports of KVKs of North East region and the ICAR-Agricultural Technology Application and Research Institute (ATARI), Zone-III, North East region for five years (2009-10 to 2013-14). The shift in thrust was measured after calculating the Technology Application Index (TAI) of the overall extension system for each of the five years. The TAI consisted of six indicators (Table 1):

The TAI was calculated as the mean of the six indicators as mentioned above. The shift in focus was depicted through line diagrams.

Results and Discussion

During the last few decades, conservation of biodiversity and sustainability of a wide range of natural resources, both flora and fauna in the region has faced enormous challenges. Global climate change has also threatened availability of water required for farm based livelihood. The ever changing pattern of rainfall and erratic monsoon bears testimony of the fact. In the grim context of rural livelihood security being under severe threat, sustainable management of natural resources requires to be given the top most priority in the region in order to preserve the environment, conserve the natural resources, restore the ecological balance and ensure livelihood security of rural masses.

Susceptibility of North Eastern peasants to Environmental degradation

Gradual environmental degradation is evident in the entire North Eastern part of the country (Pandey *et al.* 2013). Environmental degradation will act as a major factor in perpetuating poverty particularly among the

rural poor of the region, as opined by experts (Anon, 2012). Poverty is invariably prevalent among the small and marginal farmers of the region. Among a total of 4.11 million operational holdings covering 5.41 million ha of area in the region, as high as 3.37 million (81.98 %) holdings are small to marginal (Anon 2014). These are struck by poverty to an extreme level and are highly susceptible to the consequences of environmental degradation. Among the North Eastern states, Tripura possesses the highest (95.85%) and Nagaland the lowest (14.61%) proportion of highly susceptible holdings.

Targeted outreach of the KVKs to highly susceptible households

A state wise crude estimate reveals that on an average each of the KVKs of North East region are to reach a total of 52,730 operational holdings, of which as high as 43,230 holdings are susceptible to environmental degradation. The challenge seems to be the highest in the state of Tripura where the KVKs need to cater to the mitigation and contingency needs of about 138,500 susceptible holdings (Table 2). Given the limited manpower existing in the KVKs, operating with very limited budget, the figures pose threatening challenge to almost all the state KVKs of the region particularly in the context of the hardships faced in the region for effective communication and outreach.

Area wise relative thrust laid by KVKs of North East region in technology application

The KVKs as the main driver of the public agricultural extension system mainly focused upon six thrust areas for technology dissemination in the last two decades, the highest priority (35.53%) being attached to field crop production followed by crop and resource management (27.38%). Although it can hardly be argued in a strict sense that the North Eastern region suffers from inadequacy of the factors of production, both production and productivity of field crops in the region remain below the national average (Anon 2014). Therefore, in an effort to enhance production and productivity of major food crops, the KVKs in the region during the last decade laid primary thrust upon field crop production and crop vis-à-vis resource management; introduced in high numbers technologies related to improved crop production including high yielding varieties and improved package of practices. Food habit of all the tribes and most of the non-tribal population in the region is predominantly non-vegetarian food articles based. In fact, fish and meat including chicken, beef and pork contribute to an integral part of daily diet in the region as the major sources of protein and naturally livestock

production and management (12.79%) was an important thrust area under intervention of the North Eastern KVKs.

The region is bestowed with enormous amount of forest and other natural resources, like timber, bamboo, honeybee, mushroom etc. These resources treated with scientific knowledge and systematic craft have huge potential for income generation and for providing sustainable livelihood to the poor tribal inhabitants. Coupled with the fact that unemployment is a chronic problem in the region due to meagre presence of industries and other non-farm employment opportunities, the enormous potential of naturally available raw materials to generate income, small scale enterprises (10.89%) was considered as an important thrust area of intervention by the KVKs in the region.

The diversities in topography, altitude and climatic conditions in North Eastern region offer ample scope for introduction and adoption of technologies related to cultivation of a wide range of horticultural crops including vegetables, fruits, flowers, tuber crops, spices and condiments. The KVKs in the region in the recent years have introduced and standardized package of practices of high value fruit crops varying from highly temperate to subtropical as well as tropical, albeit large scale adoption of those in a commercial scale is still awaited. The KVKs took up horticultural production (10.51%) as a prospective thrust area. Human resource mobilization (2.91%) was the sixth priority area in which the KVKs intervened during the period under investigation (Fig.1).

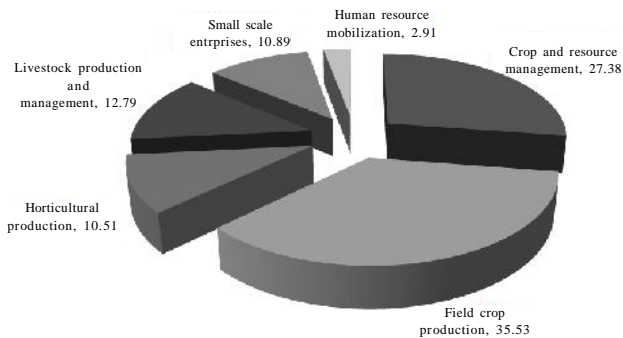


Fig. 1. Thrust areas of technology application of KVKs in North East region

Shifting thrust of technology application in North East region

As mentioned earlier, the Technology Application Index (TAI) for each of the studied five years, i.e., 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14 was calculated separately (Table 3).

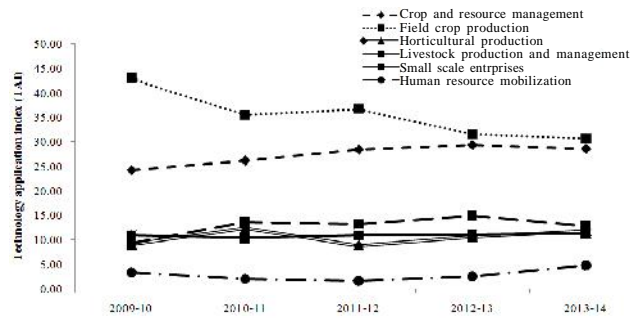


Fig. 2. Shifting thrust of technology application by KVKs in North East region

Considering 2009-10 as the base year as well as the representative year of the last decade, it could be noticed that there had been a visible shift in thrust in overall technology application in North Eastern region, as guided by the KVKs. Whereas near about half of the total thrust in technology application was laid upon field crop production (43.06%) during 2009-10, the relative thrust has come down to less than even one third (30.64%) in 2013-14. The relative thrust started shifting since 2010-11, the same year in which ‘National Initiative on Climate Resilient Agriculture’ (NICRA) was launched in the region by the Indian Council of Agricultural Research.

In compliance with the motto of the initiative-sustainable use and recycling of natural resources, some innovative, low-cost, environment friendly technological modules tailor made for the susceptible resource poor farmers of the region came into effect. Soil health management was taken up as an important module under natural resource management by the KVKs for the reason that topography of the region makes it highly prone to soil erosion.

Sustainability of soil health and fertility had been overlooked in the region since long due to exhaustive methods of cultivation which led to enhanced pondering upon improved soil management practices, soil conservation and organic farming (Mondal 2011). The steep hills of the region where the problem of soil erosion has become very high due to ever shortening length of fallow in the jhuming cycle, efficient soil health management practices through a judicious blending of commercial and organic fertilizers is likely to be an essential feature (Grogan *et al.* 2012). Technologies related to evaluation of superior varieties of cereals, pulses and oilseed crops with improved scientific package of practices, requiring higher dose of inorganic fertilizers was the primary thrust of almost all the KVKs of the region in the last decade, but it gradually shifted to more environment friendly technological modules and practices like, integrated crop management, resource



Table 2. Estimated targeted outreach of KVKs to operational holdings highly susceptible to environmental degradation in North Eastern region (Number in '000)

Sl. No.	State	No. of operational holdings	No. of small and marginal holdings	% small and marginal holdings	No. of KVKs	Targeted outreach per KVK (Total)	Targeted outreach per KVK (small and marginal)
1	Arunachal Pradesh	109	40	36.7	15	7.27	2.67
2	Assam	2720	2328	85.59	28	97.14	83.14
3	Manipur	151	126	83.44	9	16.78	14.00
4	Meghalaya	210	161	76.67	5	42.00	32.20
5	Mizoram	92	80	86.96	8	11.50	10.00
6	Nagaland	178	26	14.61	9	19.78	2.89
7	Sikkim	75	57	76	4	18.75	14.25
8	Tripura	578	554	95.85	4	144.50	138.50
9	North East	4113	3372	81.98	78	52.73	43.23

Source: Authors' calculation using data from Annual Reports of KVKs and ICAR-ATARI of North East region for the years 2009-10 to 2013-14.

Table 3. Year wise TAI of thrust areas of technology application in North East region during 2009-10 to 2013-14

Sl. No.	Thematic Area	Technology Application Index (TAI)				
		2009-10	2010-11	2011-12	2012-13	2013-14
1	Crop and resource management	24.29	26.20	28.45	29.34	28.59
2	Field crop production	43.06	35.59	36.84	31.53	30.64
3	Horticultural crop production	9.06	12.22	8.92	10.54	11.80
4	Livestock production and management	9.35	13.59	13.22	14.93	12.84
5	Small scale enterprises	10.90	10.35	10.90	11.01	11.28
6	Human resource mobilization	3.33	2.04	1.68	2.64	4.84

Source: Authors' calculation based upon Agricultural Census data, 2010-11 of GOI and Annual Report of ICAR-ATARI, North East region, 2014-15.

conservation, organic farming, soil health management and biotechnology-led input production.

High stream frequency and drainage density serves to the watershed areas in the region with immense runoff potential. Therefore majority of the North Eastern region is considered to be conducive to surface water resource development (Lama *et al.* 2015). In North East India, ground water resources are underutilized to the tune of 58-82%. That the average annual rainfall in North East Region is as high as 10,000 mm per year when compared to the national average of only 1170 mm, there remains huge scope of water harvesting and recycling and multiple use of water (GOI 2013). *Jalkund* (a small scale water harvesting structure), zero fuel treadle pump and stone lined bore well were such technologies successfully promoted by the KVKs and widely adopted by the small and marginal farmers of the region (Gogoi *et al.* 2012). The *Jalkund* and bore wells helped in collection of huge amount of rainwater otherwise wasted and using as per

need in the dry periods for irrigating mainly fruits, flowers and vegetable crops, supplying drinking water to the livestock and domestic purposes as well. Accordingly, as observed, the relative thrust of technology application produced an inclining trend in the areas of horticultural production and livestock production and management since 2011-12 (Fig. 2). Among the other natural resource and crop management strategies, homestead production of bio-fertilizers, green manuring and mulching for in-situ soil moisture conservation, soil reclamation, embankment for checking soil erosion, drought resilient interventions like rejuvenation of abandoned water bodies and system of rice intensification (SRI), flood resilient interventions like renovation of drainage channels, introduction of submergence tolerant crop varieties became the most popular and impactful KVK interventions in ensuring environmental protection and sustainability (Paul *et al.* 2014). There has thus been a visible shift of the public



agricultural extension system in general and Krishi Vigyan Kendras in particular in the pattern of technology application from mere production based towards an all inclusive and integrated system based technology transfer taking into due consideration judicious use and recycling of natural resources.

Conclusion

The livelihood and survival of local tribes in North Eastern region is largely natural environment based. In the meagre presence of industries and service opportunities, farm based options continue to be the major livelihood source of majority and as predicted will be so in the upcoming future. Making use of naturally available raw materials and products formed an integral part of survival and it was hardly perceived by the local tribes as a profitable venture and livelihood strategy. The KVKs with systematic efforts popularized a number of small scale enterprises hardly requiring investment and mainly involving utilization of natural resources as the raw materials. Forest resources in the region provide livelihood to many in different ways. Therefore, it is quintessential to preserve the environment in the region in all means and ways possible. The observed shift in thrust of the public agricultural extension system from mere production based technology application exploring the natural resources to a system of farming that integrates natural resource conservation technologies with environment friendly crop management practices will definitely help in combating the present status of environmental degradation in the region.

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