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Review of Literature

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Chapter 2

Review of Literature

2.1 Introduction

Review of existing literature is most important to any research attempt. It provides idea similar studies conducted elsewhere; to get an insight in to theoretical framework; method and approach; and the finding attained therein. Therefore, a comprehensive review literature is a subsequent part of any investigation. Besides obtained an idea about the past studies, the main purpose of review of literature is to identify the research gaps in the particular theme or issues. It also helps to a great extent to identify problem, formulate objectives, decide upon methodology, and exemplify the impact of the study. In view of above fact, in this chapter a review of previous research works has been complied to enable better understanding of the research in various dimensions. Thus, this chapter provides description of research works carried out by different researchers in the areas that is correlated to the objectives of this particular study. In this chapter: - the review of relevant literature has categorized into three sections. First section presents the reviews related to nature, magnitude, trends, and patterns of crop diversification. The second section presents the reviews associated with determinants of crop diversification, and particular impact of climate change. In the third section present the literature related to crop diversification and economic efficiency.

2.1.1 Literature Review on: Nature, Trends, and Patterns of Crop Diversification

2.1.1.1 Global context

Sichoongwe et al. (2014) explored the factors and intensity of crop diversity among small land holding size in the southern province of Zambia. Tobit model has been used to test the drivers of diversification. For this analysis they used data from secondary. The results found

crop diversification has been affected positively and significantly by the factors such as landholding size, quantity of fertilizer used, plough tillage and market distance.

Rehima et al. (2013) initiated a primary study on 393 farmers to catch up the diversification status in Ethopia. The scenario of diversification has been seen by Margalef index of richness and Heckman two stage model. Probit and OLS has been worked out for estimating the factors affecting crop diversification in Ethopia. The variable gender has positive impact on diversification implying the probability of diversification is higher in female headed households. Further education, size of landholdings, number of plots and distance from market positively affects the diversification. The drivers such as knowledge about trade, association with social organization and fertility of plots have significant negative impact on crop diversification.

Joshi et al. (2004) identified determinants of agriculture diversification in South Asia. From the estimation, it was found that the agricultural diversification moved towards high-value commodities. It is because of the changing factors of development such as an increase in per capita income, changing food consumption patterns, increasing urbanization and infrastructure development. These drivers are encouraging for future growth and agricultural diversification. However, the degree of diversification has been seen less in most of the South Asian economies. It is because food security issues and the government policies are obsessed with self-sufficiency in cereals.

Benin et al. (2003) found the factors of crop diversification of inter-and infra-specific diversity in Ethiopian Highlands. Physical and household characteristics of the farms such as livestock assets and the proportion of adults are showing statistically significant impact on diversity among and within cereal crops. Demographic aspects such as age of household head and adult education levels affect only infra-specific diversity of cereals.

Weiss and Briglauer (2002) estimated the impact of household characteristics on the dynamic on-farm diversification in Austria. The study has framed from 1980, 1985, and 1990 period of time and found that the small size of farms are more specialized than large size farms.

2.1.1.2 Indian context

Basavaraj et al. (2016) explained nature, extent and factors influenced the crop diversification at the micro level in Gadag district in Karnataka. The primary data were collected from 30 sample in 1997, while the secondary data area under major crop groups were obtained to the period from 1998-99 to 2011-12. The results showed the growth rate is higher for area under horticultural crops and pulses as compare to area under cereals, oilseeds, fiber and other crop groups. The estimation revealed that proportion of cereal crop groups has fall down from 32.53 percent to 28.81 percent and that of fruits and vegetables has increased considerably from 0.10 percent to 0.25 percent for fruits and from 4.66 percent to 7.80 percent for vegetables. Further, farm size, gross irrigated area, and net return per farm were the major factors which influenced the crop diversification.

Kumar and Gupta (2015) present the performance of diversity in crops during 1990-91 to 2011-12 in India. Simpson diversification index has shown Indian agriculture system is changing from traditional survival agriculture system to high-value return system but it is not equally distributed across states as well as across different crop sub-sectors. The study also made efforts to know the determinants of crops diversification by using Fixed Effect Model (FEM). The results of FEM have shown that cropping intensity, average annual rainfall, and gross irrigated area to be the key factors of crop diversification. Based on the findings, it argued that policy support in terms of improved cropping intensity, gross irrigated area, insurance coverage, and infrastructure development need to be extended to the farmers.

Dasgupta and Bhaumik (2014) described the role of crop diversification on agriculture growth along with the 'expansion effect' and 'substitution effect' in West Bengal. This study completely used secondary data from 1980-81 to 2009-10. The results revealed that a major change in area under the crops (i.e., boro rice, oilseeds and potatoes) occurred due to substitution effect. The substitution effect has shown significantly negative and stronger than the expansion effect for aus, aman and pulses. However, in the case of fruits and vegetable both substitution and expansion effects have a strong and positive impact.

Kumar et al. (2012) estimated the performance and determinants of crop diversification in four eastern states namely Bihar, Jharkhand, Odisha, and West Bengal of India. Tobit model was applied to find the factors of diversification. The regression outcomes found the technology, level of education, modern implements, and road connectivity has shown significant positive impact on diversification towards higher-return crops. The study also suggested that smallholders have a large interest for cultivation of horticultural crops.

Acharya et al. (2011) tried to explore the nature and degree of "crop diversification in Karnataka". To measure the diversification level Composite Entropy Index (CEI) has been used and results found that diversification level of commercial crops have increased. The factors -infrastructural and technological are negatively related to the level of crop diversification. The adoptions of basic infrastructural facilities (i.e., irrigation, fertilizer, markets, and roads) are raising the process of agricultural development and crop diversification. "The study also found that per capita income, proportion of area under HYVs of cereals, proportion of urban population, share of gross irrigated area, rainfall, average holding size, market density, and fertilizer consumption are the major factors responsible for the changes in crop diversification".

Bhattacharya (2008) has studied the performance of crop diversification in South Asia along with the factors responsible for the crop diversification. The result of Simpson diversity index reveals that countries such as Bangladesh and Bhutan were basically moving toward specialization in food grains whereas countries Nepal, Pakistan, and India slowly moving toward crop diversification. Among South Asian countries Maldives has attained high level of diversification till 1980s but the level of crop diversification has not been increased over time.

Birthal et al. (2007) explained the measures of household participation in cultivation of fruits and vegetables by farm size at the macro level. The study results showed that the diversification of high value crops raise farm incomes, particularly in underdeveloped countries. The results described small holders showed more involvement production in high-value crops mainly fruits and vegetables as compare to larger farm holders.

Joshi et al. (2006) discussed about the factors of agricultural growth and the role of high value crops diversification in India. They found that the growth of wheat and rice production have fall down, and more emphasizes has been given to cultivate of high-value crops. The study authorized that grain-dominated in northern and eastern regions of the country, and found price was the key source of growth. On the other side, in southern and western regions technology was main source of growth in crop income. However, diversification towards high-value crops (i.e., vegetables and fruit) augmented about 27 percent in the 1980s and 31 percent in 1990s.

Mahajan (2004) conducted a study on crop diversification in Kangra. They found that the developed agriculture area is relatively more diversified as compared to less developed area. The factors are responsible for diversification in developed agriculture areas comprise social factors (distance from education, age and number of family member); economic factors

(income from farm and non-farm area, tenancy, tractor and farm size) whereas in underdeveloped agriculture areas factors are tenancy, on and off farm revenue, and holding.

Mani and Varadarjan (1985) in their study in India conclude that large farms found more diversify when compared to small farms. Their functional analysis gives the result that diversification leads to diminish the risk associated with farm business.

2.1.1.3 Punjab specific

Chhatre et al. (2016) discussed on crop diversification, farmers' decision-making process and risk management in Indian agriculture. The study results indicated that adoption of single wheat-paddy cropping pattern; and incentive of free electricity and overuse of water pumps are key reasons for depletion of ground water in Punjab. They found that risk factors labor, price, credit, and yield risk that might promote crop diversification and reduce dependence on paddy and wheat. The results designated that a portfolio of substitute crops (onion, cauliflower, capsicum and tomato) has higher net expected returns related to the predominant paddy-wheat cropping pattern. This concluded that the alternate cropping pattern is given more surplus production in the market of the same product.

Choudhury et al. (2013) made an attempt on crop diversification and crop water demand analysis by using the remote sensing data and GIS approach in central Punjab. The study suggested that the current cropping pattern adopted by farmers in Jalandhar district of Punjab has directly leads to over exploitation of the ground water and soil of land due to applying high quality of chemical fertilizers. To resolve these problems, they also suggested that at least 40 percent of total agricultural area under wheat-rice pattern should be interchanged by other lower water consuming, high value and soil enriching crops.

Singh et al. (2009) explained the factors influencing economic viability of marginal and small farmers in Punjab. Primary data has been collected from three districts of Punjab Ropar (wheat-maize zone), Ludhiana (wheat-rice zone) and Bathinda (wheat-cotton zone). Discriminant statistical technique has used and results found that off-farm income and rationality in domestic expenditure are the key factors of feasibility of marginal farmers. Therefore, they suggested focus should be given to generate off-farm employment opportunities, assuring remunerative prices and input facilities are need to provide for these farmers.

Kurosaki (2003) presents the performance of crop diversification and specialization empirically for the case of West Punjab. This study has given to more priority of four major crops viz., cotton, rice, sugarcane, and wheat. It is found cropping patterns of survival agriculture changed substantially, more attention given to the crops that have potential of higher value and growing productivity at the aggregate level. These variations reflected comparative advantage and given to the progress in aggregate land production. Ray et al. (2005) explained the crop diversification based on soil and weather requirements of different crops in Punjab using GIS (Geographical Information System). The analysis showed there is a need for diversifying wheat-rice cropping pattern, and need to increase the area under such crops those required fewer inputs and enrich soil health. Further, they analyzed south-western Punjab is appropriate for less water consuming crops (i.e., desi cotton, pearl millet, gram etc.,) whereas north-eastern Punjab is suitable for maize based cropping system. Rice can be replaced by maize and other crops in central Punjab where to control the exploitation of water.

In brief, it was observed that the cropping pattern has been change over time due to changing demand for different food items. It is governed mainly by the agro-ecological and

technological factors in a particular area. Overall depiction based on available literature at international level, national level, and state specific shows that till 1980s the trends moved towards cereals particular to wheat and rice. It was mainly because of the advent of green revolution technologies and to meet the domestic demand for staple foods. However from 1990s onwards, relative share in acreage under coarse cereals and pulses have declined and that of fruits and vegetables have increased substantially as a response to integrating the local markets with global markets during post WTO era. But, particularly in Punjab state, area under cereals (wheat and rice) are still larger than others crops.

2.1.2 Literature Review on: Determinants of Crop Diversification

2.1.2.1 Global context

Piedra-Bonilla et al. (2020) explained the role of climate variability on crop diversification categories. The results of probit model show that variability in temperature and precipitation has an impact on each diversification category on same way. The higher variation in climate change lead to higher probability of municipality in very diversified category. Subsequently, intensifying crop diversification could reduce the agricultural risk against extreme climate events.

Asfaw et al. (2018) analyzed the empirical evidence on the adaptation procedure in Niger rural communities. From the estimation, it was found that the household size, accessibility of financial markets, gender, and modern varieties of seeds are positively and significantly associated with both crop and labor diversification.

Thamo et al. (2017) explained the impact of climate variability on agricultural productivity, and also explained how farming system are adapted to suit the new climatic conditions in the western Australian wheat-belt. It was found that profit margins were much more sensitive to climate change than production levels (i.e., yields).

Nguyen et al. (2017) mainly compare the factors that affect farmers' decision regarding the land use choice and crop diversification of rural household. They studied in two different provinces of countries Thailand and Vietnam. A sample size has been collected around 514 farm household in Ha Tinh (Vietnam) and 422 farm household in Ubon Ratchathani (Thailand) in two different years 2007 and 2013. By using fixed effect regression model results found that a livelihood platforms, weather shock, and physical economic condition of the living localities are positively influenced the farmers' land use decision.

Meraner et al. (2015) made an attempt to explore determinants of farm diversification in Netherland by using farm structural survey (FSS) 2011. The study has worked out binary logit model for the determinants of farm diversification in general and multinomial logit model to look out the factors for specific diversification activity. The result of binary logit shows that age, population density and type of soils affect the farm diversification negatively, whereas economic size (measured by Standard output unit), all type of farms (exclude horticulture farms) have positive significant impact on diversification. The result of diversification activity categories (i.e. broadening, deepening and both broadening and deepening) reveals that there is negative impact of age on the entire diversification category where as it is positively affected by family size.

A study has been conducted by (Kasem & Thapa, 2011) on the factors that affecting crop diversification level in Thailand, along with the impact of crop diversification on the farmer's income. The study has taken 245 samples of diversified and non-diversified farmers. The result shows that the large-size farmer prefers mono-cropping pattern while small farmers tried to diversify cropping pattern. Labour shortage, market unavailability, soil suitability, lack of knowledge on growing other crop is some of the factors that restrict large farmers to

diversify. Furthermore, outcome of the impact of crop diversification on income reveals that various type of economic benefit is associated with the diversified cropping pattern. It is found that the income level of the farmers has increased who diversified the crops.

A study put forwarded by Rahman (2009) attempted to elaborate the economic determinants of crop diversity in farms of Bangladesh. The 406 sample of farmers in 21 villages have taken. Herfindahl, Margalef and Shannon indices have been used to compute the concentration, richness and evenness of crop, respectively. Logit and OLS have been used to identify the factors that affecting diversity in cropping pattern. The result of regression analysis explicit that likelihood of crop diversification is positively affected by farm size, owner operator, education of farmer, farmer's membership in NGO's and developed infrastructure region while it is negatively affected by less developed irrigation facility and decline price of fertilizers and animal power service.

Ashfaq (2008) identified the determinants of farm diversification level in Pakistan. The primary survey based on 200 respondents sample from four villages of Pakistan. They have taken two villages near to the market and two of them away from the market. The results showed main drivers that influenced the diversification level are farm size, age, farming experience, off farm income, road, market, and machinery.

2.1.2.2 Indian context

Birthal and Hazrana (2019) measured the effects of climate shocks in terms of rainfall-deficit and heat-stress on agricultural productivity. Dynamic panel-data approach has been applied and found that the climate shocks (rainfall-deficit and heat-stress) damage agricultural productivity. From the estimation, it also observed that crop diversification as an important ex ante adaptation measure to cope such climatic shocks.

Birthal et al. (2015) examine the impact of severity droughts on rice production in India. It was found that 1/3rd area under rice crop has been affected by droughts mainly by moderate droughts. The improvement in controlling the adverse effect of weather shocks is mainly the reason of improvements in farmers' adaptations practices and mitigation expansion of irrigation facilities, along with other risk-coping appliance.

The extent of crop diversification is largely based on the geographic climatic characteristics, socio-economic and technological accessibility of a region (Priyadarshini & Abhilash, 2019). A number of factors viz., resources related (i.e., irrigation, climate change, soil health, etc.); technological factors (i.e., seed quality, fertilizer, post-harvest processing, etc.); price factors (i.e., inputs price, output price, profitability, procurement system, import and export, etc.); institutional factors (i.e., size of land, government schemes, density of road, accessibility of market, etc.); and household specific factors (i.e., knowledge, experience, capacity, resources base, food and feed requirement, etc.) are playing an important role to influence the area allocation pattern in a region (Alur & Maheswar, 2018).

Birthal et al. (2014) explained the sensitivity of agriculture sector in India due to climate change. The findings revealed that the variation increase in temperature has negatively impact on agricultural productivity, whereas extreme rainfall has a significant impact but the impact is very small to offset the negative impact of temperature. Further, they found adaptation of irrigation has a potential to save from adverse effect of climate shocks. Moreover, predictions indicate that variations in climate have declined the productivity of agriculture by 25 percent. Agriculture productivity is more impacted by climate shocks in arid and semi-arid regions because of its more sensitive nature in these regions. The loss will be higher in the absence of adaptation.

Kumar and Parikh (2001) assessed the relationship between farm level net-revenue and climate change in India. Further, they explore the effect of annual weather and crop prices on the climate response function. It was observed that the mainly losses in agricultural productivity are causes of climate changes.

Vyas (1996) articulated that the price responsiveness, agro-climatic conditions, technology accessible, market infrastructure, and institutional arrangements for input-output delivery are the major factors of diversification. However, Joshi et al. (2007) suggested that farm diversification is mainly directed by two forces, one is demand side factors; other is supply side factors. Therefore, specific factors observed are credit, irrigation, market infrastructure, road and transport facilities, procurement prices, and government policies on input subsidies.

Gupta and Tewari (1985) made efforts to find out the empirical nexus between crop diversification and socio-economic factors. The study has carried out primary survey of the farmers in villages of Allahabad district for the year 1981-82. The regression result depicts the farm size, market distance, net worth, and rented-in land have negative impact on diversification while intensity of irrigation, price risk, and yield risk negatively affect crop diversification in selected villages.

2.1.2.3 Punjab specific

Jalota et al. (2014) examined the impact of climate shocks on crop yield, water, and nitrogen-balance. Further, they explore delaying of planting date of crops as adaptation measures. The findings depict that time slice of the 21st century (i.e., mid-century and end-century) climate shocks would increase, as result crop productivity would decrease owing to shortening of crop duration.

Vashisht et al. (2013) estimated the impact of climate change scenario on wheat yield and water productivity. The finding shows that the increased temperature would cause reduction in wheat yield to the extent of 4, 32 and 61 percent in the mid-century periods between 2021-2030, 2031-2040 and 2041-2050, respectively.

From the above discussion, it can be concluded that the farmers' decision about cropping pattern system is depends on various factors viz., natural, man-made, and socio-economic environments factors etc.

2.1.3 Literature Review on: Crop Diversification and Economic Efficiency

2.1.3.1 Global context

Benedetti et al. (2019) analyzed input use efficiency of irrigated crop production and identify its factors, giving special focused on efficient use of water resources. A heteroscedasticity stochastic frontier production model is developed in southern Italy with a sample size of 114 horticultural farms in 2016 dataset collected from the EU farm accountancy data network. The results of the study are found that the most water consuming crops are green beans and pepper. The efficiency scores indicate that these crop farms have less technical efficiency compared to conventional farms. Further, tomato processing farms show highest level of water efficiency (5.01) with greater production level (93,239 kg/ha). Therefore, emphasis should be given to efficient management decisions to minimize water consumption and exploitation, because it is a most crucial resource for agricultural development worldwide.

Mzyece et al. (2018) estimated the impact of crop diversification on technical efficiency and income variability in Zambia. The study has used Rural Agricultural Livelihood Survey for 2012 and 2015, and employs data envelopment approach for efficiency. The estimation found that crop diversification statistically significantly improves income stability but significantly reduces technical efficiency.

Manjunatha et al. (2013) estimated the impact of land fragmentation, farm size, land ownership and crop diversity on farm profit in South India. The results of the frontier model show that there exists inefficiency among different farms. It is observed that the land fragmentation is positively and significantly leads to inefficiency while land ownership and crop diversity is negatively linked with inefficiency. Additionally, it was found that land fragmentation has a significant adverse impact on farm profit. Further, it observed that small land holdings size have lower inefficiencies than larger farm holdings.

Rahman and Rahman (2009) surveyed the impact of land fragmentation on productivity and on technical efficiency in term of rice production in Bangladesh. The estimation of stochastic production frontier function shows that the land fragmentation has a statistically significant harmful effect on productivity and efficiency as expected. It is estimated that the 1 percent change in land fragmentation influenced 0.05 percent rice output and 0.03 percent efficiency. Average of elasticity estimates shows that 1 percent change in family labour and owned draft animal expand technical efficiency by 0.04 percent and 0.03 percent, respectively. Further, they found adoption of new technology improves efficiency by 0.04 percent.

Vedenov et al. (2007) explained the farm efficiency in crop production coffee producing districts in Veracruz, Maxico. The results of stochastic frontier approach indicate that the factors that are responsible to increase production efficiency level are mainly density of population, accessibility ability of road, and higher altitude.

Paul and Nehring (2005) analyzed the economic performance of U.S. farms across farm type, time, region, and farmer characteristics. The deterministic and stochastic frontier methods have been used to measure the scale economies and efficiency of corn-belt farms for 1996-2001. It is found that family farms are scale and technically inefficient. The larger farms are more efficient as compare to small size of farms.

Coelli and Fleming (2004) explained diversification economies and specialization efficiencies in the integrated coffee and food sub-systems. To know whether diversification economies exist and specialization in coffee, they applied stochastic input distance function technique. Results revealed that the substantial technical inefficiency exists, it clearly indicate that there is scope to expand crop production using same amount of inputs resources or improved production technology. Further, it was found that the key drivers that significantly lead to increase technical inefficiency are age of female household head, education level of male household head, whereas the level of family and social obligations are adversely linked with technical inefficiency.

Ahmad et al. (2002) used a primary dataset to capture the inefficiency effects in Pakistan by using stochastic frontier production approach. The results found that the degradation of land resources is due to adaptation of same crop rotations, and prevalence of higher cropping intensity. It is found that the farmers are producing 32 percent less than the target level of potential output.

Llewelyn and Williams (1996) analyzed the technical efficiency for food crop production for irrigated farms in East Java, Indonesia. The non-parametric DEA (data envelopment approach) has been used and found that the farmers are operating inefficiently because of scale inefficiency rather than pure technical inefficiencies. Also, found that "majority of the farmers operate in the region of decreasing return to scale rather than increasing return to scale". Further, it was found that the age, high school education, and diversification cropping activities were found to improve technical efficiency under rainy seasons under irrigated conditions. The analysis shows the farms that use excessive levels of inputs, particularly nitrogen fertilizer are inefficient.

Ali and Chaudhry (1990) explained inter-regional efficiency of crop production in four irrigated cropping regions in Pakistan Punjab. From the estimations of probabilistic frontier production approach found that there is a possibility to raise farmers' income by 13 percent at the same level of resources use. No any statistical significant difference in technical efficiency was found across regions. Further, observed that except in the cotton region the economic efficiency was preform similar across all regions. In cotton region it was lower because of presence of higher allocative efficiency, which is attributable to the more dynamic production technologies being adopted in that region.

2.1.3.2 Indian context

Shanmugam and Venkataramani (2006) estimated the technical efficiency and its determinants for 1990-91 across districts in India. For the analysis data has been collected from CMIE (1993) and CMIIE (2000) for 248 districts across 12 major states. The results of the stochastic frontier production function shows that Indian districts have a mean technical efficiency of 79 percent, showing that, on an average agricultural output can be increased by about 21 percent with the given or available resources. Further, they estimate the determinants of the technical efficiency and found that health, education, and infrastructure are significant determinants of the technical efficiency. The findings of the study suggest that the only improve to technical efficiency are not one-size-fits-all. Indeed, even districts within the same state would benefit differently from the same set of interferences. In that sense, it might be wise to implement policy interventions from more ground level.

Parikh et al. (1995) made an attempt on two distinct approaches such as behavioral and stochastic cost frontier is used to measures farms cost inefficiency. Stochastic frontier approach is used for inefficiencies scores. Data on household composition, farm production, inputs prices and costs were collected to 436 farms in 1990-91. The major crops are selected

for analysis primarily, wheat (38%), maize (24%), sugarcane (22%) and vegetables in Peshawar (Pakistan). The findings suggest that the small size of holdings seems to be more efficient as compare to the large land holdings size in the region.

Chavas and Aliber (1993) enlightened a non-parametric method to the measurement of four type of efficiencies in agriculture production viz., technical, allocative, scale and scope efficiencies. The model is applied on the observation 545 in 1987 of Wisconsin farms. The estimation of the study found that economic losses are largely produced by allocative and scale inefficiencies. The study proposes that almost farms tries to find out the path of improving their production process. Further, finding shows that economies of scale exist with small land holding farms and some diseconomies of scale are found for the large land holding farms.

2.1.3.3 Punjab specific

Singh et al. (2017) analyzed crop-wise resources use efficiency across farm-size in Punjab; and identifies its determinants by using plot-level cost of cultivation survey (CCS) data of principal crops from 2008-09 to 2010-11. The two-step approach has been developed, in the first step DEA technique was employed to measures technical efficiency, in the second step, Tobit regression has been work out to find the various factors to explain the variation in technical efficiency. The results revealed that the larger farm size holding are more technical efficient than the small holding size all selected crops. Further, it is found that the large farm size has used higher utilization of machine and fertilizer per hectare and relatively less use of labour. Conversely, the marginal and smallholding size farmers have applied more irrigation hours per hectare than the medium and large farm size farmers. Therefore, overall findings suggest that emphasis should be given to enhance the operational land holding size with the help of consolidation. Moreover, the also identify that there is a positive and significant

association between farm size and number of schooling. However, age, number of schooling, diversification index and bio-abiotic stress have negatively impact with technical efficiency. The average improvement in technical efficiency is probable as 26.95, 24.02, and 7.26 percent in favour of cotton, paddy and wheat respectively deprived of increasing the input use.

Sekhon et al. (2010) studied the technical efficiency in crop production in Punjab state to know how different zones have adopted the modern technology. Primary data has been collected through three-stage stratified random sampling technique in 2005-06. The state divided into three zones; sub-mountainous zone (9%), central plain zone (65%), and south-western zone (26%). The 300 sample size covered (100 marginal, 100 small, and 100 other categories) of farmers. The specific stochastic frontier production function has been estimated to find the technical efficiency of individual farm. The results of the study found that even though Punjab is agriculture rich state but still there is need to improve technical efficiency of the farms. The technical efficiency has revealed a large variation across zones; the central zone has been found most efficient 90 percent than south western and sub-mountainous. Further, the results of production function explained that the existence of disguised unemployment in sub-mountainous region.

Javed et al. (2008) estimated the economic efficiencies of production of rice-wheat pattern and also identify its determinants in Pakistan, Punjab. Two steps DEA and Tobit model approach has been estimated to measure the efficiencies scores and Tobit model for identify its determinants. The model has been applied on the 200 observation in 2005-06 by using multistage random sampling technique. It is found that the average scores of the technical efficiency is 0.83, allocative efficiency is 0.44 and economic efficiency is 0.40 percent respectively. The small size of land holding farmers are more efficient in technical efficiency

than the large holdings. But, both size of holdings farms are allocative and economic inefficient. Further, Tobit estimation indicate that the farm size, age, year of schooling, number of contacts with extension agents, credit and market distance are the powerful drivers of technical efficiency, on the other side year of schooling, number of contracts with extension agents, and access to credit has significant impact on allocative and economic inefficiencies.

Sidhu (1974) has followed the L-Y model to compare the economic efficiency of old versus new verities of wheat in Punjab from 1967-68 to 1970-71. They compare economic efficiency and price efficiency of small and large; and tractor and non-tractor operated wheat farms. The cobb-Douglas function, profit function and labour demand function are used to estimate efficiency of wheat production. The results of the cobb-Douglas production function revealed that the new wheat varieties are economically more efficient as compare to the old wheat by 48.50 percent. Further they found that there are no difference between in efficiency parameters, small and large farms have perform equal in technical efficiency and relative price efficiency. They found that tractor operated wheat farms have same economic performance as non-tractor operated farms. Similarly, the large farms are no better off than small farms. It is pointed that the small and large farmers have the same degree of economic motivation appears to hold.

2.1.4 Issues and Research Gap

After rigorous review of the existing literature on crop diversification, some significant observation can be made. Earlier studies that are carried out in different regions across the globe, recalls crop diversification as an increasing phenomenon and a popular policy prescription towards the goal of increasing income of small holders. Various estimations of

empirical studies are different substantially on the basis of selection of crops, time period, methodology, etc. and thus offer different conclusions.

In India, majority of the literatures have examined the nature and degree of crop diversification either at aggregate level (country/state/district/regional) or at farm or household level. Studies focusing crop diversification behavior at particular state Punjab is less, and all the existing studies have growing interest to measured crop diversification behavior by using different statistical tools such as Herfindahl Index, Composite Entropy Index, Gibbs and Martin Index, and many more, however none of the study has used 'Kendall's Coefficient of Concordance Index'/'Rank Analysis' for the inter temporal movements. Therefore, present study pursues the research method which has not been applied in the existing literature. Further, the earlier studies are mainly confined to time period of 20-25 years to trace the diversification patterns in the state. This study contributes to the literature by extending the time period of 58 years from 1960-61 to 2017-18.

Further, this study contributes to the literature by addressing the issue of impact of weather shocks on crop productivity at Punjab state at district level. This was one of less emphasized issues in available literature. Therefore, the present study not only incorporates this issue but further enables to identify the micro level problems of farm sector followed by appropriate policy formulations to resolve them also.

In addition, several empirical studies have provided prominent works on technical production efficiency. However, an important aspect, that received little attention in the empirical literature, is related to the decomposition analysis of production efficiency. From this perspective, the present study contributes to the literature as it applies decomposition analysis of technical efficiency across regions. This decomposition analysis of efficiency intends to provide the sources of efficiencies or inefficiencies among different farms. Similarly, there is

the dearth of studies that could recommend the amount of input reduction in order to increase output across regions of Punjab. In this backdrop, the present analysis throw lights on the slacks and the targets setting appliance to evaluate the way for improvement in the context of inefficient tehsils. Thereby, this study, under this analysis, explains how much proportion of each input has to be reduced for each inefficient tehsil to attain the same output. This analysis assists to withdraw those inputs which are used in unreasonably in the production process.