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An Introductory Analysis

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Chapter 1

An Introductory Analysis

"Crop diversification has emerged an important alternative to attain the objectives of output growth, employment generation and natural resources sustainability in the developing countries".

Petit and Barghouti (1992)

1.1 Introduction

The agriculture sector is a primary and oldest source of income and employment in emerging economies (Mohammad, 1981). Therefore, sustained growth in the sector is a prerequisite for the development of these economies. Such growth is even more eminent in those countries, where more than half of the country's population is dependent on the agriculture sector and related activities for their livelihoods. Since the beginning of reforms in the1960s, a dominant agricultural system has followed in developing economies. Such economies have constantly put efforts on improved production of cereals particularly rice, wheat, and maize (Hutagaol, 2006).

India is not an exception. High population growth in economy and opening of the agriculture sector for export are placing immense pressure on farmers to produce more. However, the growth in farm production is constraint by accessibility of resources. Therefore, to increase agricultural production, application of high-yielding varieties (HYVs) was introduced as a part of the Green Revolution. HYVs gave higher return than earlier cultivators, as result agricultural production of food crops has increased dramatically. It observed that the area under crops cultivation has increased by 8 percent between 1960 and 1987, productivity

increased by 51 percent and production nearly doubled by 81 percent in the country (Vaidyanathan, 1994).

Undoubtedly, initially green revolution brought the economic prosperity in Indian farming. However, many studies claim that this revolution had shown adverse impact on production by the mid-1990s. Although, the food grains production elevated at 3.5 percent per annum during 1980s, but it had decelerated to 1.5 percent from 1990-96. Thereafter, country has shown witnessed drastic change in the sector. A highly commercialized agriculture system has replaced the traditional diversified cropping system with the mono-cropping system (Hutagaol, 2006). Adaptation of new technology, higher application of fertilizer and pesticide practises on fixed land, and lack of crop rotation gave birth to various problematic phases such as degradation of natural resources, reduced soil quality, depletion of groundwater, and various socio-economic aspects of the land cultivators (Sajjad & Prasad, 2014). For India, (Sehgal & Abrol, 1994) estimated that 64 percent of the land area is degraded due to adverse impacts of this revolution. In particular, an intensive crop production has threatened the long-term sustainability of agriculture (Eicher, 2003). Under such a scenario, these fundamental questions arise (i) what are the most significant factors striving for agricultural production in such economies where agriculture resources are scarce and opportunities to enhance productivity are dwindling? (ii) what is the possible way to achieved stainable production in such a scenario? (iii) whether farmers are producing the optimal output from the existing pattern of crops and inputs used or not? (iv) what is the possible risk-coping appliance to enhance the agricultural productivity against the weather shocks?

The various policy makers have suggested for crop diversification choice, to combat with such challenges and acceleration in growth. Crop diversification considered as an instrument to achieve development goals by anticipating a shift in production activities, adjusting in the

economic environment, and deals with the challenges of natural resources degradation. Ray et al. (2005) and Acharya et al. (2011) recommended that crop diversification can minimize the adverse effect of the monoculture system. By changing to the cropping patterns, it is possible to minimise the area under high input requiring crops; and maximise the area under crops that needs a smaller amount of input and enrich soil health. In the context of Sudan, it was found that diversity in crops reduces income variability (Guvele, 2001) but in the case of China it was found that the crop diversification improves their farmers' income (Van den Berg et al., 2007). Further, Kar et al. (2004) estimation shows that crop diversification helps to mitigate drought effects and increased water use efficiency in upland areas. Therefore, crop diversification has been pursued as a way to improve the long-term variability of agriculture sector by increasing the profitability and overall stability of the sector.

1.2 Concept of Crop Diversification

Crop diversification refers with the structural change in crop-mix in any geographical economy. A change in inter-crop and intra-crop over time within the crop growing sector is directly related to the progressive of agricultural economy. The progress in technology has changed the cropping pattern, and it shifted the traditional varieties of crops by new high yielding varieties crops. In India, "within the cropping sector mainly the crop diversification has been taking place in terms of a shift in area from food crops to non-food crops" (Pandey & Sharma, 1996).

There is two type of diversification in agriculture: - (i) crop diversification and (ii) enterprise diversification. This study mainly focuses on crop diversification which includes (a) shifting of one crop to other crops and (b) adding more crops to the existing cropping system.

1.3 Crop Diversification at India Level

Indian agriculture has been diversifying from traditionally grown less remunerative crops to more remunerative crops. This structure has rapidly changed after the green revolution. The area under commercial crops (non-food crops) has doubled since the 1960s and now equals half of the area under food crops (Vyas, 1996). Within food crops, area under superior cereals (i.e. rice and wheat) is increasing while that area under inferior cereals (like jowar, bajra, pearl millet, etc.) is declining. Studies that have particularly examined the change in cropping pattern in Indian context revealed that the highest area covered under food grain is in north-east region, north-west region, east region, and central region, while the southern region is the leader in production of non-food grain crops. The northern dry zone is more diversified than the northern transitional zone (Kumar & Gupta, 2015).

1.4 Crop Diversification in Case of Punjab

Punjab is an agriculturally rich state and holds a special status in Indian agriculture due to their most considerable involvement to the national pool of food grains such as around 70 percent of wheat and 50 percent in case of rice. The agrarian economy of Punjab has achieved a significant growth due to the advent of green revolution. The state has recorded largest increase in the index of production of cereals around eleven-fold during 1960-61 to 1994-95 (Lindsay et al., 1995) as a result the state attained self-sufficiency in food production and move from past food crisis. As results the state has observed a paradigm shift in its cropping pattern, from a diversified practice it has shifted to a specialized one, and relatively more remunerative crops (Sood et al., 2000). Primarily, the substantial area under input-intensive crops (mainly wheat and rice) have taken place at the cost of traditional low input crops, and become the most predominant crops in the state. They covered 44.07 and 36.03 percent of the cropped area in 2018-19 against 29.59 and 4.8 percent in 1960-61,

respectively. The area under maize, millets, and groundnut has shifted with rice, while the area under gram, rapeseed/mustard, and barley has shifted with wheat (Sood et al., 2000). In the state, the largest portion of the food grain production around 95 percent of the entire comes from rice and wheat (Aulakh, 2002). It was the evolution of high-yielding varieties and better response of input resources in terms of fertiliser, pesticide, and water accessibility (Grewal & Sidhu, 1990).

Recently, the most progressive state has been under a deep economic crisis. The farmer's decision to produce a single-cropping pattern on fixed land has become a major challenging issue in the farming sector. The adverse effects of excessive use of synthetic inputs in post green revolution era are become a result of declining ground-water table, waterlogging, salinity, etc. Further, stagnant growth in agriculture productivity and wide variation in terms of income generation has been seen within state (Singh & Grover, 1991). Thus, by decelerating agriculture growth, the state has lost its pre-eminent position of being the state with the highest per capita income in the country. However, in 2014-15, Punjab stood at the seventh position in per capita income amongst 21 major states of the country. So that if current growth scenarios continue, it might be possible a surprise that the state slips further down in this hierarchy of large Indian states in terms of its per capita income. It is considering the negative agro-ecological impacts of recent adopting cropping system of Punjab. Therefore, suitable strategies for cropping system are needed in the state essential for sustainable agricultural development.

1.5 Rationale and Objectives of the Study

The importance of the agriculture sector of Punjab has been well recognised. Although, share of the sector has declined to the state domestic product (SDP), but it still has a significant role for the rural population, because it provides various ingredients of life to the people. The

introduction of modern technology in mid 1960s' has brought a revolutionary change in the sector. The applications of advanced inputs and changing institutional factors have added a new dimension to agriculture. The emphasis was only given to produce rice and wheat to accomplish growing demand in the competitive market for food grain. Farmers are resorting to addition of more and more fertilizers to obtain higher yields or similar levels to previous years. As result, the sector has facing various environmental challenges such as an increase in soil salinity, increased pests and diseases infestation, depletion of water, and reduced bio-diversity. The monoculture system reduces non-food grain crops' production, leading to a nutritional imbalance in the area. The health of land soils has been impaired due to the emergence of multi-nutrient deficiencies and falling of organic carbon levels. The soils are presently operating on a negative nutrient balance. Thus, to sustain future agricultural development, it must be followed environment friendly cropping pattern.

In Punjab, crop diversification is a major component to drive a positive change in the state. Here, crop diversification is seen to address the problem of price fluctuation, environmental degradation due to excess use of pesticides, chemical fertilizers, water exploitation etc. (Johl, 1986). Beside this, crop diversification is also plays an important role in fulfilling basic needs and rising farmer income.

Thus it becomes inevitable in the presents scenario of Punjab, to verify the extent of crop diversification and its determinants. It has also been expected from crop diversification to be instrumental in mitigating the negatives effects of weather shocks. It is, therefore necessary to examine crop diversification on this standard. Similarly, crop diversification is also linked positively with productivity, and thus, enhances the economic efficiency of the farms. This is an interesting dimension of crop diversification. So estimating the economic efficiency of the

farms; and determining the contribution of crop diversification on the economic efficiency of farms are also the key concerns of agriculture in Punjab.

Therefore, the presents study entitled *'An Empirical Analysis of Determinants of Crop Diversification in Punjab.'* aims at following six specific objectives:-

(i) To explore the trend and pattern of crop diversification in Punjab.

(ii) To identify the factors those determine crop diversification.

(iii) To assess the impact of weather shocks on crop productivity.

(iv) To examine the adaptation benefits of crop diversification against weather shocks.

(v) To estimate the economic efficiency of crop production in Punjab.

(vi) To determine the effect of crop diversification on economic efficiency.

1.6 Structure of the Thesis

The thesis is structured in six chapters. **Chapter 1: An Introductory Analysis** represents a brief summary that discusses conceptual framework of the study. In this chapter, rationale and objectives of the study is presented. **Chapter 2: Review of Literature** presents scientific reviews of literature on crop diversification and its various perspectives. **Chapter 3: A Temporal Analysis of Crop Diversification in Punjab's Agriculture** presents the performance and changing pattern of crops, and also identifies the factors those are responsible for this change. In this chapter, data has used from Directorate of Economics and Statistics (DES) of India and Economic and Political Weekly Research Foundation (EPWRF) for estimations. The composite entropy index (CEI) has been used for measure the degree of crop diversification. Further, rank concordance analysis has been used for the inter-temporal movement. **Chapter 4: Weather Shocks, Crop Productivity, and Crop Diversification: Adaptation Practices in Punjab** represents the relationship between weather shocks and crop productivity, along with the analysis of effectiveness of crop diversification to cope with

such weather shocks. For this analysis two dataset has been used such as International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and Indian Metrological Department (IMD). Additionally, fixed effect regression approach has been applied for panel dataset. The economic efficiency of farms in producing the optimal output from the given resources has been estimated in **Chapter 5: Economic Efficiency of Agriculture in Punjab.** The dataset has been used from a survey of "Comprehensive Scheme for Cost of Cultivation (CCS) of Principal Crops" administered by "Directorate of Economics and Statistics, Ministry of Agriculture". The two most popular DEA (Data Envelopment Analysis) techniques namely CCR and BCC models for crop production efficiency have been applied. Further, the super-efficiency slacks based measurements (SBM) model has been used to estimates most efficient tehsil among the fully efficient tehsils. Lastly, **Chapter 6: Major Findings and Policy Implications** draws significant policies implications based on findings of the study and conclude the thesis.