Chapter 3

Methodology and Data Source
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METHODOLOGY AND DATA SOURCE

This chapter deals with the locale of the study area, sources and nature of data used and various statistical tools and techniques employed for analysing the data. The methodology is described under the following heads:

3.1. Locale of the study area

3.2. Nature and sources of data

3.3. Analytical tools and techniques employed

3.4. Definition of terms and concepts used in the study

3.1. Locale of the Study Area

The present study is undertaken in region level as well as all India level during the period from 1975-76 to 2009-10. A multi-agency approach comprising co-operative banks, scheduled commercial banks and regional rural banks has been followed for purveying credit to agriculture at all India level.

As regional level, the study took only the disbursement of institutional outstanding credit by scheduled commercial banks to agriculture sector during the post-reform period in different regions of India. In our analysis the country is divided into six regions, namely, Northern Region, North-Eastern Region, Eastern Region, Central Region, Western Region and Southern Region. The Northern Region includes the States and Union Territories viz., Jammu & Kashmir, Himachal Pradesh, Rajasthan, Haryana, Punjab, Delhi and Chandigarh. Assam, Manipur, Meghalaya, Mizoram, Arunachal Pradesh, Nagaland and Tripura States constitute the North-Eastern Regions1. The state and Union Territories viz., Bihar, Jharkhand, West Bengal, Orissa, Sikkim and Andaman & Nicobar are included in Eastern Region. The Central Region comprises the States of Uttar Pradesh, Uttarakhand, Madhya Pradesh and Chhattisgarh. Western Region is the combination of the States and Union Territories of Gujarat, Maharashtra, Goa, Daman & Diu and Dadra & Nagar Haveli.

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1 Sikkim state was included in North-Eastern Region until 2002.
Lastly, Southern Region consists of the States and Union Territories of Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, Lakshadweep and Pondicherry.

The study uses the published data of the Reserve Bank of India on loans provided to cultivators which is classified by the size of operational holdings for the distribution of direct institutional outstanding credit (short and long-term) to farmers based on the size of land holdings during the last two decades (1991 to 2000 and 2001 to 2010). According to RBI, cultivators operating less than 2.5 acres are referred to as "marginal" cultivators, between 2.5 and 5 acres as "small" cultivators and above 5 acres as "big" cultivators respectively.

3.2. Nature and Sources of Data

For evaluating the objectives of the study, secondary data were collected from different sources. The study is largely based on analysis of the published time series data covering the period from 1975-76 to 2009-10. The following are the data sources: Handbook of Statistics on Indian Economy, Statistical Tables Relating to Banks in India, Basic Statistical Returns published by Reserve Bank of India, Food and Agriculture Organisation (FAO) of the United Nations, All India Rural Credit Survey, 1954, National Climate Change (NCC) Research Report, Money and Banking of Centre for Monitoring Indian Economy (CMIE) Report and Agricultural Statistics at a Glance, Directorate of Economics and Statistics of Ministry of Agriculture, Government of India.

3.3. Analytical Tools and Techniques Employed

For analysis of trends and composition of institutional credit to agriculture, statistical tools like compound annual growth rates (CAGR) has been used for trends analysis, coefficient of variation has been used to check the variability in the composition of institutional credit to agriculture, diagrammatic representation and above all, regression analysis have been used.

The compound annual growth rate has been computed in two different ways which are shown in the form of two types of equations:

1) For computing the compound annual growth rate, the study fits exponential trend equations for the period 1975-76 to 2009-10. In a regular time series (say

2 "Big" cultivators consist of both medium and large farmers.
with an interval of generally one year, average annual growth rate in the series is usually obtained by estimating an exponential equation of the type:

\[ x_t = b_0 b_1^t e^{u_t} \]

where,

'\( e \)' stands for the base of natural logarithm.

'\( u_t \)' represents disturbance term associated with '\( x \)' variable at time '\( t \)'.

The unknowns '\( b_0 \)' and '\( b_1 \)' are estimated through the ordinary least squares (OLS) method as applied to the linearized version (achieved through logarithmic transformation) of the given function. The growth rate '\( r \)' in \( x_t \) is then computed as:

\[ r = \left[ \text{Antilog} \left( b_1 \right) - 1 \right] \times 100 \]

where,

'\( r \)' represents compound annual growth rate

The study examines the hypothesis of constancy, increasing and decreasing in the rates of growth in an institutional outstanding credit to agriculture during the post-reform period in India. The conventional approach for such analysis is to carry out for the usual growth rate analysis over the sub-periods (In this case for pre-reform period from 1975-76 to 1990-91 and, for the post-reform period from 1991-92 to 2009-10). The conventional approach has two major drawbacks:

- The number of observations available for estimation of rates of growth should be fairly large (say \( \geq 14 \)). However, sub-periodization may result in a severe loss of degrees of freedom available for estimating of the rates of growth.

- The approach pre-assumes constancy in the rates of growth within each of the sub-periods which, however, may be far from reality in a multiplicity of situations (Sethi, 2008).

Keeping in mind these limitations associated with the conventional approach, the following alternative approach has been undertaken.

For this purpose, we may estimate an exponential equation of the type:
\[ x_t = b_0 b_1^{(1-D)t} b_2^D t e^{u_t} \] ............(i)

where,

'D' stands for a dummy variable, assuming values of 0 and 1 during pre and post-reform periods respectively.

During the pre and post-reform period, equation (i) would be equivalent respectively to:

\[ x_t = b_0 b_1^t e^{u_t} \text{ and } x_t = b_0 b_2^t e^{u_t} \] ............(ii)

Providing rate of growth in the corresponding periods as:

\[ r_1 = [\text{Antilog} (\hat{b}_1)-1] \times 100 \text{ and } r_2 = [\text{Antilog} (\hat{b}_2)-1] \times 100 \] ....(iii)

where,

'r_1' represents the compound annual growth rate during the pre-reform period

'r_2' denotes the compound annual growth of the post-reform period.

In fact, these two rates of growth would be computed respectively from the two sub-parts of the series. Nevertheless, as could be easily seen, the two rates could be obtained in a single stroke from the estimation involving the entire series. The equation (i) could be rewritten as:

\[ x_t = b_0 b_1^t b_1^{-D} t b_2^D t e^{u_t} \]

\[ x_t = b_0 b_1^t (b_2/b_1)^D t e^{u_t} \]

\[ x_t = b_0 b_1^t c_2^D t e^{u_t} \] .................(iv)

where, \( c_2 = b_2/b_1 \).

From the entire series, the unknowns \( b_0, b_1 \) and \( c_2 \) [Hence, \( b_2 = b_1/c_2 \)] could be obtained through the OLS technique, as applied to the log-linear version of (iv). Therefore, the rates \( r_1 \) and \( r_2 \) are obtained through (iii).

2) To compute the CAGR for the period 1992 to 2010, the study has uses the semi-log model, such as:

\[ \ln Y_t = \beta_1 + \beta_2 t + u_t \]
where,

'\( Y_t \)' is the value of the variable in \( t^{th} \) year whose CAGR is to be find out;

'\( t \)' is the time period. Number 1, 2, 3, etc. were used for the consecutive year;

'\( \beta_1 \)' and '\( \beta_2 \)' are parameters to be estimated;

'\( u_t \)' is the disturbance term.

After estimating the above regression model, the following formula has been used for computing CAGR:

\[
r = \text{(Antilog of the estimated } \beta_2 - 1) \times 100.\]

where,

'\( r \)' is the compound annual growth rate (in %).

Agricultural production function is assumed to be the function of availability of credit, labour force, cropped area, water, pesticides, fertilizer, etc. Thus the amount of agricultural output is dependent upon the above mentioned inputs. However, in this study Agricultural Gross Domestic Product (AGDP) is used as dependent variable and Institutional credit (IC), Gross Sown Area (GSA), Gross Irrigated Area (GIA), Agricultural Labour Force (ALF), consumptions of Fertilizers (FC) and Rainfall during the period of June to September (RN) are taken as independent variables. There are also other important variables (improved seeds, tractors, electricity, pesticides, etc.) which determined agricultural production but they can be purchased only with the availability of credit. The AGDP is hence indirectly affected by credit. Therefore, credit is included as an explanatory variable in the model on the basis of the argument of Carter (1989) and Iqbal et al. (2003).

For estimating whether the relationship between the two variables has undergone a significant change, due to various banking sector reform initiated in the early 90s, the entire period is divided into two: 1975-76 to 1990-91 and 1991-92 to 2009-10. The study has used Cobb-Douglas (CD) Production Function by utilizing Ordinary Least Squares (OLS) procedure for the period 1975-76 to 2009-10, to estimate whether the institutional credit to agriculture has undergone a significant change due to various banking sector reform initiated in the early 1991. The Cobb-

\[\text{In statistics, ordinary least squares (OLS) is a method for estimating the unknown parameters in a linear regression model.}\]
Douglas model is used primarily because the resulting coefficients (elasticities) indicate the relative importance of each input with respect to output (Zuberi, 1989). The variables used in the study have been collected from different secondary sources. The data regarding variables AGDP, IC, GSA, GIA and FC is from Handbook of Statistics on Indian Economy published by RBI, Mumbai. Data on ALF has been obtained from Food and Agriculture Organisation of the United Nations (FAO) and the data on RN is from two sources; (I) National Climate Change (NCC) Research Report for the period 1975-76 to 1991-92 and (II) Agricultural Statistics at a Glance from 1992-93 onwards.

The null hypothesis of the study is that the availability of institutional outstanding credit to agriculture has negative impact on agricultural gross domestic product during the post-reform period (1991-92 to 2009-10) in India. In this study the hypothesis is tested under 1%, 5 % and 10% level of significance. The level of significance is the measure of the degree of risk that we make while interpreting results. As it is the null hypothesis that is generally being tested we are always looking for low $P$ values to reject this hypothesis. The $P$ value is the probability of attaining a test statistics to establish that the hypothesis being tested is true. The smaller the $P$ value the more assured be the conclusion drawn from it.

Based on the above discussion, the Cobb-Douglas production function enables us to estimate the contribution of each individual input in the production function. But since the function is in non-linear form, all the variables have to be transformed into logarithmic form to obtain a linear model. Thus, we have the following linear model:

$$\ln AGDP_t = \beta_1 + \beta_2\ln IC_t + \beta_3\ln ALF_t + \beta_4\ln GSA_t + \beta_5\ln RN_t + \beta_6\ln GIA_t + \beta_7\ln FC + D_t + D_t*\ln IC_t + \mu_t$$

where,

$$\ln AGDP_t$$ = Natural logarithm of agricultural gross domestic product at constant prices;

$$\ln IC_t$$ = Natural logarithm of institutional outstanding credit at constant prices;

$$\ln ALF_t$$ = Natural logarithm of agricultural labour force;
\( \ln GSA_t \)  = Natural logarithm of gross sown area;

\( \ln RN_t \)  = Natural logarithm of rainfall;

\( \ln GIA_t \)  = Natural logarithm of gross irrigated area;

\( \ln FC_t \)  = Natural logarithm of consumption of fertilizers;

\( D_t \)  = Dummy variable (d =1 for post-reform period for the year 1991-92 to 2009-10; Else = 0 for pre-reform period for the year 1975-76 to 1990-91);

\( D_t \times \ln IC_t \)  = Cross product of dummy variable and natural logarithm of institutional outstanding credit at constant prices;

\( \mu_i \)  = Random error term independently and identically distributed with zero mean and constant variance;

\( t \)  = denotes time trend.

We assume \( \beta_1 \) (intercept) i.e., technology remains constant. The coefficient of \( \beta_2, \beta_3, \beta_4, \beta_5, \beta_6 \) and \( \beta_7 \) are the output elasticities to be estimated.

In order to avoid the problem of multicollinearity, all the variables included in the study (the dependent and all the independent variables) are expressed in terms of per cultivated ten lakh hectares (Iqbal, et al., 2003; Ahmad and Masood, 2010). Besides to estimate the Cobb-Douglas type production function all the variables are also converted into log form. Thus we can have the following model:

\[
\ln phAGDP_t = \beta_1 + \beta_2 \ln phIC_t + \beta_3 \ln phALF_t + \beta_4 \ln phGSA_t + \beta_5 \ln phRN_t + \beta_6 \ln phGIA_t + \beta_7 \ln phFC + D_t + D_t \times \ln phIC_t + \mu_t
\]

where,

\( \ln phAGDP_t \)  = Natural logarithm of agricultural gross domestic product per cultivated ten lakh hectare at constant prices;

\( \ln phIC_t \)  = Natural logarithm of institutional outstanding credit per cultivated ten lakh hectares at constant prices;
\[ \text{lnphALF}_t = \text{Natural logarithm of agricultural labour force per cultivated ten lakh hectares;} \]

\[ \text{lnphGSA}_t = \text{Natural logarithm of gross sown acreage per cultivated ten lakh hectares;} \]

\[ \text{lnphRN}_t = \text{Natural logarithm of rainfall per cultivated ten lakh hectares;} \]

\[ \text{lnphGIA}_t = \text{Natural logarithm of gross irrigated area per cultivated ten lakh hectares;} \]

\[ \text{lnphFC}_t = \text{Natural logarithm of consumption of fertilizers per cultivated ten lakh hectares;} \]

\[ D_t = \text{Dummy variable (d = 1 for post-reform period for the year 1991-92 to 2009-10; Else = 0 for pre-reform period for the year 1975-76 to 1990-91);} \]

\[ D_t \times \text{lnphIC}_t = \text{Cross product of dummy variable and natural log of institutional outstanding credit per cultivated ten lakh hectares;} \]

\[ \mu_t = \text{Random error term independently and identically distributed with zero mean and constant variance;} \]

\[ t = \text{denotes time trend.} \]

Estimation of the Cobb-Douglas type production function in the transformed model of expressing the variables in per cultivated ten lakh hectares showed that they are not highly correlated, although some degree of multicollinearity is still present in the model.

To reduce the presence of multicollinearity and autocorrelation in our Cobb-Douglas production type function, all the variables are transformed into log difference form. Then, we have the following linear model:

\[ \text{lndfAGDP}_t = \beta_1 + \beta_2 \text{lndfIC}_t + \beta_3 \text{lndfALF}_t + \beta_4 \text{lndfGSA}_t + \beta_5 \text{lndfRN}_t + \beta_6 \text{lndfGIA}_t + \beta_7 \text{lndfFC} + D_t + D_t \times \text{lndfIC}_t + \mu_t \]

where,
\[ \text{IndfAGDP}_t = \text{Log difference of agricultural gross domestic product at constant prices}; \]
\[ \text{IndfIC}_t = \text{Log difference of institutional outstanding credit at constant prices}; \]
\[ \text{IndfALF}_t = \text{Log difference of agricultural labour force}; \]
\[ \text{IndfGSA}_t = \text{Log difference of gross sown area}; \]
\[ \text{IndfRN}_t = \text{Log difference of rainfall}; \]
\[ \text{IndfGIA}_t = \text{Log difference of gross irrigated area}; \]
\[ \text{IndfFC}_t = \text{Log difference of consumption of fertilizers}; \]
\[ D_t = \text{Dummy variable (d =1 for post-reform period for the year 1991-92 to 2009-10; Else = 0 for pre-reform period for the year 1975-76 to 1990-91)}; \]
\[ D_t \times \text{IndfIC}_t = \text{Cross product of dummy variable and log difference of institutional outstanding credit}; \]
\[ \mu_t = \text{Random error term independently and identically distributed with zero mean and constant variance}; \]
\[ t \] denotes time trend.

The variables which are included in the Cobb-Douglas model as dependent and independent are defined as follows. AGDP and IC are measured in Rupee (C) crore at constant prices, GSA and GIA are measured in ten lakh hectares and, the data for the year 2009-10 for GSA and GIA are extrapolated, FC measured in lakh tonnes, ALF is measured in thousand persons and RN is measured in millimetre. IC for agriculture sector comprises of direct and indirect outstanding credit to agriculture and allied activities. Direct (short and long-term) outstanding credits are disbursed by Cooperatives, Scheduled Commercial Banks (SCBs) and Regional Rural Banks (RRBs) whereas indirect outstanding credits are disbursed by cooperatives, SCBs, RRBs along with Rural Electrification Corporation Ltd. (REC). FC includes Nitrogen, Phosphorous and Potassium \((N+P+K)\). Agricultural labour force is the number of economically active persons engaged in agriculture. The data on rainfall is taken from
June to September. Dummy (D) has been taken for pre-reform (1975-76 to 1990-91) and post-reform (1991-92 to 2009-10) period. All the real values were computed using 2004-05 as the base year.

3.4. Definition of Terms and Concepts Used in the Study

Advance: The amount of loan advanced by an institution, during a particular period, year or season.

Agricultural Credit: Agricultural credit is the amount, either in cash or in kind or in both form, made available for agricultural production received from the external sources (institutional and non-institutional), to be repaid in the specific period of time to the lender, with some interest for the use of funds by the borrower. The present study considered only the institutional sources of agricultural credit which provided for the purpose of agricultural use.

Agricultural Finance: Agricultural finance generally means studying, examining and analysing the financial aspects (include money matters relating to production of agricultural products and their disposal) pertaining to farm business.

Agricultural Labour Force: Agricultural labour force is the actual number of people available for work in agricultural field.

Cash Reserve Ratio: The commercial banks are required to keep a certain amount of cash reserves at the Reserve Bank of India. This percentage amount is called cash reserve ratio.

Credit: A contractual agreement in which a borrower receives something of value now and agrees to repay the lender at some date in the future, generally with interest.

Gross Cropped Area: Gross cropped area represents the total area sown once and / or more than once in a particular year, i.e., the area is counted as many times as there are sowings in a year. This total area is also known as total cropped area or total area sown.

Gross Domestic Product: Gross Domestic Product is the market value of all the final goods and services produced within a country over a given period of time.

Gross Irrigated Area: Gross Irrigated Area is the total area under crops, irrigated once and / or more than once in a year. It is counted as many times as the number of times the areas are cropped and irrigated in a year.
Gross Sown Area: Gross sown area is the area sown more than once in an agricultural year plus net sown area.


Kisan Credit Card Scheme: Kisan Credit Card (KCC) is a credit card to provide affordable credit for farmers in India. It was introduced with effect from 1998-99 for timely and easy availability of the production credit to the farmers. The scheme is being implemented by the commercial banks, cooperative banks and regional rural banks.

Large Farmers: According to the RBI published data, cultivators operating more than 5 acres are referred to as large farmers. Large farmers consist of both medium and large farmers.

Marginal Farmer: According to the RBI published data, cultivators operating less than 2.5 acres are referred to as marginal farmers.

Micro Finance Institutions (MFIs): Micro Finance Institutions are those institutions which provide financial services such as saving account, insurance fund and credit to poor and low income clients so as to help them to rise their income and thereby improve their standard of living.

National Bank for Agriculture and Rural Development (NABARD): National bank for agriculture and rural development is the apex banking institution providing finance for agriculture and rural development. It was established on July 12, 1982 with the aim for providing credit for promotion of agriculture, small scale industries, cottage and village industries, handicrafts and other allied economic activities in rural areas with a view to promote integrated rural development and securing prosperity in rural areas.

Net Bank Credit: Net Bank Credit is the Gross Bank Credit minus exempted deposits like Foreign Currency Non-Resident (FCNR\(^4\)) accounts, Non-Resident Non-

\(^4\)Foreign Currency Non Resident (FCNR) accounts can be opened and maintained by a non-resident Indian who may be an Indian citizen or a foreign citizen of Indian Origin residing outside India. The accounts are convertible / repatriable and are maintained in foreign currency in the form of fixed deposits.
Repatriable (NRNR\(^5\)) deposits. This is the basis on which achievement of priority sector lending targets is calculated.

Net Sown Area: Net sown area is the total area sown with crops in a country. Area sown more than once is counted once only.

Non-Performing Assets (NPA): Non-Performing Assets signify those distributed loans by banks and financial institutions against which repayment of principal and the due interest payment is not timely made. Once the borrower has failed to make interest or principal payments for 90 days the loan is considered to be a non-performing asset.

Regional Rural Banks (RRBs): Regional Rural Banks were established in 1975, with a view to developing the rural economy as well as to create an alternative channel to the cooperative credit structure so as to ensure sufficient institutional credit for the rural and agriculture sector.

Rural Infrastructure Development Fund (RIDF): Rural Infrastructure Development Fund was instituted in NABARD with an announcement in the Union Budget 1995-96 with the sole objective of giving low cost fund support to State Governments and State Owned Corporations for quick completion of ongoing projects relating to medium and minor irrigation, soil conservation, watershed management and other forms of rural infrastructure.

Self Help Groups (SHGs): Self-Help Groups is a village-based financial intermediary usually composed of 10-20 local women having homogeneous social and economic backgrounds, all voluntarily coming together to save regular small sums of money, mutually agreeing to contribute to a common fund and to meet their emergency needs on the basis of mutual help.

Small Farmers: According to the RBI published data, cultivators operating in between 2.5 acres and 5 acres are referred to as small farmers.

Statutory liquidity ratio: Statutory liquidity ratio refers to the amount that the commercial banks require to maintain in the form of gold or government approved

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\(^5\) A Non-Resident Non-Repatriable (NRNR) deposits were governed by Foreign Exchange Management (Deposit) Regulations, 2000. An individual NRI and Overseas Corporate Body (OCB) were eligible to open and maintain NRNR account till 31-03-2002. NRNR deposits were designated in Indian Rupees in the form of savings, current and recurring or fixed deposit accounts.
securities (bond and shares of different companies) before providing credit to the customers. It is determined and maintained by the Reserve Bank of India.

Taccavi loans: ‘Taccavi’ loans are those loans which were granted by the Government of India for agricultural purposes during the period of natural calamities and other difficulties. They were long-term in character. These loans were routed through the Revenue department of the State Government.

Twenty Point Economic Programme: Twenty Point Economic Programme was launched by Government of India in 1975 with important objectives of eradication of poverty and improvement in the quality of life of the common man, which included a point related to the issue of rural indebtedness.