International Journal of Academic Research & Development (IJAR&D)

Bi-Annual Peer Reviewed Refereed Journal

Volume 5, No. 2, July-December, 2019, Tenth Issue

A Journal of Bharti Publications

New Delhi - 110002 (India)

ISSN : 2395-1737
Volume : 5, ISSUE : 2
July-December, 2019
Publication Schedule : Twice a year

Printed in India:
Published by : Bharti Publicatons

All Correspondence Should be Address to
The Managing Editor
Bharti Publications
4819/24, 3rd Floor, Mathur Lane
Ansari Road, Darya Ganj, New Delhi-110002
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Website: www.bhartipublications.com

International Journal of Academic
Research & Development
(IJAR&D)
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Procurement of NTFPs in Kalahandi District of Odisha

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Abstract

The present study is an attempt to study the trend of procurement of NTFPs in Kalahandi district of Odisha. The study is exclusively based on secondary data collected from various published sources such as journals and articles and unpublished source such as Tribal Development Cooperative Corporation (TDCC), Bhubaneswar. The data has been used for the periods of eight years (2005-06 to 2012-13) and simple statistical techniques have been applied in order to draw the inference of the study. From the analysis, the study found that the trend of procurement of NTFPs is not impressive in Kalahandi district of Odisha as they have a constant trend of fluctuation during different periods. The present study is limited to procurement of major NTFPs found in the district during the given period of times. However, it can be extended to other districts of the state. Moreover, the future study can be carried out by linking NTFPs with their marketing or capturing other products as available in a region.

Keywords: *NTFPs, Procurement Agencies, Kalahandi, Odisha*

Introduction

Non-Timber Forest Products (hereafter NTFPs) constitute one of the important sources of livelihood for millions of people living in and around the forests across the world. All the forest products other than timber are collectively referred to as NTFPs. The NTFPs include bamboo, mahua flower, neem, amla, silk, tamarind fruit, sal seeds, kendu leaves etc. Among these products some products are used as food while others are used as medicine or any other purposes. The huge employment opportunities are created to the people who depend on NTFPs through collection and processing of these products. At global level, more than two billion people are dwelling in forest, depend on NTFPs for subsistence, income and livelihood security (Vantomme, 2003). In India about 7.5 million people are engaged in collection of kendu leaves as part time job and another 3 million are engaged in the work of processing of the leaves to *Bidi* (local cigarette) (Arnold, 1995). Thus, the forest dwellers and rural poor people are partly dependent on NTFPs in deriving their livelihood. Odisha is a forest-rich state in India covering over 31% of geographical area (FSI, 2003). The state is a major NTFPs producer in the country. The NTFPs not only supports consumption requirement but also plays an important role in providing employment and income during the leanest season. The state has the largest number of forest dependent people including tribal in particular. Nearly a half of the state population is dependent of forest. Among them, a good number of people are Schedule Castes and Schedule Tribes. It is found that about 15 million of people in Odisha, mainly tribal people, are directly and partly dependent on NTFPs for maintaining their livelihood (TRIFED, 2000 and Bhattacharya, 2006).

Nearly half of the total geographical area of Kalahandi district (4962 sq.kms) is covered with forests. In this district, tribal people living in and around the forests derive their livelihood support from the collection of NTFPs. The important NTFPs found in this district are bamboo, mahua flowers and seed, neem, kendu leaves, siali fibre, tamarind and different types of other fruits and seeds. It is noted that except a few, most of the NTFPs are restricted to a particular season and they are not common to all seasons. In all, it is stated that the NTFPs are the basic means of sustenance and livelihood

for tribal households in the district. Under this backdrop, the present study tries to study trend of procurement of NTFPs in Kalahandi district of Odisha.

Procurement agencies of NTFPs

In Odisha, the procurement and marketing of selected NTFPs was initially done by developmental agencies i.e. TDCC, OFDC, cooperative like AMCS and many others and joint sector companies like UFP till 1999. These agencies are as follows.

Tribal Development Cooperative Corporation (TDCC): The TDCC was formed in 1973 after winding up the then forest produce marketing cooperative society dealing with NTFP. It has given rights on NTFP in 11 out of 13 undivided districts in the state. Besides, it has also given the exclusive rights to 4 MFP items – Tamarind, Hill Broom, Honey and Mahua in all the 27 forest divisions of the state. The objective of TDCC was to procure the Surplus Agricultural Produce (SAP) and NTFP at fair and reasonable prices. It procures these products from tribals from its own employees in local markets and villages.

Orissa Forest Development Corporation (OFDC): Orissa Forest Corporation (OFC), a fully government owned and managed public limited company, was created in September 1962. It is the sole authorized agency to trade in kendu leaves and shares the responsibility with TDCC in case of sal seeds. In 1991, it was renamed OFDC with merger of Orissa Plantation Development Corporation, Simlipal Forest Development Corporation and later Orissa Composite Board also merged into it. Broadly, OFDC deals in Kendu (Monopoly), Sal seeds (duopoly), sal leaf, honey, arrowroot etc.

Utkal Forest Product Limited (UFPL): UFPL incorporated in 1989 associates with the agenda of systematic collection and processing of NTFP in Orissa. For operational, it has classified into four regions, subdivided into 27 division and each division comprising of 3-8 ranges. The range is the basic collection unit consisting of 50-60 collection centres looked after by commission agents. There are 29 seed types of NTFP fall under its purviews.

Large Size Multipurpose Societies (LAMPS): LAMPS was formed in 1977 on the recommendation of Bawa committee, each covering a population of 10000-20000 when it was realigned that the tribals were not enjoying fruits of their labour in the forest produce collection. Many of the existing primary agricultural cooperative societies were converted to LAMPS. Some were attached to TDCC, OFDC and some are functioning independently. However, with the implementation of NTFP policy 2000 these developmental agencies were no longer taking responsibility for procurement and marketing of NTFP rather it was transferred to Gram Panchayat (GP).

Gram Panchayat: For quite sometimes NTFP trade was monopolized mostly by private business houses that were granted lease on a long term basis to procure specific forest produces from specific forest divisions. This created problems of low payment to tribal, erratic and arbitrary procurement, and revenue loss to the state. Therefore, in order to streamline the system of collection and disposal of NTFP, which are major source of livelihood of the rural poor, especially women, the state Government came out with a new policy guideline on 31.03.2000. This gives ownership rights to the Gram Panchayat not only in the scheduled areas but also in the entire state.

NTFP Policy of 2000: The government of Orissa came out with a new policy guideline on 31 March 2000 and vested the ownership and control right to GPs to regulate the purchase, procurement and trade of NTFP as well as abolish monopoly lease system in interest of proper price realisation by primary gatherers. In the new policy, the GPs are given the power to register the traders at the local level and also to monitor their functions with regard to procurement price. Further, the GPs are now vested with the authority to cancel the registration of any trader in the event of procuring NTFPs at a rate lower than the minimum procurement price fixed by the government for that product. There is no restriction on the traders on number and volume of produces that they want to trade and transact provided they pay the registration fees. As per the policy, the GPs cannot use their discretion in registering the traders though they can always reprimand unscrupulous ones involved in low payment, irregular procurement etc. However, in the process of empowering GPs to regulate the procurement and trade of NTFPs since 2000, the government is still in the process of making desired amendments/formulating a set of rules under the GP Act and Orissa Timber and other Forest Produce Transit Rules 1980.

Dependency of people on NTFPs

NTFPs constitute one of the important sources of income for the large number of people living in and around the forests and those who are involved in the processing and transport of these products. Some of the major evidences concerning it are given as follows.

Pradhan (1995) made a study on collection of NTFPs in Keonjhar district of Odisha. The study revealed that sal seeds were collected by men, women and children. Sal leaves were basically collected by women while tassar and weed for building materials were by men. But all other NTFPs were procured mainly by women and children. Another study made by Patel, et al (2008) focused on collection of minor forest products in Gujrat. The study found that there is high variability of these

products in the collection. A decreasing trend was noticed in the collection of products like tendu leaves, mahua flowers and doli. However, the procurement of gum and other products had increased. Thus, the study concluded that the overall decrease in collection of the products was observed. This was mainly due to the depletion of forest resources. Appasamy (1992) stated that the majority of NTFPs collectors were males in the Palani hills of Tamil Nadu. The higher proportion of NTFPs was sold for generation of income rather than for home consumption. It was found that about 50 % of the firewood was used for home consumption and the rest was sold. Similarly, a carried out by Sawhney and Engel (2003) in Bandhavgarh National Park, India revealed that majority of the sampled households (97%) were involved in collection of NTFPs. Mostly, they used to sell their procured products. Overall, the sale of NTFPs constitutes the most important source (26%) of cash income for the households. From the sale of different NTFPs, the highest amount of income is generated from amla product (42%). This is followed by Tendu leaves (41%), mahua12 (12%), fuel wood (4%) and Chironji (1%). The NTFPs helped to sustain the people especially landless and marginalized groups during lean season. Besides, these products also supplement their total income. The study found that NTFPs have made a significant contribution (86%) to the annual income of the households. Apart from the economic value of NTFPs, local communities were also enjoying several qualitative benefits from the forest. These benefits are received by them to meet their medicinal, religious and aesthetic needs (Vidyarthy and Guptha, 2002).

From the above discussion, a vacuum was found that rare study has carried out in Kalahandi district of Odisha with regards to procurement of NTFPs. Thus, in order to fill the research gap, the present study is carried out with the objective to study the trend of procurement NTFPs in the study area. The study is exclusively based on secondary data. The data are compiled from official records of TDCC, Bhubaneswar during period from 2005-06 to 2012-13. Besides, information related to the present study gathered from other secondary sources i.e., PCCF, OFDC, Ministry of Forest Department and DFO of Kalahandi Division. The simple statistical tools have been used to derive the conclusion of the present study.

Procurement of NTFPs in Kalahandi

Kalahandi district is covered with dense forest (28.54 % of total geographical area) where the tribals and poor people living in and around the forest depend on the NTFPs for deriving their livelihood. Though the district has 13 blocks, but NTFPs are found in blocks. The NTFPs found in the district are harida, bahada, amla, tamarind, kendu, char, kendu leaf, siali leaf hill broom, mahua flower, mahua seeds, sal seeds, thorn, bamboo etc. In the present study, the major NTFPs found in the district are reflected in Table 1.1. These products are summarised as follows.

Kendu leaf: Kendu (*Diospyros Melanoxylon*) is one of the most important non-wood forest products. The leaves are used for wrapping Bidis. The use of bidis is more popular among the poor native people. The kendu leaf is a nationalized product. Odisha is the third largest producer of kendu leaf next to Madhya Pradesh and Chhattisgarh in India. It is primarily collected by the pluckers and then starts processing through different stages. After processing, the products are delivered to OFDC in the state. The procurement and processing of kendu leaf are done by the wing of forest department.

Sal seeds: Sal seed (shorea robusta) is a nationalized product since 1973. The trade of sal seed is directly controlled by the Government of Odisha. It is one of the important product obtained from sal tree, which is predominantly available in state. Sal seed is basically used for the extraction of the oil, which is used mainly in manufacturing of chocolate and other fashionable items.

Mahua flowers: Mahua flowers (Madhuca latifolia) have a special status among NTFPs. These are mainly used for brewing liquor. Besides, these are also consumed as food both for cattle and human (tribal people). It can be processed into several other products such as candies, squashes, pickles, and vinegar. These flowers are naturally fallen from the trees. The flowers are mostly collected by the people, especially Scheduled Castes and Scheduled Tribes during the period generally from March to May. The processing (drying and cleaning) of mahua flowers is quite time-consuming (over 41 hours on an average). The procurement of mahua flowers is very common in western and south-western parts of Odisha.

Mahua seeds: Besides flowers, mahua seeds also have a significant contribution to the life style of tribals. The oil of mahua seed is used as edible oil by the tribals. It is particularly used in the preparation of "Pitha" a local rice cake. These seeds are traditionally processed in Ghanis and Chappas (plank press) to obtain oil. Now, its oil is extracted from power mills. Generally, extraction of this oil was traditionally done by "teli" caste (Other Backward Castes). Mahua seed oil is also increasingly being used in manufacture of laundry soap in particular.

Tamarind: Tamarind fruit (Tamarindus indica) is one of products collected from the tamarind tree. The fruit is tamarind is used as a flavoring agent. Besides, it is also used to make medicine for constipation, liver and gallbladder problems and stomach disorders. India

holds the first position in the world in procurement of tamarind. In Odisha, many primary collectors of tamarind are forced to sell at very low rates to the local traders. A major proportion of tamarind is exported to Andhra Pradesh.

Amla: Amla (emblic myrobalan) is an edible fruit. It is used for formulations of Ayurvedic medicine. It is one of the components of "Trifala" (a mixture of Amla, Harrida and Beheda) mixture. Trifal is used as laxative in treatment of enlarged livers, piles, eye pains and other stomach complaints. Fermented liquor is used in treatment of indigestion, anaemia, jaundice and certain heart problems and for promoting urination. It is probably the richest source of Vitamin C. Besides, the fruits are also largely used in formation of hair shampoos as well used as herbal beauty products.

Harida: Harida (Chebulic Myrobalan) is the third constituent of trifala. The dried fruit pastes can be applied externally on chronic ulcers, wounds and scalds. It is also used in gargle in case of inflammation of mucous membrane of mouth. It is beneficial in blood pressure and as cardiac tonic. The power of the fruit is used as dentifrice for strengthening the gums.

The procurement of these major NTFPs in Kalahandi district is reflected in Table 1.1. In fact, there are several NTFPs found in the district. Of them, the major products which are commonly found and procured in large quantity are taken into consideration for the present study. These NTFPs are kendu leaf, sal seeds, mahua flower, mahua seeds, tamarind, amla and harida. It is apparent from Table 1.1 that the procurement quantity of these products followed a trend of fluctuation every year during the period from 2005-06 to 2012-13. If we look at the trend of each product, it makes clear that a huge quantity of kendu leaf was procured as compared to other products during the same period.

Table 1.1: Procurement of major NTFPs in Kalahandi (2005-06 to 2012-13)

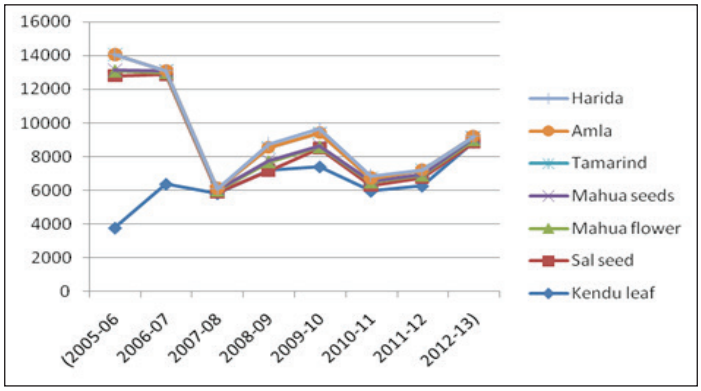
Year	Quantity procured (in quintal)						
	Kendu leaf	Sal seeds	Mahua flower	Mahua seeds	Tamarind	Amla	Harida
2005-06	3767.99	9050.1	280	43	908.69	0.9	5
2006-07	6381.46	6527.3	97	82	4.9	2.37	NA
2007-08	5822.24	82	100	49	49	1.27	4.34
2008-09	7203.33	NA	500	66	768.4	2.85	240
2009-10	7413.77	1102.8	66	66	768.4	2.85	240
2010-11	5963.71	330	200	70	150	19.26	160
2011-12	6270.38	481.66	150	93	220.32	1.86	1
2012-13	8881.92	NA	128	78.8	51.88	73	7

Source: TDCC, Bhubaneswar; NA: Not Available

The maximum quantity (8881.92 qtl.) of kendu leaf was procured in 2012-13 and minimum (3767.99 qtl) in 2005-06. The high procurement is recorded in those years in which there is a normal weather condition during the process starting from tender kendu leaves before plucking to dying and storage of the leaves. On the other hand, the low procurement is recorded in those years in which the abnormal weather conditions like hill storms and heavy rain fall damage the kendu leaves before they are plucked from the plants. The cloudy weather also harms the leaves due to improper dying of the leaves. Thus, the fluctuation of procurement of kendu leaves depends mainly on weather condition. Similarly, the procurement of other products rises and falls in different years depending upon the nature of bump crops and weather condition. The low procurement of sal seeds, mahua flower, mahua seeds, tamarind, amla and harida was recorded in those years in which there was no bump crop and bad weather condition. However, the huge procurement of these products was due to bumping crop and good weather condition during the entire process of procurement.

The procurement of these products except kendu leaves was seen from the table that sal seed was maximum (9050.1 qtl) in 2005-06 and minimum (82 qtl) in 2007-08. Likewise, the highest procurement of mahua flower, mahua seeds, tamarin, amla and harida was recorded with 500, 93, 908.69, 73 and 240 qtl. in 2008-09, 2011-12, 2005-06, 2012-013 and 2008-10 respectively and minimum was recorded with 66, 43, 4.9, 0.9 and 1 qtl in the years 2009-10, 2005-06, 2006-07, 2005-06 and 2011-12 respectively.

Figure-1.1 Trend major NTFPs in Kalahandi (2005-06 to 2012-13)



Source: Constructed by the author

It is clear from Figure 1.1 that almost all the products except kendu leaves have a decreasing trend from 2006-07 to 2007-08. Then, they have an increasing trend till 2009-10 and again have downward trend in 2010-11. Thereafter, there is further an increasing trend till 2012-

13. It may be said that the procurement trend of NTFPs in Kalahandi district is not impressive as they have a constant trend of fluctuation in the different time periods.

Conclusion

NTFPs play an important role in supporting livelihood of the people who depend on these products as their alternative source of income. The major NTFPs found in Kalahandi district are kendu leaf, sal seeds, mahua flower, mahua seeds, tamarind, amla and harida. These products are commonly found and procured in large quantity in the district. The present study focused on the trend of procurement of these limited products. From the analysis, the study concluded that the trend of procurement of NTFPs is not impressive in Kalahandi district of Odisha as they have a constant trend of fluctuation during the periods from 2005-06 to 2012-13. The present study is focused on procurement of major NTFPs found in the district during the given period of times. Beyond the scope of the study, future research can be done in other regions and it can be linked NTFPs with marketing. Moreover, it can be carried out by capturing other products as per the availability in the study region.

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Determinants of Food Grain Production in Indian States: Panel Cointegration and VECM Analysis

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Abstract

In this paper the author finds the link among the food grain production , gross state domestic product at current prices, net irrigated area, fertilizer used by states, cropping intensity, state fiscal deficit and state gross capital formation of 27 states in India from 1990-91 to 2015-16 using panel regression analysis, panel co-integration and vector error correction model. It finds positive link among food grain production, gross state domestic product at current prices, net irrigated area, NPK used by states, cropping intensity and negative relation with state fiscal deficit. Johansen-Fisher cointegration test confirmed four co-integrating equations. VECM is stable, not normally distributed and non-stationary with problem of autocorrelation. VECM states that there is significant long run association but in co-integrating equations change of food grain production and change of SDP have long run causality and they are moving towards equilibrium with slow speed of adjustment but change of net irrigated area and change of cropping intensity do not move to equilibrium level because they have no long run causality with the independent variables. On the other hand, there is short run causality running from state fiscal deficit to SDP and cropping intensity only but rest of the variables did not show any short run causality.

Keywords : *Food Grain Production, Panel Co-integration, Panel Vector Error Correction, Causality, Wald Test.*

JEL Codes: C12, C23, Q10, Q15, Q18

Introduction

Recent globalization produced a decline in costs of cross border trade in farm and other products as a result of reductions in governmental distortions to agricultural production, consumption and trade which have boosted economic growth and reduced global poverty especially in Asia. There has been a structural change in global agricultural market. There are remarkable paradigm shifts in the policy changes for climate and environment, high demand for bio-fuels, stimulation of international capital flows, effects of exchange rate of currencies and changes in WTO negotiations and clauses which had great influence in agriculture (Anderson, 2010).On the other hand, Food Security Information Network(2019) stated in the 2019 Global Report on Food Crises that more than 113 million people across 53 countries have been experiencing acute hunger of which 58% are in African countries,13% in South and South East Asian countries,24% in Middle East countries and 5% in Latin American countries. The U N Security Council called for humanitarian assistance of US$27.3 billion in 2017 to feed those hungry people. They noted that conflict and insecurity, eliminate climate shocks and economic turbulence are the main drivers of food insecurity. India contains one fourth of global hunger burden among nearly 195 million undernourished people in which 47 million or 4 out of 10 children in India are not meeting their full human potential because of chronic malnutrition or shunting. So the goal of Zero Hunger Challenge in India is fundamentally relevant. Because a few states in India such as Odisha, Bihar,Uttar Pradesh, West Bengal, Jharkhand, Chhattisgarh, Madhya Pradesh and Maharastra have been confronting with exstreme levels of food insecurity.

World food grain production in 2008-09 was 2.241 billion metric ton which rose to 2.62 billion metric ton in 2016-17 in which world wheat production was 585.4 million

metric ton in 1996 that catapulted to 729 million metric ton in 2014 and world rice production will increase to 904 million ton in 2030 from 600 million ton in 2000 and 753 million ton in 2017.The global food production should be increased by 70% to feed the world in 2050 but farming are likely to be decreasing with 8% for 8 major food crops across Africa and South Asia.

India ranks second in world rice and wheat production contributing more than 21% and 11% of world rice and wheat output. Food grain constitutes 64% of the gross cropped area although it accounts less than 25% of the total value of output of agriculture and related activities. Food grains occupied an area of 97.32 million hectares in 1950-51 which has increased to 122.65 million hectares in 2016-17 and food grain production was 50.82 million ton in 1950-51 which stipulated to 277.49 million ton in 2017-18.In 1950-51, rice was 30.81 million ton which increased to 109.70 million ton in 2016-17 and wheat production was 9.75 million ton which catapulted to 97.11 million ton in 2016-17.

There are some basic factors such as area of production, net irrigated area, fertilizer and pesticides uses, labor and capital employed, cropping intensity, GDP and capital formation in agriculture which influence the food grain production directly. There are some external factors such as environment, government policy, and infrastructure which have impact on food grain production as well. Even, the biological factors like diseases, animal, human, insects, weeds can damage crops. Modern transportation, marketing, advertising and technology affect to grow more food production by increasing intensity of food production. Prohibiting food import and tax on import may increase intensity of food production. More credit outstanding may reduce intensity of food production. Recent studies emphasized that crop growth depends on internal factors or genetic factors such as[i]high yielding ability,[ii]early maturity,[iii] resistance to lodging,[iv] drought flood and salinity tolerance,[v]tolerance to insects, pests and diseases, [vi]chemical composition of grain,[vii]quality of grain and [viii]quality of straw. And the external factors or environmental factor that affects growth of crops are [i]climatic,[ii]edaphic, [iii]biotic,[iv] physiographic,[v]socio-economic. Climatic condition have six areas such [i]precipitation,[ii]temperature,[iii] atmospheric humidity[iv] solar radiation,[v] wind velocity and [vi] atmospheric gases. Besides, there are some important macro-economic factors which have great impact on the crop production in agriculture in India. To reduce the level of poverty the policy of enhancement of food grain production is urgent because an empirical test verified that a 1% increase in agricultural yields leads to a 0.6-1.2% reduction in the number of people living below $1 per day.

In this paper the author will study the association among food grain production , state domestic product, net irrigated area, NPK consumption, cropping intensity, fiscal deficit of the state and capital formation of 27 states of India from 1990-91 to 2015-16 with the help of panel regression, panel co-integration and panel vector error correction models.

Literature review

The author described a few important relevant literatures which are related to this issue. Stockdale (1948) examined that agricultural production in British colonies in Africa usually depended on soils, water, systems of agriculture, use of livestock, crop varieties, paste and diseases, marketing arragements and social organizations respectively. Al-Tahan (1982) explored that in Iraqi agriculture during 1950-1975 input factors were farm machinery, water resources, irrigation methods. There was no significant improvement on inputs during the period but there was impact of climate and weather factors. The intensity of irrigation was positive with agricultural production of food. Weather factors such as rain-fed area and rainfall distribution were positive with food production but air temperature and soil temperature were negative with food production. During the study period, wheat and burley production have increased with area of production but fluctuation varied since coefficient of variation were 64.3% and 50.7% and coefficients of variation of area under production were 30.4% and 17.8% for wheat and burley. Kwinarajit and William (2004) studied production of rice in Thailand during 1971-1999 and they took inputs as area planted, average rainfall, paddy prices and agriculture labor force using OLS with 9 types of models (lag 1) and current price deflated by PPI,GDP deflator, nominal and current price of rice, nominal and average price deflated by PPI and GDP. They found that area planted to rice was positively and significantly related to nominal price but not real prices. Area planted to rice was more responsive to past changes in area planted, the amount of rainfall, and availability of agricultural labor than to change in paddy rice prices. Variability of rainfall was also an important constraint to growth of rice production suggesting the importance of government investment in irrigation system to reduce the risk of water shortage. Only exception was that the estimated price coefficients in four models were negative. Muhammad, Munir and Siddiqui (2007) showed that in India during 1949-50-1997-98 ,there had been increasing trends of percentage coverage under irrigation, production of rice in hectares and the percent of yield. Rahman and Parvin (2009) explored that the impact of irrigated area showed positive result on production of rice especially Aus, Aman and Boro and also rose cropping intensity which greatly

contributed to agricultural GDP in Bangladesh during 1980-81 to 2006-07. The study of Chittedi and Bayya (2012) explained that there was a significant positive relation between public expenditure and irrigation development in Andhra Pradesh (India) during 1990-2008 which increased gross area cultivated. Thus, overall impact of it was positive toward agricultural production and also led to grow more of multiple cropping. Brownson, Vincent, Emmanuel and Etim (2012) studied that export, external reserves, inflation rate and external debt have significant negative short run and long run relationship with agricultural productivity in Nigeria during 1970-2010 which were found through unit root test, cointegration test and vector error correction model. Chand and Parappurathu (2012) found multiple structural breaks in GDP in agriculture. The trend in agricultural growth from 1960-61 to 2010-11 showed upward cyclically and the states activities were categorized into greater than 4% growth rate, 2% growth rate and less than 2% growth rate. The eastern India performed the worst showing less than 2%.The authors found major drivers of agricultural growth in India which are capital formation, primary inputs, terms of trade of agriculture vis-à-vis non-agriculture, technology, cropping intensity, institutional credit and electricity.

Xaba and Masuku (2013) examined that the vegetable production was positively related with price of vegetable, family labor, distance to market, area under cultivation, fertilizer used, quantity produced in Swaziland. They used OLS method taking 100 farmers as sample .They took dummy variables such as sex of farmers, education of farmers, access to extensive service, access to credit by farmers and marketing agreements which were found positive with vegetable production .Wongnaa (2013) studied cashew production at Wenchi municipality in Ghana taking 140 respondent as sample for OLS. He found that cashew production was positively related with farm size, fertilizer used, pesticides, pruming, education and contact with extension officers while labor ,years of experience(labor in man days) are inversely related. But, physical capital was also positively related with cashew production. Mapfumo (2013) examined empirically during 1980-2010 in Zimbabwe on the linkage between agricultural production and economic growth and found that the value of agricultural production of tobacco, maize and cotton positively affected economic growth in Zimbabwe.

Di-Marcantonio, Merceles-Opazo, Barreirro-Hurle and Demeke (2014) studied 41 African countries taking cross country panel samples during 1968-2008.They used fixed effect model of panel regression among agricultural output of food as target variable and independent variables were land, irrigation, fertilizer, animals for transport, tractors, labor as inputs ,urbanization, land locked telephone line as market access, export, cereal aid, policy score, inflation as macroeconomic environment, school enrollment as human capital access and rain dummy and battle dummy as environment factors. All factors are significantly positively related but land locked dummy food aid is significantly negative relation with agricultural food production where rain dummy is insignificantly positive and conflict dummy is insignificantly negative. Sasmal (2014) verified through econometric model that there was a long run relationship between yield of food grain production and net irrigated area which was significantly positive in India during 1970-71-2007-08 and it was also true for NPK used. Kulshrestha (2014) examined econometric analysis of agricultural productivity in Rajasthan during 1990-2010 covering all districts for 16 crops to apply panel data in the models of cointegration and vector error correction. The study found that the cropping intensity and crop irrigated area had significant impact in enhancing productivity of a few crops and fertilizer consumption played a key role in all crops for increasing productivity except soya bean, cotton, kharif pulses etc. The contribution of road length had significant role in productivity of wheat, pearl, millet, barley, ground nut, maize, rice and kharif pulse.

Deshpande (2017) found out several factors of agricultural productivity in India which were availability and quality of agricultural inputs such as land, water, seed, fertilizer, access to agricultural credit, crop insurance, agricultural support price, storage, marketing, infrastructure and post-harvest activities and so on. Rehman and Luan (2017) studied an econometric analysis in China during 1980-2015 on the relationship between agricultural crop and agricultural GDP applying OLS and cointegration test and found a significant positive link between them. Priyadarshini and Nayak (2018) examined short run and long run effects of factors on agricultural productivity in India during 1980-2013 through cointegration and vector error correction model. The results suggested that there was long run equilibrium relationship between the determinants and the productivity. VECM showed that there were long run causalities running from irrigation, fertilizer, non-product specific support to inputs, electricity and private investment in agriculture. Even there were short run causalities running from irrigation and private investment to agricultural productivity. Pradhan and Mukherjee (2018) estimated the technical efficiency of agricultural production in India during 1999-2007 applying production frontier model for both cross section and panel data and found that farmer's education, household production process, proportion of irrigated area, availability of wells, yielding variety

of lands, government services, agricultural expenditure by local government and women reservation in local government significantly contributed to the efficiency of production.

Methodology and Data

The paper assumed that

$y = production\ of\ food\ grain\ (in\ thousand\ ton)$

$x_1 = State\ Domestic\ Product\ at\ current\ prices\ (in\ Rs\ lakh)$

$x_2 = net\ irrigated\ area\ (in\ thousand\ hectares)$

$x_3 = NPK\ used\ (in\ kg/hectares)$

$x_4 = cropping\ intensity\ \%:$

$x_5 = state\ Fiscal\ Deficit\ (in\ billion\ Rs)$

$x_6 = state\ gross\ capital\ formation, (in\ million\ Rs)$

Author has included the following states in India: 1. Andhra Pradesh, 2. Arunachal Pradesh, 3. Assam, 4. Bihar, 5. Delhi, 6. Goa, 7. Gujarat, 8. Haryana, 9. Himachal Pradesh, 10. Jammu & Kashmir, 11.Karnataka, 12. Kerala, 13. Madhya Pradesh, 14.Maharastra, 15.Manipur, 16. Meghalaya, 17.Mizoram, 18.Nagaland, 19.Odisha, 20.Pondichery, 21.Punjab, 22.Rajasthan, 23.Sikkim, 24.Tamilnadu, 25.Tripura, 26.Uttar Pradesh and 27.West Bengal.

All the secondary data on the above variables have been collected from Reserve Bank of India from 199-91 to 2015-16.

To examine the relationship among the food grain production with those independent variables of 27 states in India during the specified period, the author used fixed effect panel regression model after verifying the Hausman Test (1978). Residual cross section dependence test of Breausch-Pagan LM (1979), Pesaran scaled LM (2004), A Bias –corrected scaled LM test of Pesaran, Ullah & Yamagata (2008) and Pesaran CD (2004) test have been applied. Fisher (1932) -Johansen co-integration test (1991) was used to verify co-integration. Johansen (1991) Panel VECM was also used to show long and short run association where the Wald test (1943) verified the short run causality in the system equations.

Findings of the Models

To find the link among the food grain production , gross state domestic product at current prices, net irrigated area, NPK used by states, cropping intensity, state fiscal deficit and state gross capital formation of 27 states in India from 1990-91 to 2015-16,the author has used panel regression analysis. Using random effect model with period 24, cross section 22 and total observation 516, the panel regression was shown the following Table 1.

Table 1: Random Effect Model

variables	*coefficients*	*SE*	*T statistic*	*probability*
C	2.072501	0.593382	3.492693	0.0005
$Log(x_1)$	0.122551	0.015845	7.734470	0.0000
$Log(x_2)$	0.327009	0.027606	11.84551	0.0000
$Log(x_3)$	0.056487	0.022579	2.501696	0.0127
$Log(x_4)$	0.402222	0.119529	3.365052	0.0008
$Log(x_5)$	−0.008926	0.005168	−1.727367	0.0847
$Log(x_6)$	0.006468	0.005690	1.136655	0.2562

R^2=0.39,F=54.46 ,DW=1.01,*=significant at 5% level.*

The Hausman test for random effect model is tested where the value Chi-Square statistic with 6 degree of freedom is 154.426398 which rejected the Null hypothesis because probability is less than 5% .Thus the alternative hypothesis- the fixed effect model is considered as appropriate.

Now, the panel fixed effect regression model is estimated which is shown below in Table 2 where total observation =516, cross section=22 and period=24.

Table 2: Fixed Effect Model

variables	*coefficients*	*SE*	*t statistic*	*probability*
C	−6.305664	0.622548	−10.12880	0.0000
$log(x_1)$	0.177195	0.030197	5.868040	0.0000
$log(x_2)$	0.706699	0.021477	32.90521	0.0000
$log(x_3)$	0.057806	0.025805	2.240075	0.0255
$log(x_4)$	1.503085	0.127443	11.79416	0.0000
$log(x_5)$	−0.059990	0.011048	−5.430027	0.0000
$log(x_6)$	−0.015924	0.010085	−1.578964	0.1150

R^2=0.928, F=1102.63, DW=0.37,*=significant at 5% level.*

This fixed effect panel regression equation states that one per cent increase in SDP at current prices, net irrigated area, NPK used, cropping intensity, state fiscal deficit and state gross capital formation per year led to 0.177 %, 0.7066%, 0.0578%, and 1.5099%, increase in food grain production per year respectively and decrease of 0.0599% and 0.0159% food grain production per year from 1990-91 to 2015-16 in 27 Indian states. All coefficients are significant at 5% level except state gross capital formation. The regression equation is a good fit with high R^2, significant F and insignificant DW which indicates serial correlation problem.

Residual cross section dependence test assured that there is no cross section dependency since the test statistic of

Breausch-Pagan LM, Pesaran scaled LM, Bias –corrected scaled LM and Pesaran CD have been rejected from Null Hypothesis of no cross section dependence (correlation) in residuals which are given below in Table 3:

Table 3: Residual cross section dependence test

Test	*Statistic*	*df*	*Probability*
Breusch – Pagan LM	631.0239	231	0.0000
Pesaran scaled LM	17.58726		0.0000
Bias – corrected scaled LM	17.10900		0.0000
Pesaran CD	3.372049		0.0007

Now, the author is interested to study the co-integrating relationship or long run association among food grain production ,state gross domestic product at current prices, net irrigated area of states, utilization of NPK of states, cropping intensity of states, fiscal deficit of states in India from 1990-91 to 2015-16 using panel co-integration model. All the series have been converted to first difference series showing stationary series after elimination of unit root. Johansen- Fisher panel Co-integration Test is applied using log which includes 702 observations with 22 cross sections and linear deterministic trend in unrestricted co-integration rank test. Trace Test showed four co-integrating equations and Max Eigen test showed three co-integrating equations which are significant. These are given in the Table 4.

Table 4: Panel Cointegration test

Hypothesized No. of CE(s)	*Fisher Stat.* (from Trace test)*	*Probability.*	*Fisher Stat.* (from Max – Eigen test)*	*Probability.*
None	852.3	0.0000	516.6	0.0000
At most 1	399.3	0.0000	277.4	0.0000
At most 2	177.9	0.0000	128.1	0.0000
At most 3	84.59	0.0009	61.91	0.0855
At most 4	55.91	0.2022	49.72	0.4047
At most 5	61.22	0.0953	61.22	0.0953

** Probabilities are computed using asymptotic Chi-square distribution*

In Table 5, Individual cross section results have been arranged showing further verification of cointegration.

Table 5: Cross section of co-integration

Hypothesized No. of CE(s)	*Fisher Stat.* (from Trace test)*	*Probability.*	*Fisher Stat.* (from Max – Eigen test)*	*Probability.*
Hypothesis of at most 4 *co – integration relationship*				
1	13.8815	0.0863	11.4335	0.1338
2	6.8776	0.5919	5.2566	0.7092
3	11.1662	0.2015	11.0035	0.1540
4	6.8736	0.5924	6.8434	0.5078

Since, there is co-integration among variables, then the estimates of VECM have been calculated and these are given below in the matrix form.

$$\begin{bmatrix} \Delta \log y \\ \Delta \log x_{1t} \\ \Delta \log x_{2t} \\ \Delta \log x_{3t} \\ \Delta \log x_{4t} \\ \Delta \log x_{5t} \end{bmatrix} = \begin{bmatrix} 0.0108 \\ 0.1469 \\ 0.0247 \\ 0.0445 \\ 0.0015 \\ 0.0960 \end{bmatrix} + \begin{bmatrix} -0.02356 \\ -0.0253 \\ 0.05268 \\ 0.00465 \\ 0.00944 \\ -0.7166 \end{bmatrix} [EC]$$

$$+ \begin{bmatrix} -0.5152 & -0.20936 & 0.04503 & 0.0265 & 0.02652 & 0.01115 & 0.01559 & 0.00267 & -0.2647 & 0.0772 & 0.01119 & 0.00832 \\ -0.0258 & -0.00118 & -0.3708 & -0.054 & -0.0267 & 0.0176 & -0.0046 & 0.01521 & 0.1342 & -0.0238 & 0.00835 & 0.02067 \\ -0.0387 & -0.0408 & 0.0148 & -0.0535 & 0.5325 & -0.24239 & -0.0193 & -0.0558 & 0.2321 & 0.0238 & -0.0196 & -0.0168 \\ -0.0733 & -0.0275 & -0.0578 & -0.1134 & -0.01108 & -0.0409 & -0.1206 & -0.1408 & 0.39201 & 0.02805 & 3.49E-05 & -0.00575 \\ -0.0116 & 0.0028 & 0.0154 & -0.0197 & 0.00205 & -0.00154 & 0.00408 & 0.0032 & -0.1165 & -0.0556 & -0.00663 & -0.00523 \\ 0.6889 & 0.5547 & 0.8338 & -0.9188 & 0.01267 & -0.21135 & -0.2169 & -0.02501 & -1.962 & -0.0802 & -0.0409 & -0.0490 \end{bmatrix}$$

$$\mathbf{x} \begin{bmatrix} \Delta \log y_{t-1} \\ \Delta \log y_{t-2} \\ \Delta \log x_{1t-1} \\ \Delta \log x_{1t-2} \\ \Delta \log x_{2t-1} \\ \Delta \log x_{2t-2} \\ \Delta \log x_{3t-1} \\ \Delta \log x_{3t-2} \\ \Delta \log x_{4t-1} \\ \Delta \log x_{4t-2} \\ \Delta \log x_{5t-1} \\ \Delta \log x_{5t-2} \end{bmatrix}$$

The estimated VECM-1 is not a good fit (where R^2=0.227,F=11.07, AIC=-0.338459,SIC=-0.220809) yet the coefficient of error correction is significant and negative which represents that it moves towards equilibrium. .

Δ log(y) is significantly related with $\Delta\log(y_{t-1})$ and $\Delta\log(y_{t-2})$ negatively

Here the estimated VECM-2 is a bad fit because no coefficients are significant except error correction which implies that it is tending towards equilibrium (where R^2=0.16,F=7.157247, AIC=-0.621406,SIC=-0.503756).

The estimated VECM-3 is also a bad fit but $\Delta\log(x_{2t})$ is negatively significant with $\Delta\log(x_{2t-1})$ and $\Delta\log(x_{2t-2})$ and the coefficient of error correction term signifies divergent movement where R^2= 0.235217,F=11.54537*, AIC= 0.682662,SC=0.800312 .

The VECM-4 is a bad fit with divergent error correction although there is negative relation with $\Delta\log(x_{3t})$, $\Delta\log(x_{3t-1})$ and $\Delta\log(x_{3t-2})$ significantly where R^2= 0.035322,F=1.374502, AIC= 0.526776,SC=0.644426.

The VECM-5 is a bad fit with divergent error correction although there is negative relation with $\Delta\log(x_{4t})$, $\Delta\log(x_{5t-1})$ and $\Delta\log(x_{5t-2})$ significantly where R^2= 0.062818,F=2.516148, AIC= -3.013300,SC=-2.895650.

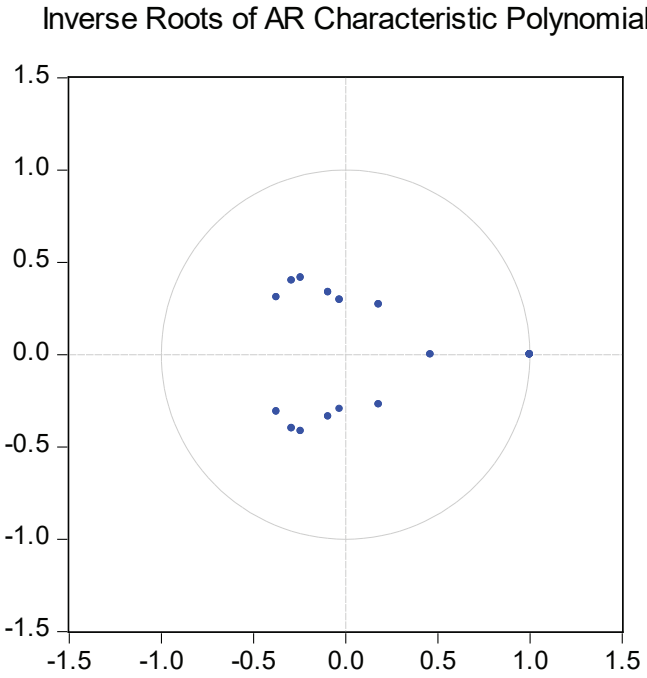
The estimated VECM-6 is also a bad fit but $\Delta\log(x_{5t})$ is significantly related with $\Delta\log(x_{1t-2})$ negatively and the error correction is negative and significant which implies that it moves towards equilibrium when R^2= 0.277780,F=14.43803, AIC= 3.811709,SC=3.929359.

This estimated VECM consists of 5 unit roots, 12 imaginary roots and one root is positive but less than one so that all roots lie on or inside the unit circle which proves that the model is stable but non-stationary.

Table 6: Values of Roots

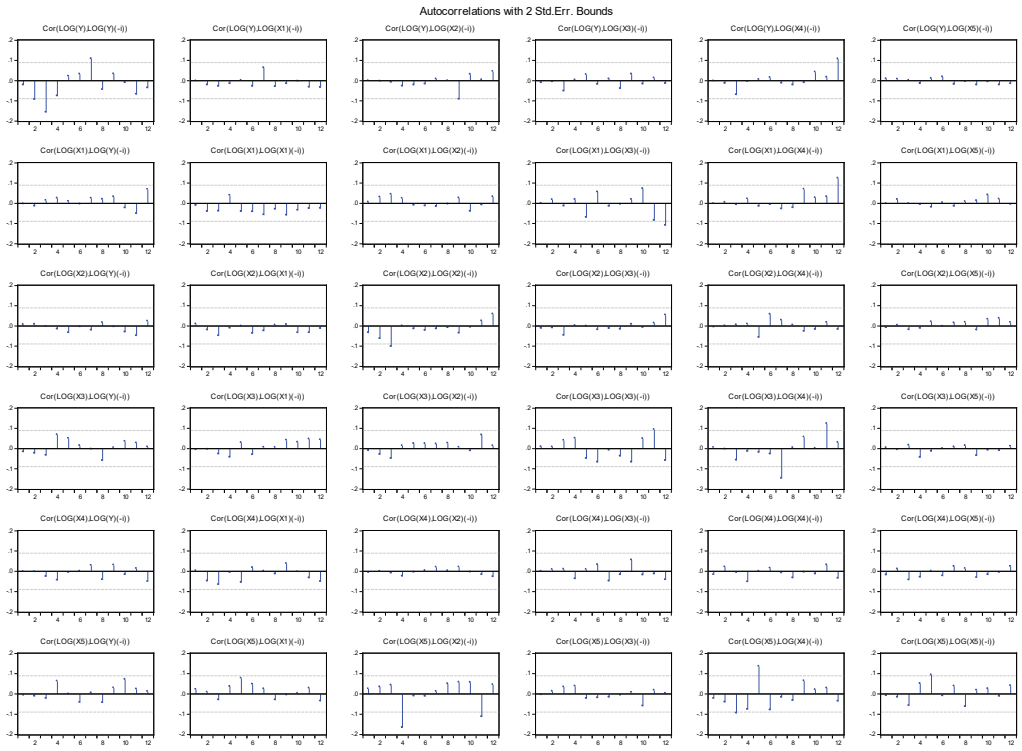
roots	*modulus*
1.000000	1.000000
1.000000	1.000000
1.000000	1.000000
1.000000	1.000000
1.000000	1.000000
–0.292093 + 0.400400*i*	0.495619
–0.292093 – 0.400400*i*	0.495619
–0.373831 + 0.309236*i*	0.485156
–0.373831 – 0.309236*i*	0.485156
–0.241553 – 0.415995*i*	0.481040
–0.241553 + 0.415995*i*	0.481040
0.461959	0.461959
–0.093514 – 0.337077*i*	0.349808
–0.093514 + 0.337077*i*	0.349808
0.180849 + 0.271276*i*	0.326032
0.180849 – 0.271276*i*	0.326032
–0.031385 + 0.296726*i*	0.298381
–0.031385 – 0.296726*i*	0.298381

Figure 1: Unit Circle



The residual test of VECM for correllogram confirms that there are autocorrelations among all the variables such as food grain production, GSDP, net irrigated area, fertilizer intake, cropping intensity and state fiscal deficit respectively. It is seen in Figure 2.

Figure 2: Auto-correlation of residuals



The VEC residual serial correlation LM test suggests that there are serial correlations among variables because LM stat with lag 1,lag 2 and lag 3 were computed as 62.428,77.908 and 76.854 respectively whose probabilities are less than 5% with null hypothesis of no serial correlation at lag.

Hansen -Doornik (1994) VEC residual normality test rejects H0= null hypothesis of residuals are multivariate normal since the Chi-square of Skewness and Kurtosis are rejected and probabilities of Jarque-Bera are also rejected at 5% level of significance. It is shown in Table 7. (Total observations=502, period-1990-91-2015-16)

Table 7: VEC Residual Normality test

component	skewness	chi-square	Degree of freedom	probability
1	–2.393634	189.1577	1	0.0000
2	–4.005192	309.6861	1	0.0000
3	–4.005192	320.1743	1	0.0000
4	–2.864513	227.3583	1	0.0000
5	–2.166972	169.7827	1	0.000
6	–2.621121	207.9519	1	0.0000
Joint		1424.111	6	0.0000
component	Kurtosis	chi-square	Degree of freedom	probability
1	19.74241	0.876503	1	0.3492
2	80.03112	856.8662	1	0.0000
3	93.13488	1244.985	1	0.0000
4	42.50402	428.4343	1	0.0000
5	29.02280	386.5760	1	0.0000
6	18.29044	67.10714	1	0.0000
Joint		2984.846	6	0.0000
component	Jarque-Bera	Degreeoffreedom	probability	
1	190.0342	2	0.0000	
2	1166.552	2	0.0000	
3	1565.160	2	0.0000	
4	655.7926	2	0.0000	
5	556.3587	2	0.0000	
6	275.0591	2	0.0000	
Joint	4408.957	12	0.0000	

Thus, the VECM is not normally distributed.

VEC residual heteroscedasticity test when there is no cross terms with 502 observations during the same period showed that the Chi-Square value of Joint test with 546 degree of freedom is found as 1605.446 whose probability is less than 5% ,so that there is heteroscedasticity problem in joint test without cross terms.

The impulse response functions indicate that VECM is non-stationary which implies that any shock to the variables does not tend the model towards equilibrium (Figure 3).

Figure 3: Impulse Response Functions

The co-integrating equation in the VECM states that there are significant long run causalities running from net irrigated area, utilization of fertilizers and cropping intensity of all the states in India to food grain production of Indian states during 1990-91-2015-16. It is convergent towards equilibrium insignificantly since t value of the coefficient of $\log(x_{1t-1})$ is not significant at 5% level.

$$logY_{t-1} = 10.25000 - 0.187211 logx_{1t-1} - 0.974638 logx_{2t-1} - 0.242382 logx_{3t-1} - 2.027352 logx_{4t-1} + 0.633326 logx_{5t-1}$$
$$(-1.34) \qquad (-9.76)^{*} \qquad (-2.51)^{*} \qquad (-3.92)^{*} \qquad (10.28)$$

$^{*} = significant\ at\ 5\%\ level$

In Figure 4, the instability of the co-integrating equation is plotted which is tending to equilibrium level insignificantly.

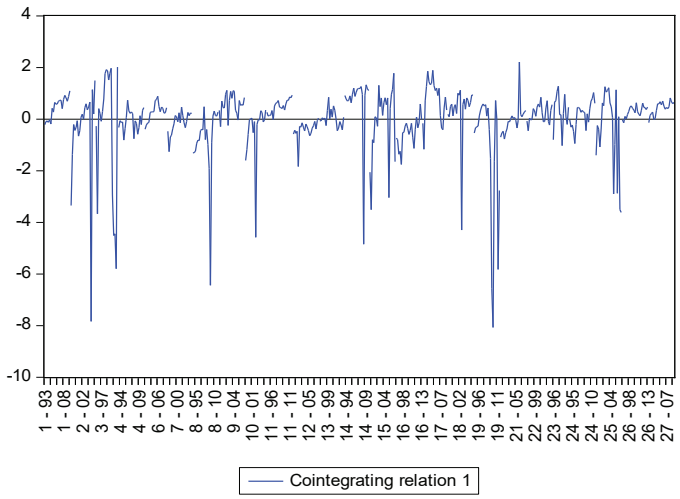


Figure 4 : Cointegrating Equation

Now in VECM, the paper verified whether there were long run and short causalities running from x_1, x_2, x_3, x_4, and x_5, on yi.e. causalities running from state domestic product, net irrigated area of state, fertilizer consumption of state, cropping intensity, and state fiscal deficit to food grain production respectively.

The estimated system equation [1] is given below taking 25 cross sections, 22 periods and 527 observations where food grain production is dependent and rest are independent variables.

$$\Delta log(y_t) = c(1)log(y_{t-1}) - 0.1872log(x_{1t-1}) - 0.974log(x_{2t-1}) - 0.242log(x_{3t-1})$$
$$-2.0273log(x_{4t-1}) + 0.6333log(x_{5t-1}) + 10.249 + c(2)\Delta log(y_{t-1}) + c(3)\Delta log(y_{t-2})$$
$$+c(4)\Delta log(x_{1t-1}) + c(5)\Delta log(x_{1t-2}) + c(6)\Delta log(x_{2t-1}) + c(7)\Delta log(x_{2t-2})$$
$$+c(8)\Delta log(x_{3t-1}) + c(9)\Delta log(x_{3t-2}) + c(10)\Delta log(x_{4t-1}) + c(11)\Delta log(x_{4t-2})$$
$$+c(12)\Delta log(x_{5t-1}) + c(13)\Delta log(x_{5t-2}) + c(14)$$

In Table 8, the values of coefficients, standard error, the t values and probabilities of the constants have been arranged.

Table 8: System equation 1

	coefficients	standard error	t statistic	probability
$c(1)$	–0.023507	0.009763	–2.407731	0.0164
$c(2)$	–0.520356	0.045472	–11.44334	0.0000
$c(3)$	–0.210590	0.045361	–4.642496	0.0000
$c(4)$	0.041784	0.052757	0.792012	0.4287
$c(5)$	0.025587	0.052880	0.483863	0.6287
$c(6)$	0.008331	0.027070	0.307776	0.7584
$c(7)$	0.008891	0.028829	0.308386	0.7589
$c(8)$	0.011792	0.028911	0.407886	0.6835
$c(9)$	–0.015201	0.029580	–0.513889	0.6076
$c(10)$	–0.018451	0.170306	–0.108339	0.9138
$c(11)$	0.067574	0.168955	0.399954	0.6894
$c(12)$	0.011306	0.006435	1.757007	0.0795
$c(13)$	0.007837	0.005798	1.351707	0.1771
$c(14)$	0.011875	0.012640	0.939539	0.3479

R^2=0.229675,F= 11.76 ,AIC=-0.354500,SC=-0.241140,*=significant at 5% level.*

The co-integrating equation (1) is estimated as:

$\Delta logy_t$=-0.023507$logy_{t-1}$-0.18721$logx_{1t-1}$-0.9746$logx_{2t-1}$-0.242381$logx_{3t-1}$-2.0273$logx_{4t-1}$ +0.6333$logx_{5t-1}$ +10.2499 where c(1) is negative(-0.023507) and significant(t=-2.407731),thus there are long run causalities running from x_1,x_2,x_3,x_4, and x_5 to y ,the speed of adjustment is 2.35% per annum, i.e. it is moving towards equilibrium although speed is very slow.

Again, there is no short run causality running from SDP to food grain production because the Wald test confirmed that $\chi^2(2)$= 0.673942 (probability =0.71) and F(2,513) =0.336971 (probability = 0.71) so that null hypothesis of short run causality is accepted assuming c(4)=c(5)=0.

Secondly, assume C(6)=c(7)=0 in the Wald test, it is found that χ^2 (2)= 0.133969 (probability = 0.9352) and F(2,513)= 0.066985(probability=0.9352),so that there is no short run causality running from net irrigated area to food grain production.

Thirdly, there is no short run causality running from NPK consumption to food grain production because from the Wald test χ^2 (2)= 0.482635(probability= 0.78) and F(2,513)= 0.241317 whose probability is 0.78 so that null hypothesis of no short run causality is accepted assuming c(8)=c(9)=0.

Fourthly, there is no short run causality running from cropping intensity to food grain production since χ^2 (2)= 0.183655 (probability= 0.91) and F(2,513)= 0.091828 (probability= 0.91) so that null hypothesis of no short run causality is accepted assuming c(10)=c(11)=0 as observed from the Wald test.

Fifthly, the Wald test assured that there is no short run causality from state fiscal deficit to food grain production since χ^2 (2)= 3.458413 (probability = 0.17) and F(2,513)= 1.729207 whose probability is 0.17 so that null hypothesis of no short run causality is accepted assuming c(12)=c(13)=0.

Lastly, the residual test for normality, the value of Jarque-Bera =5149.736(probability =0.000) which means that the residuals of $\Delta logY_t$ is not normally distributed.

Moreover, residual cross section dependence test with null hypothesis of no cross section dependence (correlation) in residuals showed that Breusch –Pagan LM, Pesaran scaled LM and Pesaran CD statistic are 420.4335, 3.896055 and 7.901143 whose probabilities are 0.000 each (df=300) which means that there is cross section dependence in $\Delta logy_t$ In the Figure 3 of the impulse response function, the long and short causality from x_1,x_2,x_3,x_4, and x_5 to y have been shown in the figures of the first row.

Likewise, in VECM , the paper checked whether there are long run and short causalities running from x_2, x_3, x_4, x_5 and y to x_1 i.e. causality running from state domestic product, net irrigated area of state, fertilizer consumption of state, cropping intensity, and state fiscal deficit to food grain production respectively.

The estimated system equation-1 of the VECM-1 has been approaching towards equilibrium which is nicely plotted in Figure 5.

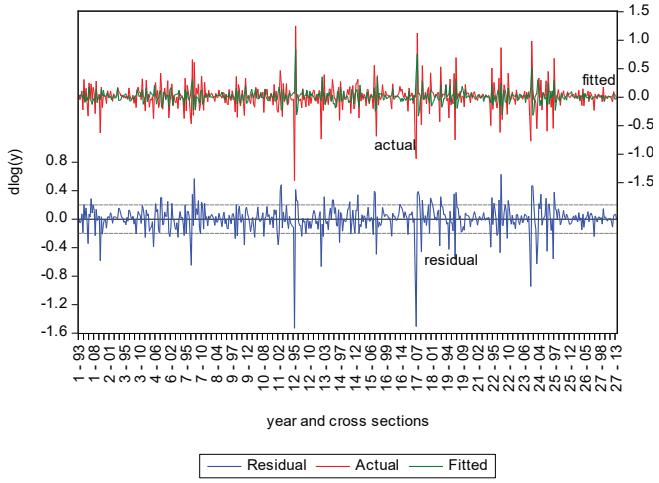


Figure 5: VECM 1 tends to equilibrium

The estimated system equation [2] is given below taking 25 cross sections, 22 periods and 524 observations where gross state domestic product is dependent and the rest are independent variables.

$$\Delta log(x_{1t}) = c(15)log(y_{t-1}) - 0.1872log(x_{1t-1}) - 0.974log(x_{2t-1}) - 0.242log(x_{3t-1})$$
$$-2.0273log(x_{4t-1}) + 0.6333log(x_{5t-1}) + 10.249 + c(16)\Delta log(y_{t-1}) + c(17)\Delta log(y_{t-2})$$
$$+c(18)\Delta log(x_{1t-1}) + c(19)\Delta log(x_{1t-2}) + c(20)\Delta log(x_{2t-1}) + c(21)\Delta log(x_{2t-2})$$
$$+c(22)\Delta log(x_{3t-1}) + c(23)\Delta log(x_{3t-2}) + c(24)\Delta log(x_{4t-1}) + c(25)\Delta log(x_{4t-2})$$
$$+c(26)\Delta log(x_{5t-1}) + c(27)\Delta log(x_{5t-2}) + c(28)$$

The values of coefficients, standard error, t statistic and probability are arranged in the Table 9.

Table 9: System equation-2

	coefficients	standard error	t statistic	probability
$c(15)$	–0.022991	0.008571	–2.682342	0.0075
$c(16)$	–0.022094	0.039300	–0.562177	0.5742
$c(17)$	0.004307	0.039208	0.109841	0.9126
$c(18)$	–0.368871	0.045608	–8.087895	0.0000
$c(19)$	–0.055450	0.045716	–1.212927	0.2257
$c(20)$	–0.026398	0.023419	–1.127215	0.2602
$c(21)$	0.013757	0.024919	0.552068	0.5811
$c(22)$	–0.003199	0.025142	–0.127232	0.8988
$c(23)$	0.004951	0.025652	0.192993	0.8470
$c(24)$	0.127847	0.147288	0.868010	0.3858
$c(25)$	–0.023703	0.146048	–0.162297	0.8711
$c(26)$	0.006640	0.005592	1.187574	0.2356
$c(27)$	0.017055	0.005027	3.392842	0.0007
$c(28)$	0.148449	0.010946	13.56226	0.0000

R^2=0.15 , F=7.036, SC=-0.532375, AIC=-0.646232

The co-integrating equation (2) is estimated as

$\Delta logx_{1t}$=-0.022991logy$_{t-1}$-0.1872logx_{1t-1}-0.9746logx_{2t-1}-0.2423logx_{3t-1}-2.0273logx_{4t-1}+0.633logx_{5t-1}+10.24 where c(15) is negative(-0.022991) and significant(t=-2.682342). Thus there are long run causalities running from y,x_2,x_3,x_4, and x_5 to x_1.The speed of adjustment is 2.29% per annum, i.e. it is moving towards equilibrium although speed is very slow.

Now it was found that there is no short run causality running from net irrigated area to SDP because the Wald test confirmed that χ^2 (2)= 2.535129 (probability=0.28) and F(2,510)= 1.267565 (probability = 0.28) so that null hypothesis of short run causality is rejected assuming c(20)= c(21)=0.

Secondly, there is no short run causality from NPK consumption to SDP because the Wald test confirmed that χ^2 (2)= 0.059754 (probability= 0.97) and F(2,510)= 0.029877 (probability= 0.97) so that null hypothesis of short run causality is rejected assuming c(22)= c(23)=0.

Thirdly, there is no short run causality from cropping intensity to SDP because the Wald test confirmed that χ^2 (2) = 0.821183(probability = 0.66) and F(2,510)= 0.410592(probability= 0.66) so that null hypothesis of short run causality is rejected assuming c(24)=c(25)=0.

Fourthly, there is short run causality running from state fiscal deficit to SDP because the Wald test confirmed that χ^2 (2) =11.70927 (probability= 0.00) and F(2,510)= 5.854636(probability = 0.00) so that null hypothesis of no short run causality is rejected assuming c(26)=c(27)=0. Similarly, there is no short run causality running from food grain production to SDP.

Finally, the residual test for normality suggested that Jarque-Bera is found as 125916 whose probability=0.00, therefore it is not normally distributed. And residual cross section dependence test with null hypothesis of no cross section dependence (correlation) in residuals showed that Breusch –Pagan LM, Pesaran scaled LM and Pesaran CD statistic are 488.7362, 6.684502, 9.739658 whose probabilities are 0.000 each (df=300) which means that there is cross section dependence in $\Delta logx_{1t}$.In the Figure 3 of the impulse response function, the long and short causality from y,x_2,x_3,x_4 and x_5 to x_1 have been shown in the figures of the second row.

From VECM the estimated system equation [3] is given below taking 25 cross sections, 21 periods and 507 observations where net irrigated area is dependent and the rest are independent variables.

$$\Delta log(x_{2t}) = c(29)log(y_{t-1}) - 0.1872log(x_{1t-1}) - 0.974log(x_{2t-1}) - 0.242log(x_{3t-1}) - 2.0273log(x_{4t-1}) + 0.6333log(x_{5t-1}) + 10.249 + c(30)\Delta log(y_{t-1}) + c(31)\Delta log(y_{t-2}) + c(32)\Delta log(x_{1t-1}) + c(33)\Delta log(x_{1t-2}) + c(34)\Delta log(x_{2t-1}) + c(35)\Delta log(x_{2t-2}) + c(36)\Delta log(x_{3t-1}) + c(37)\Delta log(x_{3t-2}) + c(38)\Delta log(x_{4t-1}) + c(39)\Delta log(x_{4t-2}) + c(40)\Delta log(x_{5t-1}) + c(41)\Delta log(x_{5t-2}) + c(42)$$

The values of coefficients, standard error, t statistic and probability are arranged in the Table 10.

Table 10: System equation-3

	coefficients	Standard Error	t statistic	probability
c(29)	0.054370	0.016980	3.201994	0.0015
c(30)	–0.044297	0.076985	–0.575395	0.5653
c(31)	–0.044080	0.077664	–0.567565	0.5706
c(32)	0.005534	0.089213	0.062031	0.9506
c(33)	–0.049774	0.089584	–0.55561	0.5787
c(34)	–0.570680	0.047902	–11.91342	0.0000
c(35)	–0.258351	0.049027	–5.269576	0.0000
c(36)	–0.021708	0.050226	–0.432210	0.6658
c(37)	–0.045990	0.050346	–0.913476	0.3614
c(38)	0.239176	0.288168	0.829990	0.4069
c(39)	0.037284	0.284807	0.130911	0.8959
c(40)	–0.021266	0.011361	–1.871786	0.0618
c(41)	–0.017237	0.010079	–1.710133	0.0879
c(42)	0.027304	0.021438	1.273623	0.2034

R^2=0.27 , F=15.54, SC=0.803576, AIC=0.686813,*=significant at 5% level*

The co-integrating equation -3 is observed as below.

$\Delta logx_{2t}$=0.054370$logy_{t-1}$-0.1872$logx_{1t-1}$-0.9746$logx_{2t-1}$-0.242$logx_{3t-1}$-2.0273$logx_{4t-1}$+0.633$logx_{5t-1}$+10.249

Since, c (29) is positive (0.054370) and significant (t=3.201994), thus there are no long run causalities running from y,x_1,x_3,x_4 and x_5 to x_2 ,the speed of adjustment is 5.43% per annum, i.e. it is not moving towards equilibrium.

If c (30) = c (31) = 0, then the Chi-square (2) = 0.4573 (p = 0.795),i.e., there is no short run causality from food grain production to net irrigated area. If c(32)=c(33)=0,then the Chi-square(2)=0.3859 (p=0.8245), i.e., there is no short run causality running from SDP to net irrigated area.

Now it was found that there is no short run causality running from NPK consumption to net irrigated area because the Wald test confirmed that χ^2 (2)= 0.939254(probability=0.62) and F(2,510) = 0.469627(probability=0.62) so that null hypothesis of no short run causality is accepted assuming c(36)=c(37)=0.

Again, there is no short run causality running from cropping intensity to net irrigated area because the Wald test confirmed that χ^2 (2) = 0.690381(probability = 0.70) and F(2,510) = 0.345191 (probability = 0.70) so that null hypothesis of no short run causality is accepted assuming c(38)=c(39)=0.

Even, there is no short run causality running from state fiscal deficit to net irrigated area because the Wald test confirmed that the χ^2 (2)= 4.343150 (probability =0.11) and F(2,493)= 0.1151(probability =0.11) so that null hypothesis of no short run causality is accepted assuming c(40)=c(41)=0. Similarly, there is no short run causality running from food grain production and SDP to net irrigated area.

The residual test for normality suggested that Jarque-Bera is found as 167228.4 whose probability=0.00, therefore it is not normally distributed. And the residual cross section dependence test with null hypothesis of no cross section dependence (correlation) in residuals showed that Breusch –Pagan LM, Pesaran scaled LM and Pesaran CD statistic are 405.4497, 3.284344, 0.915779 whose probabilities are 0.000 for first two and 0.3598 for third (df=300) which imply that there is cross section dependence in $\Delta logx_{2t.}$In the Figure 3 of the impulse response function, the long and short causalities from y,x_1,x_3,x_4 and x_5 to x_2 have been shown in the figures of the third row.

From the VECM the estimated system equation [5] is given below taking 25 cross sections, 22 periods and 510 observations where cropping intensity is the target variable and the rest are independent variables.

$$\Delta log(x_{4t}) = c(57)log(y_{t-1}) - 0.1872log(x_{1t-1}) - 0.974log(x_{2t-1}) - 0.242log(x_{3t-1}) - 2.0273log(x_{4t-1}) + 0.6333log(x_{5t-1}) + 10.249 + c(58)\Delta log(y_{t-1}) + c(59)\Delta log(y_{t-2}) + c(60)\Delta log(x_{1t-1}) + c(61)\Delta log(x_{1t-2}) + c(62)\Delta log(x_{2t-1}) + c(63)\Delta log(x_{2t-2}) + c(64)\Delta log(x_{3t-1}) + c(65)\Delta log(x_{3t-2}) + c(66)\Delta log(x_{4t-1}) + c(67)\Delta log(x_{4t-2}) + c(68)\Delta log(x_{5t-1}) + c(69)\Delta log(x_{5t-2}) + c(70)$$

The values of coefficients, standard error, t statistic and probability are arranged in the Table11.

Table 11: System equation-5

	coefficients	stadard error	t statistic	probability
c(57)	0.009464	0.002677	3.535668	0.0004
c(58)	–0.011145	0.012127	–0.919011	0.3585
c(59)	0.005001	0.012134	0.412158	0.6804
c(60)	0.016951	0.014084	1.203557	0.2293
c(61)	–0.019162	0.014073	–1.361618	0.1739
c(62)	0.001886	0.007923	0.238034	0.8120
c(63)	0.001884	0.007812	–0.151602	0.8796
c(64)	0.002126	0.007926	0.268195	0.7887
c(65)	–0.011821	0.007933	–1.490156	0.1368
c(66)	–0.115137	0.045518	–2.529499	0.0117
c(67)	–0.057478	0.044975	–1.277980	0.2019
c(68)	–0.006382	0.001770	–3.605764	0.0003
c(69)	–0.004778	0.001582	–3.020328	0.0027
c(70)	0.002155	0.003390	0.635581	0.5253

R^2=0.066562, F=2.720676 , SC=-2.887674 , AIC=-3.003912, *=significant at 5% level*

The co-integrating equation-4 is found as:

$\Delta\log x_{4t}=0.009464\log y_{t-1}-0.1872\log x_{1t-1}-0.9746\log x_{2t-1}-0.2423\log x_{3t-1}-2.027\log x_{4t-1}+0.633\log x_{5t-1}+10.249$

Here, C(57) is positive (0.009464) but significant (t=3.535668), so there are no long run causalities running from x_1,x_2,x_3,x_5 and y to x_4 respectively. Thus the system does not move to equilibrium but its divergence is significant.

If c(58)=c(59)=0, then the Chi-square (2) = 1.6447 (p=0.4394) which is accepted as no causality, i.e. there is no short run causality from food grain production to cropping intensity. If c(60)= c(61)=0, then the Chi-square(2)=5.10912(p=0.077),i.e. there is no short run causality from SDP to cropping intensity. If c(62)=c(63)=0,then the Chi-square(2)=0.1411(p=0.931),i.e. there is no short run causality from net irrigated area to cropping intensity. Now, if c(64)=c(65)=0,then the Chi-square(2)=2.4216 (p=0.298),i.e., there is no short run causality from NPK consumption to cropping intensity.

Now it was found that there is short run causality running from state fiscal deficit to cropping intensity because the Wald test confirmed that the χ^2 (2)=15.04988 whose probability is 0.00 and F(2,496)= 7.524939 whose probability is 0.00 so that null hypothesis of no short run causality is rejected assuming c(68)=c(69)=0.In a similar way, it was found that there are no short run causalities running from food grain production, SDP, net irrigated area, NPK consumption to cropping intensity.

Lastly, the residual test for normality suggested that Jarque-Bera is found as 12285.87 whose probability=0.00, therefore, it is not normally distributed. And residual cross section dependence test with null hypothesis of no cross section dependence (correlation) in residuals showed that Breusch –Pagan LM, Pesaran scaled LM and Pesaran CD statistic are 361.2106, 1.478294, 0.638147 whose probabilities are 0.000 , 0.1393 and 0.5234 respectively (df=300) which means that there is cross section dependence in $\Delta\log x_{4t}$ In the Figure 3 of the impulse response function, the long and short causalities from y,x_1,x_2,x_3 and x_5 to x_4 have been shown in the figures of the 5th row.

Therefore, the paper proved that there are four co-integrating equations where $\Delta\log y_t$ and $\Delta\log x_{1t}$ have long run causalities and they are moving towards equilibrium with slow speed but $\Delta\log x_{2t}$ and $\Delta\log x_{4t}$ do not move to equilibrium level because they have no long run causalities with the independent variables. On the other hand, there are short run causalities running from state fiscal deficit to SDP and cropping intensity only but other variables do not show any short run causality.

Limitations and future scope of research

There are several limitations of this model because author does not include environmental variables, agricultural credits of each state, labor employed in the production, and other infrastructural factors which could affect food grain production. The model could use political and social factors, educational level and foreign direct investment as dummy variables to explain variation of food grain production. State intervention might be judged through SDP and fiscal deficit of the states. Therefore, the model has enough scope for extending its independent or dummy variables to explain further in the offing. The paper does not include other two co-integrating equations along with their estimated VECM equations. It is left for further research. Even, the Kao (1999) and the Pedroni(1999) models for panel cointegration test were not computed to compare the results with Fisher-Johansen cointegration model.

Suggested policies

For rice production in India, several improved land and crop management practices and reducing environmental impacts, including more efficient irrigation, direct seeding, improved fertilization and effective weed control can raise yields. Several reduced tillage management options to help conserve soils in Indian rice-wheat cropping systems have been developed and are increasingly used while the rising costs of irrigation are already driving shifts from irrigated rice towards other more water-efficient food crops.

Improved water management including proper soil preparation, crop selection and timing of planting to reduce runoff and utilize available water resources even in the absence of the irrigation are important policies for implementation. Efforts to overcome water constraints on crop production in smallholder systems include irrigation and other water management practices, and the use of diverse and drought resistant varieties, are required (Pretty et al, 2006).

Improved soil management, promoting the use of crop rotations, intercropping with leguminous species, may reduce tillage and incorporate agricultural residues. Minimal tillage and the retention of crop residues in particular can often reduce soil erosion, reduce GHGs and support soil fertility, and may raise yields (Hobbs et al, 2008).

Improved pest (including disease and weed) management through integrated pest management (IPM), relying primarily on interventions supporting crop health and discouraging pest outbreaks have seen growing effectiveness and acceptance among farmers(Khan et al,2011).

Good practices to manage environmental impacts, intercropping and the incorporation of crop residues into soils after harvest to maintain soil fertility, using of clean planting material to manage viral diseases , better storage of roots in the soil, improved harvest and storage practices and improved processing methods are especially useful to reduce post-harvest losses with cassava(Legg et al,2014).

Food Crop Act, Land use Act, Intensive Schemes for paddy, cotton and oilseed should bring sharply into focus the possibility of changing crop pattern in India. The revamp of National Food Security Mission, Monitoring and Evaluation of all projects at national level, reform funding patterns, bringing green revolution to Eastern India and more emphasis on diversification programmes are the key policy issues in India to grow more food grain production.

On the macro variables concerned, reduction of state fiscal deficit, convergence of SDP in agriculture, stability in the wholesale price index of agricultural commodities, increase in crop loan and insurance ,agricultural credit and minimum support prices should be given prior importance. A greater infrastructure in agriculture might boost agricultural production which will enhance the share of agriculture in state domestic product.

Conclusion

The paper concludes that one per cent increase in SDP at current prices, net irrigated area, NPK used, cropping intensity, state fiscal deficit and state gross capital formation per year led to 0.177 %, 0.7066%, 0.0578% and 1.5099%, increase in food grain production per year respectively and decrease of 0.0599% and 0.0159% food grain production per year from 1990-91 to 2015-16 in 27 Indian states in fixed effect panel regression model. Johansen-Fisher panel cointegration test confirmed that Max Eigen statistic contains three co-integrating equations in and Trace statistic contains four cointegrating equations. It means that there is significant long run association with food grain production of Indian states from state net irrigated area, utilization of fertilizers of the states, cropping intensity of the states during 1990-91-2015-16.VECM is stable, non-normal distribution and non-stationary having problem of autocorrelation. In co-integrating equations change of food grain production and change of SDP have long run causality and they are moving towards equilibrium with slow speed of adjustment but change of net irrigated area and change of cropping intensity do not move to equilibrium level because they have no long run causalities with the independent variables. On the other hand, there are short run causalities running from state fiscal deficit to SDP and cropping intensity only but the rest of the variables do not show any short run causality.

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Evaluation of Biological Agents in Warfare

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Abstract

Biological weapon had been used by Assyrians to poisoned their enemy in 6th century B.C., in 1346 Mongol warriors of the Golden Horde died of plague and their bodies were thrown over the walls of Crimean city Kaffa, resulting in the killing of estimated 25 million Europeans, The British Army used small pox against native Americans during the siege of Fort Pitt in 1763, resulting in the killing of estimated one hundred native Americans in Ohio country in 1764, during the world war 1 imperial German government used anthrax and glanders and became encourage to produce biological weapon because of its advancement through bacteriology and germ theory in 1900, as germ warfare, is produced by biological toxins or infectious agents like bacteria, viruses, fungi(living organisms) and perhaps lethal or non-lethal etc. who are universally recognized as dead but reproduces by making of biological weapons to kill humans, animals, plants or to devastates entire universe, effects of biological war is similar to nuclear war, it can wipeout an entire community or an entire civilization from the universe, attack by insects over enemies is called entomological warfare, entomological weapon is recognized as biological weapon, biological weapon, chemical weapon and nuclear weapon are different kinds but they are not conventional warfare, the war is for universal devastation, biological weapon uses for strategic advantage over enemy either by threat or deployment, also known as area denial weapon, it can be deployed, stockpiled, or developed by individual, terrorist or a nation state over their enemy. As a student and a researcher of the area in international development and international affairs, I always would like to explore areas which can be useful for the knowledge and information and can be a message to the world for its security, I am interested to pursue my PhD in the areas of international development and writing articles is a part of my preparedness for my higher studies.

Keywords: *State Sponsored Terrorism, Bio germ, Erosion of Genetic Diversity, Hague Convention, Geneva Convention, Bioweapon, Biodiversity, Endangered Species, Bioterrorism, Indigenous Culture.*

Introduction

The threat of biological warfare by using germs is a particular challenge to all countries and its authorized representative, devises long term emergency response plan, RAND has developed training and exercises for health agencies to tackle and respond bioterrorism, create guidelines to improve individual preparedness for chemical, radiological, nuclear and biological attacks by other countries, terrorist organization, it has experimented about the consequences of psychological effects of bioterrorism over entire society, human being, the abilities of producing and using chemical and biological weapons by North Korea is a threat, therefore what can we do for the mitigation of this threat? any conflict between South and North Korea could lead the use of biological weapons, so it is a concern to think about, think about Syria's program of biological weapons, they could be threat for the USA directly or indirectly through various terrorist organizations, various technological advancement has been discovered such as Crispr, a biotechnology makes genetic editing easier, cheaper and accessible but is there any guarantee that advancement of biotechnology can stop biological, chemical war and make the conventional charts obsolete?

Literature Review

The history of the development, production and use of biological weapons is large, it had seen in ancient empire warfare, in first world war and in second world war, even today it is secretly developing, and producing by

few countries, various agreements, conventions held in the past and in present but the outcome is zero, the declaration of elimination of bio, chemical weapon has not been succeed, powerful countries are making for the status of power, terrorist organizations are getting together morally supported by few countries for the use of bioterrorism, steps has taken to tackle any incidents but the question is how prepared we are to survive from a biological war? It can happen any moment without any clue or identification because of its environmental characters. Therefore, steps need to be taken for the survival of human and the animal world and its ancient, traditional culture as it's positive signs, but negligence by the official representative(government) can lead the devastation of entire human being include its traditional culture.

Methodology

I follow books, articles, newspapers, web links, collect information's from those sources, I make a draft and edited it various times by adding, deleting information, thus I understand the topic, gain knowledge, and make a final report on it and I follow the criteria of citation at the end.

Result and Discussion

Biological warfare is also familiar as germ warfare, is produced by biological toxins or infectious agents like bacteria, viruses, fungi(living organisms) and perhaps lethal or non-lethal etc. who are universally recognized as dead but reproduces by making of biological weapons to kill humans, animals, plants or to devastates entire universe, effects of biological war is similar to nuclear war, it can wipeout an entire community or an entire civilization from the universe, attack by insects over enemies is called entomological warfare, entomological weapon is recognized as biological weapon, biological weapon, chemical weapon and nuclear weapon are different kinds but they are not conventional warfare, the war is for universal devastation, biological weapon uses for strategic advantage over enemy either by threat or deployment, also known as area denial weapon, it can be deployed, stockpiled, or developed by individual, terrorist or a nation state over their enemy but if it uses with no notice over enemy than it recognizes as bioterrorism over the country or group or individual who uses it, use of biological weapon or chemical weapon is the violation of international laws such as; customary international humanitarian law, and international treaties, therefore use of biological weapon in arm conflict is war crime, offensive biological weapons such as; stockpiling, production, and its use over anyone have been outlawed by the convention of biological weapons in 1972 where 170 countries participated due to its importance and to prevent from any kind of biological warfare, it is more dangerous than nuclear weapon because of its effectiveness, it takes days to be effective after using and as a result immediately it cannot be stooped, living organisms like plague, smallpox, have ability to transmit person to person and over entire population, it can be effective even over friendly forces, it remains a significant concern for the military and civilian population of all nations, biological weapon had been used by Assyrians to poisoned their enemy in 6th century B.C., in 1346 Mongol warriors of the Golden Horde died of plague and their bodies were thrown over the walls of Crimean city Kaffa, resulting in the killing of estimated 25 million Europeans, The British Army used small pox against native Americans during the siege of Fort Pitt in 1763, resulting in the killing of estimated one hundred native Americans in Ohio country in 1764, during the world war 1 imperial German government used anthrax and glanders and became encourage to produce biological weapon because of its advancement through bacteriology and germ theory in 1900, by the Hague convention in 1907 production, development and uses of biological and chemical weapons has been condemned and was showed respect on the laws and customs of the war on land, however the Geneva protocol of 1925, banned the use of asphyxiating, poisonous or other gases, as chemical weapons, as well as the use of bacteriological methods of warfare but it did not actually prohibit the production, development and the stockpiling of bio and chemical weapon, a complete ban were made in the 1930s in the framework of the League of Nations, but there was no success, provision of biological and chemical weapon agenda appeared of the Eighteen-Nation Committee on disarmament in Geneva, called the conference on disarmament in 1968, a year later, the United Nations published an influential report on the problems of chemical and biological warfare, and the question received special attention at the UN General Assembly, UN report concluded that certain chemical and biological weapons cannot be confined in their effects in space and time and might have grave and irreversible consequences for humans and nature and this would apply to both the attacking and the attacked nations, at the end of 1960s, the Biological Weapons and Toxin Convention was signed in 1972 and entered into force in 1975, history of these weapons production did not have good rapport, Britain in world war 2nd made a laboratory for the advancement of biological weapons and weaponized itself though Britain never used but thus it produced agents like anthrax, tularemia, botulism etc. for industrial production, following the UK, Japan and France also started their biological weapon program, biological weapon is an appeal to the terrorist for its easy

production as a common technology, difficult to detect and easy for them to escape, because biological weapons through food, poison, bacteria and through different species has incubation for three to seven days, after that they start to work and in the meantime terrorist's gets enough time to lead, CNN's report on Al-Qaida's biological weapon experiment was dangerous, they reported that the terrorist organization started to produce loose association of cells for cyanide and ricin attack, it has been argued that biological agents can be controlled and can be declared an offensive war by the rational state against any country, but attacking through small pox can be controlled, it can be worldwide affects including users country, however agent like bacteria can be controlled, anthrax can be controlled easily and can be created in a garden shed, biological agents can be used against human such as over civilian and military, bacillus anthrax is very effective because of its various forms such as; it can be started through ordinary influenza like symptoms to a lethal hemorrhagic mediastinitis within three to seven days with a fatality rate approximately 90% or over on untreated patients, bacteria like bacillus anthracis, brucella spp, burkholderia mallei, burkholderia, pseudomallei , chlamydophila psittaci, coxiella burnetii, francisella tularensis, some of the rickettsiaceae, shigella *spp.*, vibrio cholerae, and Yersinia pestis are considered for biological weapons or have been weaponized, viral agents like bunyaviridae (rift valley fever virus), Ebolavirus, many of the flaviviridae (Japanese encephalitis virus), machupo virus, Marburg virus, variola virus, and Yellow fever virus have been weaponized or considered to be biological weapons, Toxins can be used as weapons or have been weaponized including ricin, staphylococcal, enterotoxin B, botulinum toxin, saxitoxin, and several mycotoxins. These toxins and the organisms are sometimes referred to as select agents. In the United States, their possession, use, and transfer are regulated by the Centers for Disease Control and Prevention's Select Agent Program, the USA during cold war invented a anti-crop capability that could harm plantation, plant disease like bioherbicides or mycoherbicides had been discovered for the destruction of enemies agriculture and it was one of argument that because of anti-agricultural agents Sino-Soviet conflict did not turn into a general war, disease like wheat blasts and rice blasts had been weaponized in aerial spray tanks and cluster bombs for delivery to enemies watershed in agriculture regions to initiate ephiphytotics, US offensive biological warfare was based on its vast arsenals of plant disease during 1969-70's, during the world war second herbicidal warfare program had been used on Malaya, Vietnam in counterinsurgency operation which had been discovered by the USA and Britain for plant growth regulator, in 1980 Soviet Ministry of Agriculture discovered variants of foot and mouth disease and rinderpest against cow, African swine fever for pigs, and psittacosis to kill chicken. These agents were prepared to spray from tanks attached to airplanes over hundreds of miles, code name ecology, during the Mau Uprising in 1952, the poisonous latex of the African milk bush was used to kill cattle, entomological warfare is another biological warfare used by insects over enemy, Japan used insects as their biological weapons over enemies, plague is this kind of biological agent, it can be used in varieties such as infecting insects with a germ and then dispersing insects over target area, insects then act as vector by biting enemies and thus infection persons, another form is to direct attack against corps, and the another one is to attack on enemies by bees, wasps and so on, these are ways of modern biological warfare, disease like canine distemper on the North American black footed ferret, Caspian seal, and the African wild dogs were outbreak dangerously, canine distemper is dog viral disease can be spread into wildlife population with the results on susceptible species of wild carnivores and this dog disease was cultured and tested in biological weapon laboratories, it was last seen among the wild population of the North American black-footed ferret and the African wild dog population of the Serengeti National Park in Tanzania, as a result other animals of the region were threatened by the spillover infections of canine distemper and rabies from domestic dog populations and one third of the Serengeti's resident lion died because of this viral disease, those viral animal diseases like monkey pox, marburg fever, plagues were spread into animals including human world especially during wartimes emergencies such as breakdown in medical and veterinary support system, civil conflicts etc., during the civil war in Southern Rhodesia(Zimbabwe) viral biological agents like anthrax, rabies were spread among wild animals and domestic animals in that country, in 2000 and 2001 estimated 1000 documented human cases were discovered and 11 of them were dead due to anthrax viral disease, there was very little evidence of bio weaponizations against human in Zimbabwe because of various rival conflicts among communities, but it was not sufficient proof for allegations, the country was always facing lacking of food, lacking sustainability, as a result villagers took risk for food or sale of meat by butchering diseased cattle, and hides, causing human death. The meeting of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological and Toxin Weapons and Their Destruction in Geneva, Switzerland held in 2010 to prevent and minimize the consequences of natural outbreaks of dangerous infectious diseases as well as the threat of alleged use of biological weapons against BTWC

state parties(The Bacterial and Toxin Weapons Convention, in March 1975 was the first multilateral disarmament treaty banning an entire category of weapons of mass destruction by the efforts of 22 countries leaders, declaration of the convention is about four pages long, bans the development, production stockpiling, or acquisition of biological agents or toxins of any type or quantity that do not have protective, medical, or other peaceful purposes, or any weapons or means of delivery for such agents or toxins. Under the treaty, all such materiel is to be destroyed within nine months of the treaty's entry into force. The BTWC currently has 163 states parties and 110 signatories), 60 day course of prophylactic antibiotic treatment for individuals had exposed to low doses of anthrax, data is available to local public health officials in real time, most models of anthrax epidemics indicate that more than 80% of an exposed population can receive antibiotic treatment before becoming symptomatic, and thus avoid the moderately high mortality of the disease, because of biological weapons threat in our modern time since the past, biodefence system has been discovered for its analysis and immediate identification of encountered suspect materials, USA's Lawrence Livermore National Laboratory (LLNL), employs a sandwich immunoassay, in which fluorescent dye-labeled antibodies aimed at specific pathogens are attached to silver and gold nanowires. In the Netherlands the company TNO has designed Bioaerosol Single Particle Recognition eQuipment (BiosparQ), a system that would be implemented into the national response plan for bioweapon attacks in the Netherlands, researchers at Ben Gurion University, Israel, are developing a different device called the Biopen, essentially a Lab-in-a-Pen, which can detect known biological agents in under 20 minutes using an adaptation of the ELISA, a similar widely employed immunological technique, that in this case incorporates fiber optics, in 2013 a total of 180 countries had signed the Biological Weapons Conventions as updated and fresh convention, Taiwan is also among the states to sign the treaty, they all promised again by signing that they will not develop or produce, stockpile any kind of germs, agent, nerve gas as biological weapons, however few countries have capability to produce and they keep continue as their countries interest, there are five different types of agents that could be weaponized and used in warfare or for terrorism; such as bacteria which is single-cell organism cause diseases such as anthrax, brucellosis, tularemia, and plaque, rickettsiae, microorganisms, that resemble bacteria but differ in that they are intracellular parasites reproduce inside cells, Typhus and Q fever are examples of diseases caused by rickettsia organisms, viruses which is intracellular parasites, that can be weaponized to cause diseases such as Venezuelan equine encephalitis, fungi, which is pathogens that can be weaponized for use against crops to cause such diseases as rice blast, cereal rust, wheat smut, and potato blight, toxins, which is poisons that can be weaponized after extraction from snakes, insects, spiders, marine organisms, plants, bacteria, fungi, and animals, an example of a toxin is ricin, which is derived from the seed of the castor bean. According to the Centre's for Disease Control and Prevention bioterrorism is an intentional production of viruses, bacteria and other germs that can be used for the destruction of human being intentionally through aerosol spray, in explosive devices, injected into skin (North Korean leader is famous for the use of biological agent through injected into skin, he thus killed his step brother at the airport), bacteria like bacillus anthracis is the most affected germ to be used in a bioterrorism attack causes anthrax which is deadly infection in people and animals, easily found in nature and survives for a long time in environment, it can be released in powders, sprays, water or through food etc. because of its versatile character, in 2011 anthrax spores were sent through the US postal system, 22 people were affected and 5 among them were dead, nobody was able to caught the guilty party, it has been classified by the US Center for Disease Control as Category A agent, posing a significant risk for national security, variola major(smallpox) is another potential germ to be used in a bioterrorism attack, it spreads from person to person but due to the invention of medicine and successful launch of immunization program by the UN, the threat of using smallpox as biological weapon has decreased against human being, it was believed that small pox have been used as a biological weapon against Native Americans and in American Revolutionary War, pneumonic plague is another kind of germ can be used as biological weapon, which develops rapidly and does not respond well to antibiotics, on the other side bubonic plague is not that dangerous because of its treatment through antibiotics, cholera is another germ to be used as biological weapon added to a major water source, vibrio cholera had been weaponized by the United States, Japan, South Africa, Iraq etc. tularemia, especially francisella tularensis can be another biological weapon cases fever, swelling of lymph, glands, pneumonia, fever, cough, vomiting, diarrhoea etc. it can cause infection by entering through breaks in the skin or by breathing into the lings, Japanese studied about this bacterium and the United States stockpiled it, Dr. Kenneth Alibek a former scientist involved in USSR biological weapons program to develop tularensis agent for the red army against German troops in the battle of Stalingrad during the world war 2nd, according to the Johns Hopkins Center for Public Health Preparedness aerosol dissemination of f.tularensis in populated area

would be acute, without specification, febrile illness after few days of infection, it can be deadly without antibiotic treatment, ebola virus disease is deadly induced by infection first discovered in Congo in 1976 transmitted to human from the animal causing fatality rate estimated 50 percent, it is dangerous to use as biological weapon because of high fatality rate, it was a suspense that the former USSR produced ebola as a biological weapon under a five year plan implemented between 1986 and 1990, however there is no evidence of it being used, marburg haemorrahagic fever comes from marburg virus of the filovirus family, includes the ebola virus, it is a category A virus by the CDC's, former USSR conducted experiment of marburg virus in aerosol form and to transform it into a biological weapon as their strategic weapon against NATO, they preferred to produce marburg virus for q fever because of estimated 90 percent fatality rate, aflatoxin, a group of harmful metabolites produced by strains of fungi for cell or organ death, liver disease, according to the United Nations Special Commission(UNSCOM) Iraq produced and deployed different munitions with aflatoxin during gulf war, there are some others germs like monkeypox (found in Africa, was identified in 1970, it can be weaponized, pneumonia due to monkeypox may cause death) arbiviral encephalitides(members of the alphavirus genus, associated with encephalitis, came from horses first, it has high fatality rate, can be occurred from mosquito bite, it can spread through air) viral hemorrhagic fevers, staphylococcal enterotoxin B, bunya virus, mycotoxins, typhus and many viruses and bacteria can be uses as biological weapons, a biological agents are going to be more dangerous because of the invention of gene editing technology(CRISPR) which helps scientists to easily modifying DNA sequences to alter gene function, it has good and bad side, it helps to correct genetic defects but it has the potential for terrorists organizations or for dictators of the globe, editing of human germline could be harmful which is possible by this technology and might create genetic changes. From the period of 1990-95, the AUM Shinrikyo sect used both biological weapons and chemical weapons on target in Japan, attempted four attacks using anthrax and six using botulinum toxin on various targets including US naval base at Yokosuka, however they were not the master of biological weapons technology and attempts were mostly unsuccessful, Al-Qaeda operated an anthrax laboratory in Afghanistan prior to overrun by the US and Afghan Northern alliance forces in 2001-02, anthrax-laden letters were sent to politicians and prominent individuals in America, few of them were killed and mostly were sent to the hospital while forcing the evacuation of congressional office buildings, the offices of Governor of New York, newspaper offices, and several television network headquarters etc. a report had been publishing by the FBI saying that, letters were sent by a microbiologist who had worked in the US army, he committed suicide after being named a suspect in the report and investigation, though it was not proved, during the cold war followed by world war 2nd both Russia and the United States and their ally countries were preparing to develop and research on biological weapons, though United States and allies obeyed and complied the law and the rules of the biological weapons convention in 1972 and its treaty in 1975 but Russia and its allies did not comply and produced biological weapons, former Soviet Union developed a program in 1980 to produce smallpox in large quantities stored in refrigerated tanks to using as biological weapon agent, it was easy for them due to the lack of checking by the international committee of biological weapons verification, after the collapse of Soviet Union, then President Boris Yeltsin confirmed that Russia violated the convention law(Biological Convention Law) and declared to terminate their weapons program, The United States and Russia agreed to work together to contain the spread of biological warfare capabilities and find out ways to stop transferring those weapons to rebel or terrorist groups outside the border of the former USSR, civilian jobs were created by the financing of the US for estimated 60,000 scientists who worked for Soviet biological weapons program, according to the book of the historian of University of Western Ontario, Donald Avery, Canadian Government had secret role to develop biological weapons since world war 2nd , Canadian scientists worked with both the British and Americans to develop anthrax for the use of bio-weapon against Germany and Japan, according to the historian, Canada's first biological weapons lab on Grosse Ile near Quebec city closed at the end of the world war 2nd but during the cold war bio-weapons research center was at the Suffield military base in Alberta, Canada was working with Americans for the project called Project 112, testing weapon in Alaska and Alberta and spraying simulated biological weaponry in North American cities, including Winnipeg, however it had been denied by the Canadian Government that Canada was involved to develop, produce biological weapons with British and the Americans, however, Canada by obeying all international convention against biological weapons implements the biological and toxin weapons convention through a series of laws over biosafety, biosecurity, nonproliferation and the control of biological materials, the most important Canadian law for the protection against biological weapon is the Human Pathogens and Toxins Act., run by the Public Health Agency of Canada Centre for biosecurity, Canada is sharing data about Canadian laboratories, research into biological weapons defense conducted by the government

and military, capacity to develop vaccines to the international agency of confidence building measure for her respect and compliance over international treaties, there were various conference held to protect the world and to stop producing biological weapons since the first Biological Weapons Convention(BWC) on 10th April 1972 and its enforcement on 26th March 1975, the second review convention in 1986 agreed that all the states parties were to implement a number of confidential building measures(CBM's), confidential building measures were expanded through the third review conference in 1991, then in 1996 as the fourth conference, then in 2001 as the fifth conference and in 2006 as its sixth conference, seventh conference was in December, 2011 where 103 state parties to the convention were participates, working for peace, rights and well-being, a motto implemented by the UN for the elimination of all biological and chemical weapons, threat of biological weapon is more broader, and reality than nuclear weapon because of its deadly and cheap development, 1 gram toxin can kill 10 million people, purified form of botulinum toxin is estimated 3 million times more potent than Sarin, a chemical nerve germ, a SCUD missile filled with botulinum toxin could affect an area of estimated 3700 square kilometer, an area 16 times greater than could be affected with Sarin, missiles production is expensive and when they fly, become hot, so it has to be fitted with cooling system, on the other side biological agents are killed and easy to produce and use for others, a nation with advanced pharmaceutical and medical industry basically can produce large numbers of biological weapons, conventional weapon explode once and then finished , but with a few particles of Hanta virus many thousands of people could become carriers that infect thousands more people, this is the difference between biological weapon and conventional or nuclear weapon, a seed culture of anthrax bacteria could be grown to mass quantities in around 90-96 hours, and the level of technology needed to do this kind of work is also much lower when compared to Nuclear weapons, techniques are mostly used can be found in text book and journal and available in the courses of college and universities, while nuclear weapons material is not that easy to access. The first recorded use of biological agents is the Romans using dead animals to foul the enemies' water supply. This had the dual effects of decreasing enemy numbers and lowering morale, history of biological weapons production and its use against enemies has various examples worldwide; 1346-1347, Mongols catapult corpses contaminated with plague over the walls into Kaffa (Crimea), forcing besieged genoans to flee causing of the epidemic of plague that swept across medieval Europe killing nearly 25 million, in 1710 Russian troops used plague-infected corpses against Swedes, 1767 during the French and Indian Wars, the British give blankets used to wrap British smallpox victims to hostile Indian tribes and they killed due to this unknown disease, Canadian aboriginals in earlier years died due to unknown diseases came from British traders, in 1916-1918, German agents used anthrax and the equine disease glanders to infect livestock and feed for export to Allied forces, incidents include the infection of Romanian sheep with anthrax and glanders for export to Russia, Argentinian mules with anthrax for export to Allied troops, and American horses and feed with glanders for export to France, in 1937, Japan begins its offensive biological weapons program though their unit 731, the BW research and development unit, located in Harbin, Manchuria, during developments and experimental programs estimated 10,000 prisoners were killed in Japanese, in 1939, nomonhan incident, Japanese poison in Soviet water supply with intestinal typhoid bacteria at former Mongolian border, it was the first use of biological weapons by Japanese, in 1940, Japanese dropped rice and wheat mixed with plague which carrying fleas over China and Manchuria, in 1942, USA begins its offensive biological weapons program and chooses Camp Detrick, Frederick, Maryland as its research and development site, in 1945 Germany was the tactical user of biological weapons, large reservoir in Bohemia is poisoned with sewage, in 1951, in a test of BW dispersal methods, biological simulants are sprayed over San Francisco, USA, in 1966 United States conducted a vulnerable test to covert biological weapon attack by releasing a harmless biological stimulant into New York city subway system, in 1969, President Richard Nixon of the United States announced unilateral dismantlement of the U.S. offensive BW program and concerned on Soviet biological program as well, in 1970, President Nixon extends the dismantlement efforts to toxins, closing a loophole which might have allowed for their production, in 1978 Bulgarian exile Georgi Markov was stabbed with an umbrella injected with a tiny pellet containing ricin, a highly toxic, natural protein, it was an association by then Soviet Union because of his spying against Soviet, from 1965 to 1991 then President Saddam Hussein of Iraq developed offensive biological weapon ability which included anthrax, botulium, toxin and aflatoxin, as current example, Sergei and Yulia Skripal, father and daughter were found semi-conscious on a public bench near a shopping center in a small English town of Salisbury on Sunday, March 4, 2018 and were transported to a hospital, after investigation by British investigators, it was declared by the British Government that Skripals and Bailey were attacked with novichok, a chemical agent developed by then Soviet Union in the 1970's-80's, After the breakup of the Soviet Union, Vil Mirzayanov, a chemist who helped develop the agent,

said that Soviet laboratories had developed enough of the substance to kill several hundred thousand people, prevention, protection, detection, treatment, and decontamination are few technical method to prevent such warfare, prevention method can be through preventive action by the international inspection regime to deter the production and dissimilation of biological agents, protection through protective suits, clothing, gas masks and filters may provide limited protection for short periods of time, but the persistence of biological agents such as anthrax makes such protections mainly useful for military personnel and first responders, Anthrax can remain active and potentially lethal for at least 40 years, anthrax is an exception than other agents because of longer living germ, it can be an establishment and maintenance of a good health care system due to biological threat, vaccination is a form of protection, which may provide substantial protection against naturally occurring agents, though vaccines often provide limited or no protection against genetically engineered variants designed to defeat such vaccines, so protection has limitation of such biological weapon warfare(Ebola in 2014 as the recent incident broke entire West Africa from the epicenter of Congo, showed the world how weak our health care system, how helpless we are and how's are preparation against biological germs, however many countries took steps to improve global health security in order to monitor and respond to disease threats, but there is more work to do for enough protection of human development in health care), dictation against bio weapon is to detect it, and its source, though it takes few hours to days but the advancement of biotechnology will help to reduces time for detection and more reliable, USA and its allied force against Iraq during gulf war were suffered because of the lack of detection, detectors like SMART (Sensitive Membrane Antigen Rapid Test), JBPDS (Joint Biological Point Detection System), BIDS (Biological Integrated Detection System), IBAD (Interim Biological Agent Detector)are available for such modern warfare, treatment options after infection depend on whether or not the infectious agent is identified, If not identified, massive doses of antibiotics may be given in hopes that something may work for the survival, this is why in a biological warfare arena health care system must need to improved and maintained well, decontamination is another method from the survival of germ weapon, it can be through using chemicals, hit, UV rays etc. it can work against anthrax agents which can alive or active estimates forty years, biological and chemical, there are few countries plus Taiwan have had or are currently suspected of having biological weapons programs, they are Canada, China, Cuba, France, Germany, Iran, Iraq, Israel, Japan, Libya, North Korea, Russia, South Africa, Syria, the United Kingdom, the United States, India, Pakistan, Kazakhstan, Egypt, Sweden, Norway are suspecting to have their secret biological program in today's scenario, though they are all member of the biological and toxin weapon convention, but there is no way to know about the truth, therefore international committee, organizations and world bodies for inquiries are not that influential in reality, there are few terrorist organizations including Al Qaeda network are also believed to have financial resources and political influences, contact to have access biological weapons production, developmental practices and nurtured its culture, it is believed that the sophisticated bioweapons facilities and arsenals is the range of estimated $10,000 to $100,000, an amount which could be easily affordable by those terrorist organizations like Hamas, Al-Qaeda, Hezbollah, Hijbul-Mujahidin, Lashkar-E-Taiba and many more global terrorist organizations, country like Libya, Syria, North Korea, Iran are suspecting to have their own state sponsored biological weapons program even today which endangers the entire world because of their direct or indirect relations or supportive relations with global terrorist organizations for economic reasons, and to spread terror globally, biological weapons cultures, diseased animals, infectious materials can be easily introduced into international cargo transportation networks for shipment to the USA with no risk of identification, it can be easily acts in developing countries due to improper handling containment of production and their storage facilities, deployments of affected agents in transit etc.

Conclusion

Biological weapon, chemical weapon is more dangerous and affective than nuclear or thermonuclear weapon and difficult to identify because of its long time and slowly reactions, it has history from generation to generation to use against animals, crops, human being, it seems little possibility to prevent such attack on animal world, it can be easily used or can be easily spread in entire world for the destruction of civilization because of available and easier access of technology from the text books in school, the United Sates must strengthen its capacity for early detection of diseased animals, and sources that can be caused for biological germ threat or can be used as weapon, and thus increases the ability and availability of control technologies and containment facilities, collaboration between scientists and policy makers of the country must be built for the building of more developed structures that can protect as much

as possible from the impact of spillover of agricultural bioweapons on ecosystem and nonagricultural system of national economies, these initiatives must be built in every country in the world or more assistance program from the developed countries to developing countries for their protection against bio germs or weapon, world population is growing but the invention of technologies are not inventing much to tackle well of those threat, state sponsored terrorism against enemy country, organized crime by powerful countries, terrorist organizations are the stakeholders for various threats and they have to decide whether they would like peace or not, it is very important to improve mechanism for the integration and intergovernmental cooperation, communication, networking and collaboration to combat and control those bioagents, more medicines, vaccination, purification of water, environmental concern need to increase and discover, public health and system need to be more modernized, importance of food security has to be prioritized, otherwise containment of biological germs disease will spread, threat of weaponization will increase and developed secretly, result in the erosion of genetic diversity in the animal world, indigenous people and thus the total destruction of human livelihood and the cultural civilization.

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Measuring the Social and Political Diversity and their Impact on Income Inequality

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Abstract

This paper studies the impact of social diversity and political structure on the income inequality of an economy. Paper studies the various measurements of political and social diversity by forming the indices for political coalition and social diversity. Effective number of political party index is constructed by forming the HHI (Herfindahl-Hirchman Index). Effective number of party shows the degree of government coalition. Fractionalization and polarization indices are constructed to measurethe social diversity and polarization. This paper discusses the impact of growth of various sectors on income inequality. Gini coefficient is used to measure the income inequality. Finally, Prais-Winsten method of regression is used to find the impact of social and political diversity and economic growth on income inequality. It is found that social diversity has a statistically significant positive impact on income inequality in short run while in long run it is negative. Social polarization has a negative impact on inequality but it is in short run, in long run, this impact is positive. Effective numbers of parties has short run negative significant impact on income inequality. The value added in agricultural sector, industrial sector and service sector are also important factors which influence the income inequality.

JEL Classification: O11; Z12; O53; D72; D63; R11

Keywords: *Effective Number of Political Parties, Social Diversity, Polarization index, Fractionalization index, Gini Coefficient.*

Introduction

India is considered as the rapidly growing economy. This mixed economy has vast culture with different type of languages, races and ethnicities. With cultural diversity, India is a world's largest democracy with various ideologies and political parties. In short, India is a place where there is a coexistence of social and political diversity.

Social and political diversity can affect the income inequality directly and indirectly. Political and social diversity affect the inequality directly through the endowments and indirectly by affecting the growth and per capita GDP. Political system and social polarization is important as far fairness of the economy and society is concerned. Political system and institutions are important as far as social conflicts are concerned (Montalvo, J. G., &Reynal-Querol, M., (2005)). Authors express concern about high levels of corruption due to diversity.

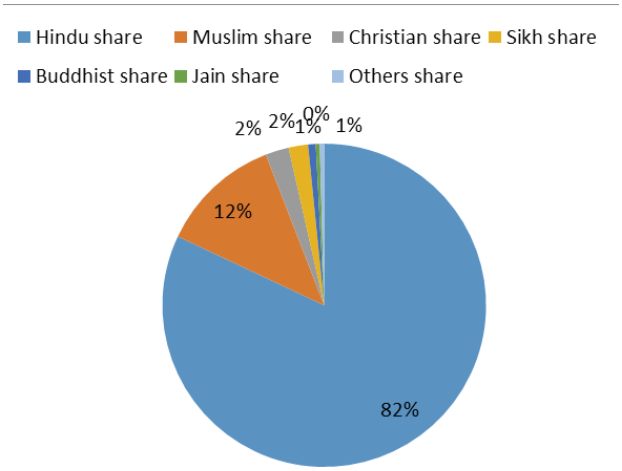

Figure 1: Population division-1991 census

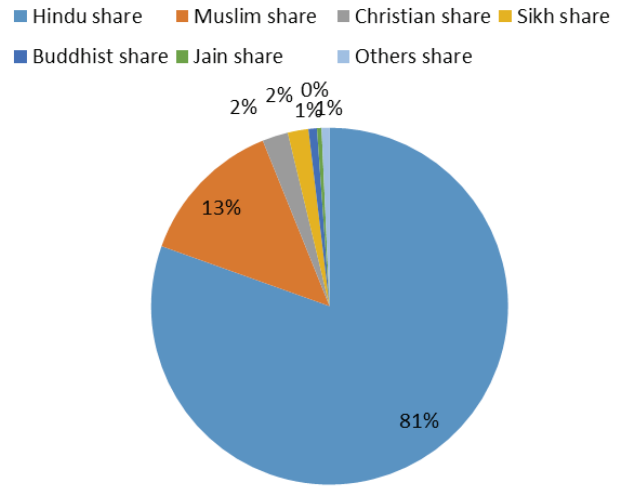

Figure 2: Population division-2001 census

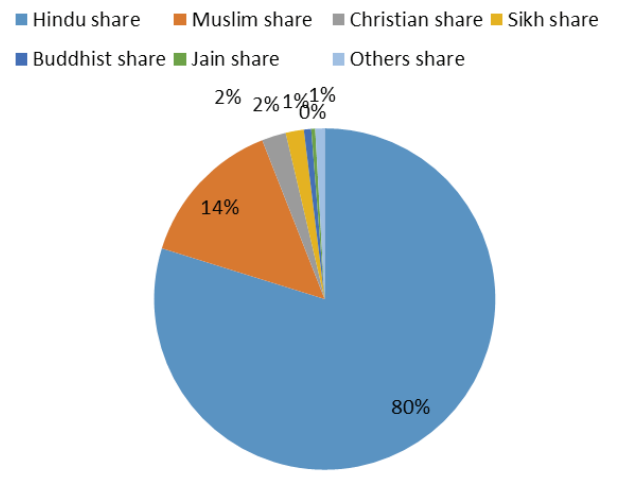

Figure 3: Population division-2011 census

Data source: The census of India 1991, 2001 and 2011

According to these pie charts, share of the religions in India is more or less same while share of Muslims community has been increased by small margin.

Table 1: Fractionalization and polarization index from the year 1993-2013

Year	Fraction-alization index	Polariz-ation Index	Year	Fraction-alization index	Polariza-tion Index
1993	0.316367	0.867208	2003	0.335153	0.890880
1994	0.318581	0.870180	2004	0.335919	0.891768
1995	0.320779	0.873082	2005	0.336680	0.892644
1996	0.322960	0.875916	2006	0.337438	0.893508
1997	0.325124	0.878681	2007	0.338191	0.894361
1998	0.327271	0.881378	2008	0.338939	0.895201
1999	0.329401	0.884009	2009	0.339684	0.896031
2000	0.331514	0.886572	2010	0.340424	0.896848
2001	0.333609	0.889070	2011	0.341159	0.897654
2002	0.334383	0.889981	2012	0.341891	0.898449
			2013	0.342617	0.899232

Source- Census, India.

This table 1 gives appropriate picture of social diversity in India. The fractionalization index[1] shows the social diversity. More the fractionalization index, more are the number of ethnicities in India. Given figures are moderate as it suggests that the fractionalization index is around 35% in India. Easterly and Levine (1997) find the existence of an inverse relation between per capita GDP growth and ethnolinguistic fractionalization. The conflicts and fractionalization index are positively correlated which implies the high probability of conflict in highly diversified society (Montalvo, J. G., & Reynal-Querol, M., 2005).

Table no. 1 gives the information about polarization index. This index shows the separation among the various religions in society. Higher the polarization index, more will be the separation among the various groups in the society, as observed in the case of India.

Montalvo, J. G., & Reynal-Querol, M. (2005) suggest that polarization index might be low at high level of fractionalization index. Authors find that growth is directly affected by ethnolinguistic fractionalization while it is indirectly negatively affected by ethnic polarization[2] as it increases the incidences of civil war and conflicts. Quality of policy and institutions is adversely affected by ethnic conflictthat's why ethnic fractionalization has negative impact on growth (Alesina, A., Devleeschauwer, A., Easterly, W., Kurlat, S., Wacziarg, R., 2002). The paper also talks about how ethnically fragmented societies lead to inefficient provision of public goods, lower level of

trust and participation in social activities, and decreased economic growth. Additionally, governments find it harder to reach a consensus on redistribution to the needy when the society is fractionalized. Easterly and Levine (1997) also find the negative correlation between ethnic fractionalization and schooling, fiscal surplus, financial depth, and the log of telephones per worker.

With social diversity, political diversity affects the income inequality directly through redistribution and indirectly through policies and decision which affect the economic growth and other indicators. ENP (Effective number of parties) is developed by Laakso and Taagepera(1979). ENP helps to measure the coalition in the political system. Laakso and Taagepera conclude the ENP might not be correlated with government instability but ENP might be helpful to measure the instability in the party system.

Table 2: HHI and ENP from the year 1993-2013

Year	HHI	ENP	Year	HHI	ENP
1993	0.0402	24.8901	2004	0.0915	10.9297
1994	0.0402	24.8901	2005	0.0743	13.4616
1995	0.0402	24.8901	2006	0.0743	13.4616
1996	0.2387	4.1892	2007	0.0743	13.4616
1997	0.0802	12.4748	2008	0.0743	13.4616
1998	0.1052	9.5033	2009	0.0743	13.4619
1999	0.1143	8.7522	2010	0.0743	13.4622
2000	0.1156	8.6516	2011	0.0743	13.4622
2001	0.1156	8.6516	2012	0.0743	13.4622
2002	0.1156	8.6516	2013	0.0743	13.4622
2003	0.1156	8.6516			

Source-ENP, HHI, Winning parties and seats from Election Commission of India

The above table shows the parties in power in India from 1993 to 2013. Apart from ENP, the HHI (Herfindahl-Hirschman index)[3] has been used (1/ENP) to indicate whether the government in power is a one-party government or a coalition. Sasmal, J. (2011)suggests that the interest of government might be different than the maximizing the economic growth but government might be interested in the political gain. Banerjee & Newman (1993) and Galor&Zeira (1993)

The recent literature on our topic is not available which motivated for further study. In this paper, we try to analyze the impact of the fractionalization index, polarization index, ENP and value added in agriculture, manufacture and service sector on gini coefficient. We have taken the value added in agriculture, industrial and services sectors from the World Bank. The polarization index and the fractionalization index is formulated from the data collected from the Census of India. ENP is constructed from the data extracted from the Election Commission of India.The data related to Gini-coefficient is taken from World WID– World Wealth & Income Database, The Chartbook of Economic Inequality, Pikkety's database, Emanuel Saez's database from Centre for Equitable Growth and World Bank. Time period for our research is 1993-2013.

Methodology

Fractionalization index is used to measure the social diversity

$$\text{Fractionalization index} = 1 - \sum_{i+1}^{n} (\text{Share of } i^{th} \text{ religion in total population})^2$$

More the fractionalization index more will be the diversity in the society.

Polarization index is used to measure the polarization that is separation in the society.

Polarization index

$$= 1 - \sum_{i+1}^{n} \left(\left(\frac{0.5 - \text{Share of } i^{th} \text{ religion in total population}}{0.5} \right)^2 * \text{Share of } i^{th} \text{ religion in total population} \right)$$

Polarization index is developed by Montalvo, J. G., &Reynal-Querol, M. (2005) and given by Esteban, J. M., & Ray, D. (1994). Higher the polarization index, higher will be the polarization in the society.

Both indices lie between 0 and 1.

Effective numbers of political parties is formulated by constructing the Herfindahl-Hirschman Index (HHI).

$$HHI = \sum_{i+1}^{n} \left(\frac{\text{Seats won by } i^{th} \text{ political party in coalition)}}{\text{Total seats in Loksabha}} \right)^2$$

$$ENP = \frac{1}{HHI}$$

High ENP reflects the higher number of political parties in the government which shows the high degree of coalition.

Prais–winsten[4] time series regression is used to the impact of ENP, fractionalization index, polarization index, value added in agriculture, industrial and service sector on gini coefficient. Lag of one year of all independent variables is also considered.

Gini Coefficient

$=\alpha+\beta_0*ENP_t+\beta_1*FRAC_t+\beta_2*POL_t+\beta_3 *Agri_t+\beta_4*Indu_t+\beta_5 *Service_t+\beta_6*ENP_{(t-1)}+\beta_7*FRAC_{(t-1)}+\beta_8*POL_{(t-1)}+\beta_9*Agri_{(t-1)}+\beta_{10}*Indu_{(t-1)}+\beta_{11}*Service_{(t-1)}+\mu$

Gini Coefficietn = Government Spending

ENP = Effective Number of political parties

FRAC = Fractionalization Index

POL = Polarization Index

Agri = Value added in Agriculture sector

Indu = Value added in Industrial sector

Service = Value added in Service sector

1. Result and conclusion

Table 3

Number of obs	19
F(12, 6)	5.43
Prob> F	0.0243
R-squared	0.9157
Adj R-squared	0.7472

Table 4

Gini Coefficient	Coef.	Std. Err.	t	P>|t|
Agri_t	0.00000	0.00000	-2.33 (.)	0.05900
indu_t	0.00000	0.00000	-1.49	0.18700
service_t	0.00000	0.00000	1.46	0.19400
ENP_t	-0.00084	0.00036	-2.3 (.)	0.06000
FRAC_t	66.74975	24.04613	2.78 (*)	0.03200
POL_t	-48.13584	17.91171	-2.69 (*)	0.03600
Agri_t-1	0.00000	0.00000	5.7 (***)	0.00100
Indu_t-1	0.00000	0.00000	-4.24 (**)	0.00500
Service_t-1	0.00000	0.00000	0.58	0.58500
ENP_t-1	-0.00037	0.00035	-1.07	0.32600
FRAC_t-1	-86.32081	21.07832	-4.1(**)	0.00600
POL_t-1	59.74977	17.79729	3.36 (*)	0.01500
_Cons	-3.54931	9.47628	-0.37	0.72100
Durbin-Watson statistic (original)			1.603142	
Durbin-Watson statistic (transformed)			2.413653	

Results show that value added in agriculture, ENP and polarization index have statistically significant negative impact on gini coefficient in short run while fractionalization index has positive significant impact on gini coefficient. Lag of value added in agriculture and polarization index have positive significant impact on gini coefficient while lagof value added in industrial sector and fractionalization index have significant negative impact on gini coefficient.

In short run, agriculture sector is improving the social fairness by reducing the income inequality. Majority of Indian population is still dependent on agriculture sector. Therefore the growth in agriculture sector will help to increase the income of majority population. ENP is reducing the income inequality in short run as ENP has negative significant impact on gini coefficient in short run. More the ENP more will be the parties in the government. Therefore more ENP represents the more number of representatives from various class, caste and communities in the government. Therefore it will generate the fairness policies which will reduce the income inequality in short run. Diversified society might face the violent incidences in short run which might reduce the income society. Fractionalization index has positive impact on gini coefficient in short run which suggest that the diversified society might suffer from high level of income inequality in short run. Highly polarized society might witness the rapid decision process in short run as one community can power and can take decision easily. Therefore in short run due to efficient decision system, polarization index is reducing the income inequality.

In long run, industrial sector is reducing the income inequality. Industrial sector is important as far as job creation is concerned. Therefore the growth of the industrial sector in long run will benefit the majority of population who are still waiting to get the benefits of economic growth. In this research, rural-urban migration and transmission of labor from one sector to another sector are not considered. Therefore results show that in long run, agricultural sector has positive impact on income inequality. This might be happening because in long run, majority of population is leaving the agriculture sector. In long run, fractionalization index has negative impact on income inequality. In long run, diversified society might convince the government for proper redistribution policies. In long run, polarization index has positive impact on income inequality. High polarization naturally represents the biasness in the decision system in long run as one community is more powerful than other communities. Therefore polarization will increase the income inequality in long run.

Recommendation, limitation and further discussion

Social and political diversity with sector-wise growth are the important factors as far as income inequality is concerned. Policies should be formed on the basis for the impact of social diversity, polarization, government

coalition and sector-wise growth in short run as well as long run. Migration and transmission of worker from one sector to another sector is not taken into consideration. These factors should be considered to identify the proper impact and proper channel through which income inequality is affected. In India, linguistic diversity is also an important factor. Linguistic diversity, social conflict and wars should be taken into consideration for further analysis.

Endnotes

1. The fractionalisation index measures the probability of two randomly chosen individual belonging to different groups. It does not include information on the extent of cultural or economic differences across groups. But it can be altered to incorporate information about group-based differences (Baldwin, K., & Huber, J. D. (2010)).
2. An ethnic polarization index is a measure of the extent to which individuals in a population are distributed across different ethnic groups. The index was developed byEsteban, J.M., & Ray, D. (1994).
3. HHI index is a commonly accepted measure of market concentration. It is calculated by squaring the market share of each firm competing in a market. Here it is used to measure the composition of the political party in power and whether it is a one party government or a coalition.
4. It is a joined effort of SigbertPrais and Christopher Winsten (1954).

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Implementation of Watershed Development Programmes in India: A Situational Analysis of Selected Dry Regions

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Abstract

India is a water stressed country if not yet water scare country yet. Water is crucial to maintain it's economic growth and retain self-sufficiency in food production along with realization of safe drinking water to all. Most of the large dams are either over exploited or closer to saturation. Micro watersheds are the key for water security in future. Though country has lunched watershed for all most 60 years still only a third of rain fed area in the country is under watershed development. Despite spending millions of dollars watershed development is yet to realize its full potential. Crucial to the development of successful outcome of micro-watershed intervention is its stake holders; state, PIAs, communities, donor agencies and institutions with technical expertise. Watershed is no longer seen as technical challenge but a nucleus around which sustainable livelihood, ecological security and empowerment of marginalized communities can be enhanced. This paper beings out the specific challenges India is facing in water security in future, water conservation practices in ancient times to modern times and it's relevance, benefit of promoting micro-watersheds, current state policy towards watershed development and issues that need to be addressed at grass root level for better implementation of the watershed programmes. Nine districts in three states; viz. Madhya Pradesh, Maharashtra and Rajasthan which have large rainfed areas were covered in the field work. Out of ninety villages covered i.e. ten villages in each district, only fourteen of them has any IWMP intervention. The investigations shows all 14 IWMPs are either lagging or stagnated, yet to be operational in any credible sense, most of them hardly have any livelihood activities and political differences at local level seriously crippled the functioning of the watershed committees. Urgent intervention is required to ensure timely release of funds from center to state to institutions below, better coordination among various departments operating in the watershed area, putting effective mechanism to ensure difference among villagers not crippling functioning of the watershed committees and to ensure timely training and credit supply to self-help groups to motivate them to take up some livelihood activities. The better management of watersheds are crucial to water security and water governance in India. None of these projects visited by us were of any possibility for conducting any rigorous exercise involving advance analytical tools like cost-benefit techniques, Net Present Value Techniques or sensitivity analysis.

JEL classification: Q25, Q28, Q29, Q30

Keywords: *Participatory Approach, IWMP, PIA, Water Conservation, Watershed Management*

Introduction

'Water' apart from 'Air' is one of the most crucial element to sustain life in earth. In cosmos our 'Earth' is the only planet which sustains life because we have both water and air elements in this planet. Most of the planet is covered by sea water. Oceans contains 96.5% of all water available in the planet. Another 1% of the water which is available on the surface is not useable as it is available as saline groundwater or in saline lakes. Thus only 2.5% of the surface water is fit for consumption for humans. Again nearly two-third of this surface water is in frozen form on glaciers in great mountains. No doubt all major rivers on earth start their journey from snowcapped mountains.

All most all civilizations in the history were founded and developed along these river basins or near sweet

water lakes or in places where ground water is fit for human consumption. As population increases, demand for water increases for agriculture, industry, hygiene and sanitation needs, construction work and as input to many other human endeavors. Apart from human life the sweet water also supports life of many aquatic animals and mammals, some of which are also essential to food chain that sustain human civilization. Over the years the pressure on water is only growing, to meet human needs as the population is increasing to nearly a billion in another couple of decades. Both sweet water and human settlements are not homogenously scattered across the planet.

India is one of such example. At present the country has population of 1.35 billion which is roughly one-sixth of the 7.7 billion population on earth in 2018 (as per 'Worldometer' data accessed on 27.10.2018). At the same time India occupies only 2.1% of the land mass on earth and supports every one out of six person on earth. At the same time it has only 4 percent of all water sources on earth (KPMG 2010). As per the KPMG report, India gets 4000 trillions of water from rain and snowfall every year. Most of these water drained to sea via major river systems and only 46 percent could be saved in lakes and ponds (natural as well as man-made). However all stored water cannot be used due to topology and other related factors.

Thus only 28 percent of total 4000 trillion liters of water is available for human consumption in India (ibid). With increase in population the demand for water is increasing for domestic, industrial as well as for agricultural purpose. As per the above report, India was consuming 581 trillions of water during the given year, of which 89 percent was for irrigation, 7 percent was for domestic use and rest were for industrial use (ibid).

Not only humans, India also has 20 percent of all domestic cattle population on the planet which again requires huge amount of water to sustain. Nearly 20.5 million people in India depends directly on livestock farming including cattle. Livestock contributes nearly 14% of total income in rural households. About 9% of the population currently employed in livestock sector. The contribution to national GDP from livestock sector is 4.1% while one fourth of all agricultural GDP comes from livestock sector (annual report 2017-18, Department of Animal Husbandry, Dairying and Fisheries, GOI). So any scarcity in availability of water will affect livelihood of millions of families in Rural India.

Water Crisis in India: Brief Overview

Water becoming a major challenges for policy makers in India. The per-capita availability of water in India has declined from 1,816 cubic metres in 2001 to 1,545 cubic metres in 2011 (KPMG and ASSOCHAM; 2018). In a given region if annual water availability is below 1,700 cubic metres per person it can be termed as a water-stressed region as per United Nations definition. According to the same report, almost 20 per cent of ground water blocks which is roughly translated to 60 percent of the districts in India, are in critical condition or overexploited. On the other hand the per capita availability of river water in India varies from 300 cubic meter to 2000 cubic meter per person per year (ibid). Since most of the rivers are perennial in nature, ground water is the major source of irrigation for the country. Ground water is the source of irrigation for more than 60 per cent of India's agriculture land. Currently ground water caters two-third of India's need for irrigation. With implementation of green revolution and limited coverage of canal irrigation, the irrigation through bore wells gain wide acceptance. In five decades the share of bore well irrigation increased from 1 per cent to 60 per cent between 1960 and 2007. Extraction of ground water has helped the country to add 84 percent more to the total net irrigated area during the independence (Shah; 2013). At the same time only 18-20 percent of the 4000 billion cubic meter precipitation every year, could be used in recharge of India's surface and ground water bodies, as the country lack necessary infrastructure for storing and managing water. At present India is largest user of groundwater in the world with an average abstraction of 251km3/year (ibid).

Not only agriculture but 85 per cent of drinking water supplies in the country comes from ground water supply. Due to climate change the spell of rain is erratic in past couple of decades. This can be detrimental to crop cycle practice in the country and may lead to more dependence on ground water. Growing urbanisation has increased pressure on available water in the country. The worrying part of domestic consumption of water is that almost 80 per cent of it comes back to ecosystem as waste water (KPMG and ASSOCHAM; 2018). This creates problem of environmental degradation and is also source of many communicable diseases. Niti Ayog observes 48 per cent of India's population is under 'high to extreme' water stress. About 75 per cent of Indian households are without drinking water connections at their homes. Nearly 70 percent of the supply water is contaminated by biological, toxic, organic, and inorganic pollutants, and not safe for human consumption, irrigation and industrial use.

A recent report from NITI Ayong, suggests by 2020, almost 54 percent of India's groundwater wells will see depletion in water level. Similarly 21 major cities may also run out of groundwater by 2020. Some 100 million people's livelihood may be affected due to decline in the availability of ground water (Niti Ayog, 2018). People

are digging deeper for ground water which increases the risk of contamination from fluoride, arsenic and other matters. At the same time both rivers and groundwater are also polluted by untreated effluents from industrial units and untreated sewage. Recent events related to climate change has adverse impact on hydrologic cycle, extreme rates of precipitation and evapo-transpiration has resulted in floods and droughts more frequently (Shah; 2013).

There are countries like Israel, Japan, Taiwan etc which have hardly any major river basins or storage of fresh water. But their focus on micro-irrigation systems enabled them to overcome the water shortage and become self-sufficient in domestic food production. Nearly 60% of arable land in these countries depends upon micro-irrigation, in India hardly 5 per cent of India's cultivated area are under micro irrigation (KPMG and ASSOCHAM; 2018). Since India receives 75% of it's annual rain fall in short span of four months i.e. July to September, during monsoon, it is very important for the country to manage the water for rest of the year (Dhawan 2017).

There are certain regions which are frequently experience drought. These areas are Southern and Eastern Maharashtra, Northern Karnataka, Andhra Pradesh, Odisha, Teleangana, Bundelkhand region spread across Uttar Pradesh and Madhya Pradesh and Rajasthan. [http://www.mapsofindia.com/maps/india/drought-prone-areas.html]. Out of total cultivable land in India, 42 percent lies in drought-prone areas. Rain is the only source of water in 54 percent of India's net sown areas. The major crops in India like Rice, wheat and sugarcane constitute about 90% of India's crop production and these are the most water consuming crops. Rice, the major staple food in India, consumes as much as 3,500 litters of water for a kilogram of grain produced. Our farmers use more water (2 to 4 times more) to produce one kilogram of a major food crop compared to China and Brazil. Such is the pressure on ground water in India, nearly 62 per cent of available 398 billion cubic meters of ground water has been extracted mainly to sustain agriculture. (Dhawan; 2017). According to Gandhi and Bhamoriya; 2011, the level of ground-water development i.e. extraction of ground water is very alarming in North-Western states of Punjab, Rajasthan and Haryana (141 per cent, 111 per cent and 105 per cent respectively). Next follows Tamil Nadu (81 per cent), Gujarat at 70 (per cent), and Uttar Pradesh/Uttarakhand (65 per cent).

Brief Overview of Evolution of Water Management in India in Ancient Times

The arguments above clearly shows India needs better water harvest and water conservation approach to sustain it's agricultural growth to feed increasing population, meeting needs of increasing pace of industrialisation along with growing drinking water requirements. While large dams on Perianal Rivers address irrigation and water supply in basin areas, the increasing siltation and irregular rain in monsoons significantly restrict their utility potential in recent times. As discussed above nearly two-third of the land in India is not having any major river basins. Rain water is the only source to millions of people and their livelihood in these areas. In absence of rain water, ground water is the only alternative for the people living in these areas.

Then ground water itself comes from surface flow of rain water which enters underground through cracks in surface and collected in rock beds underneath the soil. So tapping the surface flow to recharge ground water is an efficient way of storing water for future use. The water is also stored in lakes, ponds and wells of various sizes but the amount of water saved in aqua spheres can cater to larger area and recharge the ponds, lakes and wells itself. An efficient ground water recharge method basically slows down the flowing water which then sipped underground, in that process it also increase moisture content of the soil which further helps in growth of various vegetation in it's command area.

From centuries Indian subcontinent is known for measures storing surface water. The Indus civilisation places like Harrapa, Lothal, Dholavira has well laid out structures to capture both surface and flood water for future use. Various dynasties in north India especially in modern Bihar, Madhya Pradesh, Uttar Pradesh and Gujarat built large artificial reservoirs to store water. One such ancient reservoir lake Sudarshan in Junagadh of Gujarat built in 3rd century B.C. is still in use. Near Bhopal a largest known artificial lake was constructed by King Bhoj Parmar, in eleventh century, by constructing a vast embankment across two hills. The lake taps water from 365 streams and springs. The water is still used for drinking water requirement today.

Other such ancient lakes are lakes of Udaipur, Raj Samand lake in Rajasthan and Wullar lake of Kashmir. In South India Chola, Pandya, Pallava, Chera, Vakataka and Kakatiya dynasties developed a vast network of tanks and canals that served both agriculture and irrigation. In Deccan region large reservoirs were built in both ancient and medieval period on sites of large natural depressions and many of them are still in use. Pallavas of 7th century A.D. were famous for construction of anicuts over river cauvery. The Cholas on the other hand were famous for creating chain-tanks i.e. a number of tanks with connecting channels. It is not only rulers but also village communities and rich individual who contributed to construction of large, medium and small

reservoirs throughout the country. Apart from irrigation these large water storages also cater to the cattle and for domestic use directly or indirectly through charging of wells.

From ancient times in the arid and semi-arid areas of northwest India, communities developed mechanism and structure to collect, save and use rain water in underground storage tanks called Tanka, Kunds or Kundis. In western part of Rajasthan roof top water harvesting system is adopted from centuries and every house had such a system. Similar roof top water harvesting system is also seen today in old part of Junagadh city of Gujarat. The forts of Golconda, Junagadh, Burahnpur, Daulatabad, Ranathambor were made invincible because these forts had developed very good water harvesting systems through construction of underground pipes and tunnels to transport water to different parts of the forts.

In the desert areas (western parts of Rajsthan and Kucch in Gujarat) which gets scanty rainfall from centuries, communities built tanks, kunds, step-wells or baolis which are mostly interlinked and tap every natural water flow in the given area. These structures were known in various names as johadhs, khadins, tankas, adlaz, jhalara, modhera, vapi, medhbandhi (in agricultural plots), Virdas. The stored water is taken out through draw wells known as 'rahat' and 'dhekli'. Often these structures help people to wade through drought years for centuries. From ancient times to till date Bandharas and Tals of Maharashtra, the Bundhis in Madhya Pradesh and Uttar Pradesh, Ahars and Pynes of Bihar, Kuhls in Himachal Pradesh, Kuhals of Jammu & Kashmir, Eris of Tamil Nadu, Surangams of Kerala, Pokhurs and Pokhris in Bengal and Odisha, Kattas of Karnataka are still used by local communities to sustain agriculture, livestock, local manufacturing and drinking water during both good rain years or not so good rain years including drought years. The present water policy needs to reinforce these practices to address growing water needs of the people (Pandey 2016, Pal 2016, Sutcliffe et al 2011, Date 2009, Ayngar 2007). It is estimated that nearly 1.3 million human made lakes and pond from ancient times still exists across India. Post-Independence, India continued to focus on developing it's water resources with application of modern technologies and management practices. Focus was on identifying watersheds from it's head to end point streams and organising the required infrastructure for better management of flow as well as stock of fresh water.

Modern hydrology defines, watershed as an area from which the water flows into a common point on the drainage system. Every stream, tributary or river in the nature has an associated watershed. Small watersheds aggregate together to become larger watersheds. The starting point of a stream, with no other streams flowing into it, is called the first order stream. More than one first-order streams come together to make second-order stream. Similarly more than one second-order streams makes third-order stream and so on. It is the stream order that defines the relative location of the intended watershed project (Wani and Garg 2009).

Identifying stream order in a given watershed is helpful in estimating amount of water available in a given watershed. It helps in dividing larger watershed into smaller units for better water flow management. Terrain slope of the intended watershed is very important to identify the objectives which the watershed project can achieve. Relatively larger watershed can be managed in plain valley areas or where forest or pasture development is the main objective. On the other hand in hilly terrains or where intensive agriculture development is planned, relatively smaller watersheds are useful. People and livestock are the integral part of any watershed development initiative and their activities affect the productive status of watersheds and vice versa (ibid).

Water Management in post Independent India

Watershed development and management in independent India has undergone many phases. It started with the River Valley Projects of the 1950s but it was only in the 1980s that the Government of India (GoI) began dry land development programs using a 'watershed approach'. Throughout the development of watershed initiative in India, mainly three Ministries of Government of India, viz., the Ministry of Environment and Forests (MoEF), the Ministry of Agriculture (MoA) and the Ministry of Rural Development (MoRD) are involved (MoRD 2016, Shah 2016, World Bank, 2016a, Nagaraja and Ekambram 2015, Symle et al 2014, Gray and Srinidhi 2013, Wani and Garg 2009, Sharma 2005).

In 1962 soil conservation works in the catchments of major river valley projects were taken up through watershed to check soil erosion and it's consequence on storage capacity of large dams. In 1967 first comprehensive policy on watersheds were made. In 1971 under Rural Works Programme, watershed development were given priorities. In 1973-74 Drought Prone Area Programme (DPAP) was launched under MoRD to promote economic development and mainstreaming of drought prone areas through soil and moisture conservation measures. In 1977-78, Desert Development Programme (DDP) was launched under MoRD where the objective was to minimize adverse effects of drought and desertification through reforestation. The DDP also adopted watershed development approach to achieve it's objective.

In 1989 Integrated Wasteland Development Programme (IWDP) was launched under MoRD with the objective of regenerating degraded non-forest land through silvipasture and soil and water conservation techniques at the village level through promotion of micro-watersheds. Same year another programme named Integrated Afforestation and Eco-Development Scheme (IAEPS) was launched under Ministry of Environment & Forests (MoEF) and State Forest Departments to restore and regenerate the ecological balance of degraded forests on a watershed basis using a participatory approach (involving local communities).

In 1990 National Watershed Development Project for Rainfed Areas (NWDPRA) under Ministry of Agriculture (MoA) was launched to promote sustainable natural resource management, enhance agricultural production, restore the ecological balance, reduce regional disparities, and create sustained employment opportunities in rainfed areas of the country. In 1992 Indo-German Watershed Development Programme8 (IGWDP) was launched to rehabilitate micro-watersheds for the purpose of regeneration of natural resources and sustainable livelihoods, using a participatory approach. National Bank for Agriculture and Rural Development (NABARD) and the Watershed Organisation Trust (WOTR) were the nodal agencies to implement the scheme. This is also the period when donor agencies from foreign countries funded various micro watershed projects in India. Department for International Development (DFID), Government of the United Kingdom, Swedish International Development Agency (SIDA), Swiss Development Cooperation (SDC), the Royal Netherlands Embassy (RNE), the Danish International Development Agency (DANIDA) and the development agencies of Germany and Japan were some of the major donors to implement micro watershed across the length and breadth of the country.

In 1994 MoRD brought common guidelines for watershed development to promote micro watersheds through participatory approach. It invested huge amount of money in micro watershed to complement the effort of the voluntary organisations supported by the foreign donors. In 1999–2000 Watershed Development Fund was created under MoA and NABARD to provide financial support to scale up successful participatory watershed development projects in 100 priority districts. In 2001, government of India revised the 1994 watershed guidelines and brought other programmes like IWDP, DPAP, DDP, and other similar programs notified by GOI under the common guideline. Participatory approach was now universal to all ongoing watershed schemes.

In 2002 National Afforestation Programme (NAP) combining IAEPS and three other forestry programmes was launched under MoEF to develop forest resources using a participatory approach and build capacity of communities who depends on the forest. In 2003, MoRD brought out Hariyali guidelines to focus on further Integration of local community level institutions in implementation of DPP, DPAP, and IWDP. In 2005 the largest job guarantee programme in the world Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) was launched under supervision of MoRD to enhance livelihood security in rural areas. Under the programme at least 100 days of guaranteed wage employment a year to every household whose adult members volunteer to do unskilled manual work. The scheme gives emphasis on creation of community based assets especially natural resources. Nearly 60 percent of the assets created under the programme is related to development of watersheds through soil and water conservation, afforestation, and land development. To quote Mihir Shah *"Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) has potential to be our largest watershed programme, giving renewed energy to the reformed Integrated Watershed Management Programme (IWMP) launched in the Eleventh Plan and launching a completely revamped programme on Repair, Renovation and Restoration (RRR) of Water Bodies"*, (Shah 2013).

In 2006 Parthasarathy Committee under Planning Commission was constituted to evaluate the DPAP, DDP, and IWDP. The Committee reviewed India's Watershed Program extensively and came out with various suggestions which led to formulation of the Neeranchal Guidelines and the creation of National Rainfed Area Authority (NRAA). The later created common guidelines for all watershed schemes under the different ministries for the development of rainfed farming systems. In 2008 NRRA came out with common guidelines for watershed development (Neeranchal) to promote a fresh framework to guide all WSD projects in all departments and ministries.

Neeranchal was formally launched in 2014 and it will run upto 2022. World Bank (WB) gave 50% of total 357 million US dollars while rest was given by Government of India. As of October 2018, only 0.23 million US dollar has been given by the WB for the programme. Out of total available fund 38% was allocated to Agricultural Extension, Research, and Other Support Activities, 34% towards construction of Irrigation and Drainage, 4% towards Public Administration - Agriculture, Fishing & Forestry and remaining 1% for other Agriculture, Fishing and Forestry.

In 2009 Integrated Watershed Management Programme (IWMP) was launched by MoRD consolidating three programs: IWDP, DPAP, and DPP. The new program aims to develop cluster of micro-watershed (1000 ha

to 5000 ha scale) to enhance sustain livelihood for the beneficiaries. In 2011 MoRD again revised its common guidelines for watershed development developed in 2008. The revision was done based on feedback received from concerned ministries, departments, state governments, and NGOs. Another revision to the revised common guideline was done in 2011 by NRRA and planning commission to integrate the objective of developing rain fed areas through IWMP (ibid).

However the performance of IWMP is not as intended by the planers. Six states that has 65.6 per cent of the total rain fed area in the country (viz. Maharashtra, Rajasthan, Madhya Pradesh, Karnataka, Gujarat and Andhra Pradesh) were sanctioned 52.8 per cent of the total projects for covering an area to the extent of 54.6 per cent with 58.9 per cent of the total funds released. However only 37.8% of the rain fed area could be covered by the projects in these selected six states, with a high proportion of area covered in Rajasthan (50.8 per cent) to a low of 29.0 per cent in Madhya Pradesh and 29.3 per cent in Andhra Pradesh. Above figures were for years 2009-10 to 2014-15 (Nagaraja and Ekambram 2015).

In 2015-16, Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) was launched. It aims at to accord high priority to water conservation and its management. PMKSY envisages to extend the coverage of irrigation with motto of **'Har Khet ko pani'** and improving water use efficiency with the slogan on **'More crop per drop'.** It aims to address the water issues in a holistic manner i.e. end to end solution in terms of creation, distribution, management, field application and extension activities related to all sources of water. All ongoing schemes related to irrigation and water conservation were merged into PMKSY. The programmes that were merged under PMKSY were Accelerated Irrigation Benefit Programme (AIBP) of the Ministry of Water Resources, River Development & Ganga Rejuvenation (MoWRRD&GR), Integrated Watershed Management Programme (IWMP) of Department of Land Resources (DoLR) and the On Farm Water Management (OFWM) of Department of Agriculture and Cooperation (DAC). For financial year 2015-16 when the programme started, an outlay of Rs.5300 corer has been made towards PMKSY. Out of the total available funds, Rs. 1800 corer was for DAC, Rs. 1500 corer for DoLR (which also runs IWMP); Rs. 2000 corer for MoWR (of which Rs. 1000 corer was for AIBP).

Currently under 'participatory' watershed development approach helps in integration of community members in watershed development alone but also promote ecosystem-based interventions (e.g. Afforestation, agro-forestry), technical interventions (e.g. human-built interventions for soil and water conservation and drought mitigation), and social interventions (e.g. women's self-help group development, capacity building) for holistic development of communities living in the watershed. At present India spends nearly 4 billion US dollar in watershed management programme every year (Gray and Srinidhi 2013). The cost benefit analysis from meta-analysis of watershed literature in India till 2012 shows the ratio to be varying from lowest 1.34 to 7.1568 (ibid).

Findings from Filed Survey

In 2015-16 and 2016-17 we have covered 9 districts in 3 states of Madhya Pradesh, Maharashtra and Rajasthan. In all these 3 states we have covered 9 districts; Damoh, Sagar and Vidisha in Madhya Pradesh, Nanded, Parbhani, Hingoli and Jalna in Maharashtra and Nagaur and Sikar in Rajasthan. The states, districts and 10 villages in each districts to be visited, were allotted to Gujarat Institute of Development Research, Ahmedabad by Ministry of Rural Development (MoRD) of Government of India for regular monitoring of its flagship programmes. IWMP is one of the programme that was monitored during the visit. A structured questionnaire is used to gather relevant information. We also held focus group discussion with various sections of the villagers to document their opinion about implementation of watershed programme in their village. As already highlighted above, Madhya Pradesh, Maharashtra and Rajasthan are among 3 out of 6 states in India having 60 percent of total rain fed areas. In Madhya Pradesh 29.0% of total rain fed areas were covered under IWMP between 2009-10 and 2014-15. In Maharashtra 35.0% of total rain fed areas were covered under IWMP between 2009-10 and 2014-15. In Rajasthan 50.4% of total rain fed areas were covered under IWMP between 2009-10 and 2014-15 (Nagaraja and Ekambram, 2015).

Status of watershed projects in Damoh, Madhya Pradesh

Damoh constitute part of Bundelkhand region that falls in Madha Pradesh. Bundelkhand region is a known water scarce region in India and also comes under 250 most backward districts in India. It has a geographical area of 7306 square kilometers, 38% of which are forested regions. The district receives help under Bundelkhand Special Package. According to 2011 census, 80% of district's population lives in rural area. Of the total district population, 19.5% are from scheduled caste and 13.1% are from scheduled tribe.

The district is facing drought like situation consecutively for past 4 years. In fact the entire Bundelkhand region is receiving 27%-47% less than normal rainfall over the years in recent past. Agriculture is the principal activity in rural areas. There is also incidence of high seasonal migration, especially after the rabi crop, in the rural areas to cities like Bhopal, Indore, Nasik, Nagpur, Mumbai,

Delhi and Surat. Failure of agriculture for successive years played a major role in accelerating migration.

Integrated Watershed Management is essential in a district like Damoh where water is scarce and the region is undergoing through drought for past four years. The district had spent Rs. 1922.29 lakhs against target of 1989.27 lakhs available for IWMP in the said year (approximately 97% of the available fund) and covered 15200 hectares of land against target of 16019 hectares (95.0%). The lion share for the programme is received from central grant while state's share is only 9.6% for the year 2014-15.

Given the fact that the district has only two major perennial rivers, Sonar and Hiran and lacks any major irrigation infrastructure, watershed development could be game changer for the district's agriculture. The coverage of watershed development has to be widened. The talukas we visited, Damoh, Bathiyagarh, Hatta and Tendukheda were having very few villages covered under the IWMP.

Only in one out of ten villages which were allotted to us in Damoh district we found any watershed development work was being carried out. This was Jangupura in Bahtiyagarh taluka. Only one check dam was being constructed under IWMP in convergence with MGNREGS. The dame was to be completed due to lack of funds. The wage payment to labour was still pending. There were no details available of the said project with the village officials or villagers. Since the project was constructed under MGNREGS, no watershed committee was required to be constituted. So participation of the community was not seen in the above said project.

Status of watershed projects in Sagar, Madhya Pradesh

Sagar is one of the centrally located districts in Madhya Pradesh having a geographical area of 7306 square kilometers, 38% of which are forested regions. The district is connected to major national and state level highways as well as rail heads. Like Damoh this district also falls in Bundelkhand region. According to 2011 census, 70% of Sagar's population lives in rural areas. Of the total district population, 34.3% are from scheduled caste and scheduled tribe.

Agriculture is the principal activity in the district. The district has also high incidence of seasonal migration due to lack of livelihood alternatives in the district in non-farm sector. After the rabi crop, large number of people from rural areas of the district migrate to cities like Bhopal, Indore, Nasik, Nagpur, Mumbai, Delhi and Surat. Failure of agriculture for successive years due to poor monsoon for past couple of years has accelerated migration.

The district had spent Rs. 2672.19 lakhs against Rs. 2726.65 lakhs available fund for IWMP in 2014-15 (approximately 98% of the available fund) and covered only 1440 hectares of land. There was no target set for the programme that year by the district administration!! The lion share for the programme is received from central grant while state's share is only 9.4% for the year 2014-15. Given the fact that the district has few perennial rivers, and lacks any major irrigation infrastructure, watershed development could be game changer for the district's agriculture. The coverage of watershed development has to be widened. Only in one out of 10 villages we visited we found any watershed related activity was undertaken (Jera village).

Only in one out of ten villages in Sagar district we found any watershed development work was being carried out. This was Jera village in Jaisinagar taluka. One check dam was constructed under IWMP as entry point activity in 2012-13. All mandatory procedures like taking clearance from gramsabha, participatory rural appraisal for beneficiaries and proper exit protocol were undertaken. The watershed committee has 3 women members.

Under livelihood component, total of 9 SHGs were formed under this watershed development programme. Few of them have taken up vegetable cultivation and goatrey. There are 4 water user groups formed, but these were not functioning during out visit due to lack of water in the check dam. These groups were also given training in running SHGs as mandated by the IWMP but no credit was available to them till the time of our visit for starting any livelihood activity.

But the details about IWMP project like area covered under the project, information about SHGs and user groups were not displayed in the notice board of gram panchayat office or community building, as mandated under IWMP guidelines. Because of lack of rain for past 4 years there was no water in the check dam when we visited. Since the district is drought prone one would expect such water conservation activities could be undertaken under MGNREGS in large scale in this region.

Status of watershed projects in Vidisha, Madhya Pradesh

The area of the district Vidisha is 7731 square kilometre, of which 20.6% are forest. According to 2011 census, 77% of Vidisha's population lives in rural areas. Agriculture is main livelihood for the people in the district. Of the total district population, 19.8% are from scheduled caste (SC) and 4.9% are from scheduled tribe (ST) as per 2011 census.

Vidisha is neighbour to Bundekhand region but not part of it. It has Betwa and few perennial rivers crisscrossing

a part of the district. In 2014-15, 4963 hectares were covered under IWMP against target of 5930 hectares. Out of total Rs. 595.57 lakhs available to IWMP, 84.0% of the available fund was utilised.

The lion share for the programme (88.0%) is received from central grant for the year 2014-15. Given the fact that the district has few perennial rivers, and only a few major irrigation infrastructures, watershed development could be game changer for the district's agriculture. The coverage of watershed development has to be widened. In none of the 10 villages we visited there were any IWMP implementations during the time of our visit.

Status of watershed projects in Nanded, Maharashtra

Nanded is of the country's 250 most backward district and receiving Backward Regions Grant Fund Programme (BRGF) since 2006. The district is facing drought like situation consecutively from 2013 onwards. The long term average annual rainfall is little over 900mm but in 2014-15 and 2015-16 the rainfall was scanty (40-45% less of long term average rainfall). Agriculture is the principal activity in rural areas which suffered heavily from monsoon failure. This leads to incidence of high migration, in the rural areas to various cities of Maharashtra and Telengana (mainly Hyderabad).

Apart from monetary income, during drought the availability of drinking water is another major problem for rural people in place like Nanded as the ground water in many of the villages have gone down to alarming level due to lack of adequate rainfall and over dependence on ground water to save at least one crop.

Integrated Watershed Management is essential in a district like Nanded where water is scarce and the region is facing drought for past four years. The district had spent Rs. 2357 lakh out of Rs. 3085.8 lakhs available to it (76.4% of the available fund) and covered little more than one lakh hectare of land against target of 2.11 lakh hectares (49.7%) under IWMP in 2015-16. The lion share for the programme is received from central grant for the year 2015-16. Given the fact that the district has mainly perennial rivers and rain is mostly scanty in recent past, watershed development is crucial for the district's agriculture. The coverage of watershed development has to be widened.

Out of the 10 villages in the district, we got IWMP being implemented in only 2 villages. These are Hasnali and Dudhad-Walkewadi villages, where IWMP being implemented from 2014 onwards and 2011 onwards respectively. In Hasnali 100 hectares were covered under IWMP during the time of out visit. In Dudhad-Walkewadi nearly 1000 hectares were covered during the same period. In both the villages the gramsabha had approved the programme and details were painted in panchayat office walls. Watershed committees were formed in both places and in Hasnali, 3 out of 15 members were women and in Dudhad-Walkewadi, 2 out of 11 members were women. In Hasnali no self-help groups or water user groups were formed yet. So the programme is limited to earthen work which helps in ground water recharge and soil conservation.

In Dudhad-walkewadi under the programme 15 self-help groups and 14 water user groups were formed. The groups were given training and revolving fund of Rs.25000 has been provided to each of SHGs. However there is no water storage yet, as the check dams not constructed so far. So both the IWMP projects are long way to go to achieve their mandate. It is also observed the IWMP related meetings/resolutions were maintained in general gramsabha record. The head of the 'Panlotsamiti' or watershed committee have hardly any clarity of the issues unless assisted by sarpanch and panchayat secretary.

Status of watershed projects in Hingoli, Maharashtra

The district is one of the country's 250 most backward district in 2006-07 and receiving Backward Regions Grant Fund Programme (BRGF) since then. The district is facing drought like situation consecutively from 2013 onwards which entire Marathawada region is suffering at present. The long term average annual rainfall is 895mm but in 2014-15 and 2015-16 the rainfall was scanty (40-45% less of long term average rainfall). Agriculture is the principal activity in rural areas which suffered heavily from monsoon failure.

Integrated Watershed Management is essential in a district like Hingoli where water is scarce and the region is facing drought for past four years. The district had spent Rs. 1468.44 lakh out of 1797.04 lakhs available to it (81.7% of the available fund) and covered 18361.3 hectares of land out of 45591 hectares that was planned (49.7%). The lion share for the fund towards IWMP was received from the central government in that year (96.2%) and balance carried forward from previous year. There was no state release. Given the fact that the district has mainly perennial rivers and rain is mostly scanty in recent past, watershed development is crucial for the district's agriculture. The coverage of watershed development has to be widened. Only 2 of the villages have any watershed out of the 10 village we have covered in the district.

These were Lohgaon and Sawna villages where IWMP being implemented from 2014 and 2011 onwards respectively. In Lohgaon 1052 hectares of land were covered under the IWMP. While in Sawna only one check dam has been constructed (of earth and boulder). In both the villages the gramsabha had approved the programme and only in Lohgaon details were painted

in panchayat office walls. Watershed committees were formed in both places.

In Lohgaon 2 out of 11 members were women and in Sawna, among 15 members 2 were women. In both Lohgaon and Sawna SHGs were formed under IWMP. In Lohgaon there were 10 SHGs and IN Sawana there were 27 SHGs respectively during out visit. All the SHGs were not functioning at the time of the survey and till date none of the SHGs had received any monetary assistance from any source. There was no water user groups formed in any of these 2 villages because the projects were not designed to hold the water. However both the IWMP projects are long way to achieve their mandate. It is also observed that the IWMP related meetings/resolutions were maintained in general gramsabha record. The head of the 'Panlotsamiti' or watershed committee were present with us and shown us the records of the meeting of the watershed committee time to time.

Status of watershed projects in Parbhani, Maharashtra

The district falls in country's 250 most backward districts and receiving Backward Regions Grant Fund (BRGF) since 2006. The district is facing drought like situation consecutively from 2013 onwards, like other parts of Marathawada. The long term average annual rainfall is 895mm but in 2014-15 and 2015-16 the rainfall was scanty (40-45% less of long term average rainfall). Agriculture is the principal activity in rural areas which suffered heavily from monsoon failure. Out of total workforce in the district, as per 2011 census, 35.86% were cultivators and another 38.63% were agricultural labourers. This implies nearly 74.5% of workers depend upon agriculture in the district, much higher than the state average is 53%. Only 12.9% (57135 hectares out of 441918 hectares cultivable land) of the cultivated area in Parbhani has access to some irrigation, rest depends upon seasonal rain. The consecutive failure in monsoon leads to incidence of high migration, in the rural areas to various cities of Maharashtra and Telengana (mainly Hyderabad).

Integrated Watershed Management is essential in a district like Parbhani where water is scarce and the region is facing drought for past four years. The district had spent Rs. 483.2 lakhs out of Rs.514.99 lakhs available to it (93.9% of the available fund) and covered 5243.26 hectares of land. However no information was available for the target set that year. The lion share for the fund towards IWMP was received from the central government in that year (95.0%) and balance carried forward from previous year. There was no state release. Given the fact that the district has mainly perennial rivers and rain is mostly scanty in recent past, watershed development is crucial for the district's agriculture. The coverage of watershed development has to be widened. In none of the 10 villages allotted to us there were any IWMP projects being implemented during the time of the survey or before that.

Status of watershed projects in Jalna, Maharashtra

The district has a sub-tropical climate, in which the bulk of rainfall is received from the southwest monsoon, between June to September. The average annual rainfall of the district ranges between 650 to 750 mm. The district often experiences drought with rainfall recording as low as 400 to 450 mm. The Economy of the Jalna district is based on agriculture and agro-industries, as the 85 % of the geographical area is under agricultural use. Out of the total 7, 61,200 hectares of the geographical area, 6,51,553 hectare of land is under agricultural use. Kharif crops are usually shown in 75 % of the total land under agriculture, where as only 40% of land are under Rabbi crops. The Jawar, Wheat and cotton are the major cereals grown in the district. The area under double crops is just 15% of total land under agriculture while area under irrigation is only 7.8% which is far below the state average. Jaikawadi project is the only major project having capacity of irrigating 36000 hecters (one-third of total irrigated area in the district).

The district is declared as one of the country's 250 most backward districts in 2006-07and receiving Backward Regions Grant Fund (BRGF) since then. The district is facing drought like situation consecutively from 2013 onwards, like other parts of Marathawada. The long term average annual rainfall is 895mm but in 2014-15 and 2015-16 the rainfall was scanty (40-45% less of long term average rainfall). Agriculture is the principal activity in rural areas which suffered heavily from monsoon failure. Out of total workforce in the district, as per 2011 census, 42.8% were cultivators and another 28.1% were agricultural labourers. This implies nearly 70.9% of workers depend upon agriculture in the district, much higher than the state average is 53%. Only 7.5% of the cultivated area in Jalna has access to some irrigation, rest depends upon seasonal rain. The consecutive failure in monsoon leads to incidence of high migration, in the rural areas to various cities of Maharashtra and Telengana (mainly Hyderabad).

Integrated Watershed Management is essential in a district like Jalna where water is scarce and the region is facing drought for past four years. The district had spent Rs. 66.9% of Rs.1382.7 lakhs available to it and covered little more than 6000 hectares of land. However no information was available for the target set that year. The lion share for the fund towards IWMP was received from the central government in that year (58.8%), followed by state government (22.0%) and balance carried forward

from previous year. Given the fact that the district has mainly perennial rivers and rain is mostly scanty in recent past, watershed development is crucial for the district's agriculture. The coverage of watershed development has to be widened. In 4 of the 10 villages we visited, there were IWMP projects being implemented but all of them are yet to achieve it's desired goals.

The villages where we found IWMP being implemented during out visit were Paradgaon and Ravana from Ghansavangi taluka and Butkheda and Shipora of Jafrabad taluka. All the mandatory processes were followed in implementation of the programme. The gramsabhas were consulted and the project proposals were approved by the panchayats in their meetings. The watershed committees were formed. In such respective committees, presence of women members were very limited. In Paradgaon 2 out of 21 members were women, while in Ravana out of 11 members 2 were women, in Butkheda out of 11 members 3 were women and in Shipora 2 out of 11 members were women.

In Paradgaon 66 SHGs were formed under watershed committee. Here the project started in 2009-10. The purpose of the watershed development was soil conservation not the storage of water per say. Out of proposed 2881.21 lakhs of rupees till date, 345.75 lakhs of rupees (12.0%) were spent till date and 139.72 hectares (6.6%) out of proposed 2115.6 hectares of land had been brought under the IWMP so far. As entry point activity one drinking water project was completed and still it provides water to villagers. However the overall performance could be termed as 'poor' because none of the SHGs were into any economically productive activity. No financial assistance had been provided to them yet. The project details were not painted on the walls of the panchyat or any other building in the village.

In Ravana, 13 SHGs were formed under watershed committee. Out of the 13 SHGs, 2 SHGs were given sewing machine each, 1 SHG was provided with flour mill, 3 other SHGs were given 30 goats each to start animal husbandry, 1 more group was provided with thresher and a landless family has been provided with resources to start a repair shop. Here the project started in 2009-10. The purpose of the watershed development was soil conservation not the storage of water per say, though earthen ponds were built. Till date 1250 hectares of land was brought under IWMP. The compartment bunding was done to check the force of the water and help in ground water recharge and protection of top soil. Three earthen ponds were constructed to hold water but had very less water due to poor rain.

As entry point activity one public well was dug to provide drinking water to villagers in Sabar Nagar locality. Also two computers were given to the school for children and one mechanized zym machines was given to the local youth club. The overall performance could be termed as 'satisfactory' because most of the SHGs were into any economically productive activity. The project details were not painted on the walls of the panchyat or any other building in the village.

In Butkheda village the watershed area was under 1000 hectares. Total of 17 SHGs were formed but they were not into any economic activity yet. Water user groups were there (36 of them) but all of them were defunct as the project yet to have any water. The informations were painted on Panchayat building wall. We verified the records of the watershed committee and found various resolutions but not much execution. In entry point activity one library was given to the village which helps children of the village to prepare for competitive examinations. People appreciated the library very much.

In Sipora village the IWMP project was at initial stage. Though 15 SHGs were formed no economic activity had been initiated yet till our visit. However in January 2016 they were given some training to initiate economic activity of their own. The gramsabha approvals for the design and work estimates for the project was underway during out visit. The project aims to treat 1232 hectares of land belonging to 300 farmers. The details of the project were yet to be painted on the wall. Overall except for Ravana, in other 3 villages IWMP has long way to go to achieve their objectives.

In case of IWMP, there is certain complain in written of mal practice in implementation of the project from Ravana village. So we recommend the concerned officials to investigate the matter further if found suitable for the same by concerned authority.

Status of watershed projects in Sikar, Rajasthan

Sikar has total geographical area of 7,742.44 square kilometer of which 8.27% is under forests but these are mainly thorny bushes and shrubs. Aravali mountain range divides the districts in two topographical parts. There are no perennial rivers in the district. The most of the rain water drained into dry desert regions or to Sambar lake. Sikar district ranks 6th in terms of population, 17th in terms of area and 10th in terms of population density among 33 districts of Rajasthan.

The district experience very hot climate in summer, ranging from 45 degrees Celsius to 52 degrees Celsius, while in winter it may come down below zero degrees Celsius. The long term average annual rainfall is 460 mm and most part of the district experience dry and hot climate for most part of the year. The agriculture mainly depends upon rain water. Mostly coarse cereals, pulses, fodder and oilseeds are cultivated and recently cotton has gained popularity. Over extraction of ground water for

agriculture has complicated the issue of sustainability of agriculture in the region. Rural people in this region for centuries depend upon the state for survival in terms of food and job in absence of agricultural work due to poor monsoon. Most of the mansions, palaces, forts and public utilities in the region built during such difficult times. The district lacks any major industrial or urban centers which could create adequate employment. Migration to other parts of the country and abroad for unskilled and semi-skilled jobs is quite common in the region.

Integrated Watershed Management is essential in a district like Sikar where water is scarce. The district had spent Rs. 1516.52 lakhs out of Rs. 2495.85 lakhs available to it (60.8% of the available fund) and covered 10110 hectares of land against the target of 26667 hectares (72.0%). The lion share for the total available fund towards IWMP in 2015-16 was carried forward from previous year (64.1%). In 2015-16 the center and state releases were Rs. 585.61 lakhs and Rs.309.41 lakhs respectively.

Given the fact that the district has to depend only on rain water and ground water in absence of any perennial rivers, watershed development is crucial for the district's agriculture. The coverage of watershed development has to be widened. Only 1 of the villages has any watershed out of the 10 village, we have covered in the district.

Integrated watershed development works was only found in Kudli village (Piprali taluka). It was started in 2015-16 and to be completed by 2020-21. It covers 4800 bigha land in the village. The works were approved by gramsabha. Participatory rural appraisal (PRA) activity had been done during the starting of the project. We found signboards with all relevant details about the IWMP in the villages properly installed at prominent places. Since Sikar is part of the dry central region from Rajasthan the IWMP mostly involves construction of rain water harvesting structures for individual households and for community use.

There were 7 women self-help groups (SHGs) and 2 water user groups formed under the project. The water user committee has 10 members, 3 of them are women. However during our visit we found no physical activity has been started so far. Only training was given to SHGs in July 2016. Revolving fund was not given to them till the time of our visit. No entry point activity had been done yet. The project is worth Rs. 2 corers but the releasing of funds is not adequate to take up the construction of physical assets. We were not given information that how many community and individual water storage tanks were going to be constructed under the project.

Status of watershed projects in Nagaur, Rajasthan

Nagaur is one of the prominent districts in Rajasthan having historical, cultural, political and religious significance in both inside the state and outside. A major portion of the district falls in Thar desert. The district is connected to major national and state level highways as well as rail heads. The district is bounded by Bikaner district to the northwest, Churu district to the north, Sikar district to the northeast, Jaipur district to the east, Ajmer district to the southeast, Pali district to the south, and Jodhpur district to the southwest and west. In a way it is geographical heart of the Rajasthan state. The Aravalli Range passes through southeastern portion of the district, and the saline Sambhar Lake, India's largest salt lake lies at the southwestern corner of the district, marking the boundary with Jaipur district. It has total of 1631villages. Of the total geographical area of 17718 suare kilometers of the district, 1.3% is covered under hills and desert forests.

The district is primarily rural as 70% of the worker engaged in agriculture; 51.5% as cultivators and rest are agricultural labourers. The long term average annual rainfall is 361mm and most part of the district experience dry and hot climate for most part of the year. The agriculture mainly depends upon rain water.

Mostly coarse cereals, pulses, fodder and oilseeds are cultivated and recently cotton has gained popularity. Over extraction of ground water for agriculture has complicated the issue of sustainability of agriculture in the region. Rural people in this region for centuries depend upon the state for survival in terms of food and job, in absence of agricultural work due to poor monsoon. The district lacks any major industrial or urban centers which could create adequate employment. Migration to other parts of the country and abroad for unskilled and semi-skilled jobs is quite common in the region.

In 2015-16, the district spends 46701.7 lakhs on the total of seven programmes of Ministry of Rural Development, Government of India, which is 94% of total funds that was available to it. On all programmes, the district spent less than what was available to it. On IAY the fund utilization was 30%. On IWMP the utilization was 72%. On NRDWP the utilization was 79%. On rest of the programmes over 90% of the funds were utilized.

Out of the total funds which was available to district administration, 22792.08 lakhs (46.1%) were from central grant, 19005.31 lakhs were from state (38.4%), 7552.92 lakhs were carried forward from previous financial year (15.3%) and remaining from other sources.

Integrated Watershed Management is essential in a district like Nagaur where water is scarce. The district had spent Rs. 3814.11 lakhs out of Rs.5284.79 lakhs available to it (72.2% of the available fund) and covered 25426 hectares of land against the target of 35330 hectares (72.0%). The lion share for the total available fund

towards IWMP in 2015-16 was carried forward from previous year (62.2%). In 2015-16 the center and state release were Rs.983 lakhs and Rs.958 lakhs respectively. Given the fact that the district has to depend only on rain water and ground water in absence of any perennial rivers, watershed development is crucial for the district's agriculture. The coverage of watershed development has to be widened. Only 3 of the villages found to be having any watershed activity out of the 10 village we had covered in the district.

Integrated watershed development works were found in Mawa (Didwana taluka), Meethri and Udrasar (Ladnun taluka) villages. The works were approved by gramsabha. Participatory rural appraisal (PRA) activity had been done during the starting of the project. We found signboards with all relevant details about the IWMP in the villages properly installed at prominent places. Since Nagaur is part of the dry central region of Rajasthan the IWMP mostly involves construction of rain water harvesting structures for individual households and for community use. These structures found to be meeting the drinking water requirement of the beneficiaries from 4-6 months of the year post monsoon.

Actually Udrasar and Meethri village comes under same IWMP project. The Ringan is the third village which is covered in the same project. In Udrasar 1615 hectares of land to be covered, while in Mithri 1915 hectares to be covered. In both of these villages we visited, the village crematorium grounds were developed (boundary walls constructed and cremation sheds were provided with tin roofs) as part of entry point activity. Also 5 large community water harvesting tanks each were provided. Each of these community tanks cost Rs. 1.59 lakhs. Till date 13 individual tanks were constructed in Udrasar and 27 tanks in Meethri. The targets for each village under the project were 134 tanks and 113 tanks respectively. The cost per tank is Rs. 1.2 lakh. However the project is at present stopped due to lack of funds. Only 20 percent of the funds spent so far. In Udrasar, 9 women self-help groups (SHGs) were formed and in Meethri, 8 SHGs were formed under IWMP. In Udrasar none of the SHGs were provided with seed money yet while in Meethri 6 of the 8 SHGs got Rs. 25000 each as revolving fund. They were found only doing internal lending activities.

In Mawa village the watershed project is estimated to be Rs. 1.3 corers of which Rs. 28 lakhs or 20% spent so far. At entry point activity 4 community water harvesting tanks were constructed and village cremation ground was renovated with boundary wall and tin roof. Out of those 4 community tanks, 2 were for animals, 1 for crematorium and 1 for the school. Till date 28 individual tanks were constructed out of 101 totals to be constructed. Here 9 women SHGs were formed and provided with Rs. 25000 revolving funds. Each SHG has 5 women members. So far 15 women from these SHGs had purchased cow, 3 women had purchased buffalo and 11 women beneficiary had purchased sewing machine. Apart from these 9 SHGs, 3 individual beneficiaries were also given assistance for livelihood activities. In all 3 watershed villages we visited, we found the watershed committees were formed with adequate women members.

The gramsabha records show the discussions taken place on IWMP implementation in the village. However when we asked for records of monthly meeting registers we were told these were kept with concerned officials from taluka offices and not in gram panchayat offices. Apart from the chairman of the watershed committee no other member came to meet us. Overall we found the IWMP programme in all these 3 villages are facing shortage of funds and it is unlikely they will meet the target in stipulated time period. The programme suffers from irregular release of funds. Only 20-30% of the financial and physical targets met till date in Mawa, Meetrhri and Udrasar villages. Keeping in mind the water scarcity region in which most of the district falls, the programme implementation should not be delayed. The implementation of IWMP in Mawa, Meethri and Udrasar villages are in standstill. The project should start at the earliest to achieve it's objective. All the women SHGs must get revolving fund and other assistance to expand their activities.

Summary and Policy Implication

There were some major issues that emerges from the implementation of the IWMP programmes in these three states which constitute bulk of the rainfed areas in the country. There is lack of proper supervision on part of project implementing agencies or PIAs across the districts of the 3 states. Often we observe there is also tussle between panchayat and watershed committee especially in Maharashtra which are seen as competing power centers in the same village. While the members of the watershed committee are selected in participatory approach the panchayat is an elected body and often ask its opinion to be honoured in matters of decision.

In most of the 14 villages we have visited across these 3 states the projects are either stagnated or lagging. One of the reason is fund is nor released in time. Most of the structures we visited are without water during our visit due to long spell of inadequate monsoon in these areas. Due to lack of rain the check dams or ponds were being neglected and people do not see any use of them. It is found the community assets created under IWMP were not properly maintained. However the individual water tanks to collect rain water constructed in Nagaur were maintained properly as people drink water from

them. In Madhya Pradesh and Maharashtra it is found the public is not aware of the respective IWMP projects as informations are not displayed at prominent places in the village.

The immediate policy intervention that is needed to make IWMP relevant is to adhere to the timeline for implementation of the project. Since centre gives 90% of funds in IWMP, fund should be released in time. The progress of each watershed project should be made available digitally for better supervision and monitoring. The geo-tagging itself may help to preserve and maintenance of these assets. Except for couple of watershed projects it was found the livelihood activities hardly took off. Most of the SHGs were without any revolving fund or training. This is not acceptable as sustainable livelihood creation is one of the major objective of the IWMP. In case of political difference in the project area the supervising authorities most immediately step in to ensure smooth functioning of the water shed committee and water user groups. The coordination between elected local bodies like gram panchayats and selected bodies like watershed committees and water user groups is very crucial for the success of the programme. It is also observed the PIAs are short of man power, especially skilled and technical manpower like project engineers. This creates burden for existing man power and delay the progress of watershed development. The adequate manpower must be made available in PIAs.

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An Assessment of Re-finance Operation of NABARD in Himachal Pradesh

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Abstract

Indian economy is agricultural rural economy. Without the development of the rural economy, the objectives of economic planning cannot be achieved. Hence, banks and other financial institutions are considered to be a vital role for the development of the rural economy in India. NABARD are playing a pivotal role in the economic development of the rural India. National Bank for Agriculture and Rural Development (NABARD) was established under an Act of the Indian Parliament, viz. NABARD Act 1981, and came into existence on 12th July 1982. NABARD is set up by the Government of India as a apex financial institution with the mandate of facilitating credit flow for promotion and development of agriculture and integrated rural development. The institution plays a developmental role in strengthening the rural financial institutions. The agency extends refinance support for the development of rural economy to SCARDBs, STCBs, RRBs, commercial banks, and other financial institutions approved by RBI. This paper aimed at assessing the refinance operations of NABARD in Himachal Pradesh.

Keywords: *NABARD, Refinance, Rural Credit*

Introduction

The Banking Commission (1972) favoured combining the Agricultural Refinance and Development Corporation (ARDC) and the Agricultural Finance Corporation (AFC) to farm a new institution within the RBI complex but stressed that all short-term credit should be under the control of a single authority, that is RBI. The National Commission on Agriculture (1976) exhorted the RBI to take steps, in accordance with its historic role to "integrating the total structure for financial agriculture and rural development from ground level upwards right up to creation of an Agricultural Development Bank of India as the apex organization" (Singh R. P., 1993).

The importance of institutional credit in boosting rural economy has been clear to the Government of India right from its early stages of planning. Therefore, the Reserve Bank of India (RBI) at the insistence of the Government of India, constituted a Committee to Review the Arrangements For Institutional Credit for Agriculture and Rural Development (CRAFICARD) to look into these very critical aspects. The Committee was formed on 30 March 1979, under the Chairmanship of Shri B. Sivaraman, former member of Planning Commission, Government of India (NABARD, 2017).

The Committee's interim report, submitted on 28 November 1979, outlined the need for a new organisational device for providing undivided attention, forceful direction and pointed focus to credit related issues linked with rural development. Its recommendation was formation of a unique development financial institution which would address these aspirations and formation of National Bank for Agriculture and Rural Development (NABARD) was approved by the Parliament through Act 61 of 1981. NABARD came into existence on 12 July 1982 by transferring the agricultural credit functions of RBI and refinance functions of the then Agricultural Refinance and Development Corporation (ARDC). It was dedicated to the service of the nation by the late Prime Minister Smt. Indira Gandhi on 05 November 1982. Agricultural credit is considered as one of the most basic input for conducting all agricultural development

programmes. In India there is an immense need for proper agricultural credit as the economic condition of Indian farmers are very poor (Goyal, 2015). NABARD was created in response to the aspirations of the people and Government of India to create a strong public policy institution in rural credit for building a strong rural India and accordingly, NABARD flagged capital formation in rural economy as the thrust area. From its inception NABARD is providing finance for agriculture and rural development under various schemes through different financial institutions in the name of refinance support (Muneendra & Lakshmi, 2016). Refinancing is simply replacing a loan you already have with another loan. The old loan is repaid by the new loan. It can occur with your current lender or you may go to a different lender (Financial Rights Legal Centre., 2017). This paper aimed at assessing the refinance operations of NABARD in Himachal Pradesh.

Review of Literature

Choudhary (2002) explained in his study on "Credit Flow to Agriculture : Sustaining Rural Sector", that since majority of rural population is associated with agriculture in one way or other in India, it becomes obvious that the onus of sustainable rural development is on agriculture sector. He admitted that the government is providing credit for different duration to the agriculturalists to strengthen this sector. The author also pointed out that the Kisan Credit Card Scheme introduced in 1998-99 which facilitates short-term credit to farmers, has gained popularly among them. However, according to him, the problem of recovery of loans faced by credit providing institutions has made the recycling of funds a difficult task.

Kunjukunju (2005) has analyzed the role of commercial banks, primary agricultural credit societies and primary co-operative agricultural and rural development banks in rural upliftment of Kerela. The loan advanced by banks are inadequate for the respective activities under taken by the borrowers. There is delay in getting credit. Borrowers face a number of problems in obtaining the credit from institutions. Utilisation of loans seems to be satisfactory. There is lack of supervision and guidance by the banks. Repayment performance of the loanees seems to be good. Loans advanced by financial institutions to the rural poor for productive purposes its proper utilization by them have a positive impact on their economic and social conditions.

Lodha and Trivedi (2015) examined a study on "NABARD: A Financial Inclusion through Regional Rural Banks (RRBs)", that RRBs serve the backward section of the society, the rural poor and people belonging to the lower income group. These banks play a significant role in ensuring sustainable development through financial inclusion. The objective of this study has been proved and it can be concluded that spread of financial inclusions in India through RRBs is more than significant. RRBs is an important player in financial system because of penetration and the increasing amount of loans and customers. RRBs have been able to achieve their objective to great extent by providing banking and financial services to the rural people of India.

Objectives and Methodology

The main objective of the paper is to make an assessment of refinance operations of NABARD in Himachal Pradesh. To achieve the objective secondary have been collected from various focus papers published by NABARD.

Tools and Techniques

For assessing the refinance activities of NABARD in Himachal Pradesh annual growth rate and Compound Annual Growth Rate has been Calculated.

To calculate the Annual Growth Rate in percent following formula has been used:

To calculate the Compound Annual Growth Rate following formula has been used:

$$Annual\ Growth\ Rate = \frac{Current\ Year - Previous\ years}{Previous\ Year} \times 100$$

$$CAGR = \left(\frac{EV}{BV}\right)^{1/n} - 1$$

Where, EB = Ending Value; BY = Beginning Value; n = Number of years

NABARD's Refinance Activities

The refinance facilities provided by the NABARD for different purposes, covers both production and investment credit. These facilities cover a wide range of activities, both in the farm and non-farm sector, these have been shown in Figure 1.

Figure 1: NABARD's Refinance Activities

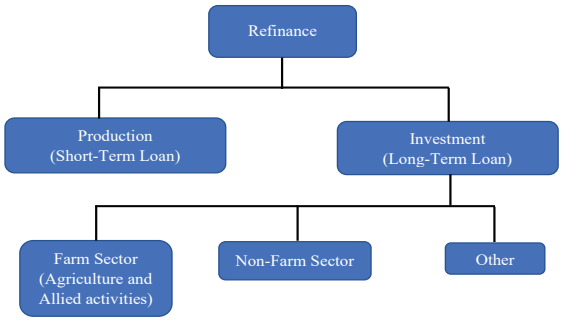


Figure 1: NABARD's Refinance Activities

NABARD's Refinance Operations in Himachal Pradesh

The economic growth in the state is predominantly governed by agriculture and its allied activities (Economics and Statistics Department., 2015). Majority of population in Himachal Pradesh lives in rural areas and their main occupation is agriculture. As the rural people in the country as well as in Himachal Pradesh lives in rural areas. The main occupation of the rural people is agriculture. So, people engaged in agriculture sector or lives in rural areas need supportive activities to enhance their situation, especially, in terms of finance and refinance. In this regard NABARD plays an important role. It not only provides loan opportunities to the rural people but also make provision for refinancing their ventures.

Short Term Refinance

NABARD is providing short term refinance in Himachal Pradesh for seasonal agricultural operation, short term weavers. Year-wise detail of short term refinance provided by NABARD in Himachal Pradesh has been depicted in table 1 and annual growth rate has been in chart 1.

Table 1: Short Term Refinance by NABARD in Himachal Pradesh

Years	Refinance Disbursement (₹ in Crores)	Growth (in %age)
2006-07	11.37	
2007-08	44.7	293.14
2008-09	62.53	39.89
2009-10	120	91.91
2010-11	198	65.00
2011-12	321	62.12
2012-13	403	25.55
2013-14	535	32.75
2014-15	720	34.58
CAGR	**58.55**	

Source: NABARD, various issues of State Focus Paper Himachal Pradesh.

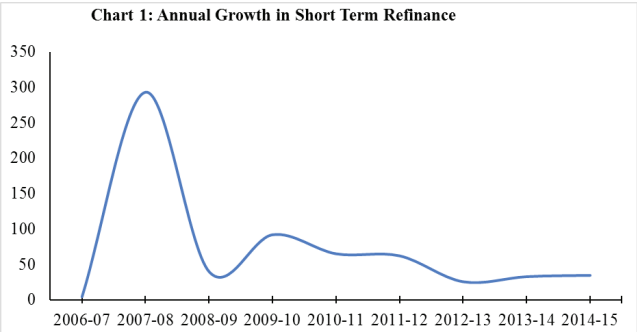


Table 1 depicts that during the 2006-07 Rs 11.37 crores were disbursed in Himachal Pradesh which increased to Rs. 720 crores in the year 2014-15. The table clearly indicates that in term of amount the short term refinance has shown an increasing trend during the period under study.

The annual growth during the year 2007-08 was recorded highest that is 293.14 per cent over the previous year. Whereas in the year 2012-13 this growth was at its lowest point that is 25.55 per cent. The compound annual growth rate (from 2006-07 to 2014-15) is showing an encouraging picture. The short term refinance grew at the rate of 58.55 per cent during the period under study.

Agency-wise ShortTerm Refinance

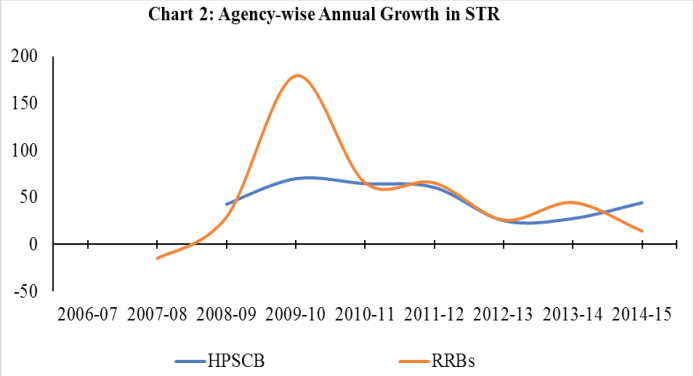
To fulfil the needs of rural people, especially, farmer, NABARD is one of the most important institution in the state. It may provisions for short term refinancing through different agencies such as Co-operative Banks, Commercial Banks, Regional Rural Banks etc.. Hence it is important to evaluate the agency wise short term refinance operations of NABARD. The detail of agency wise refinance operations has been given in Table 2 and the annual growth has been shown in Chart 2.

Table 2 reveals that in Himachal Pradesh NABARD is providing short term refinance facility mainly through HPSCB and RRB. Data shows that in the year 2007-08 the HPSCB disbursed a total of Rs.35 crores under refinance scheme of NABARD. This amount shows an increasing trend and increased to Rs. 520 crores in the year 2014-15.

Table 2: Agency- wise Short Term Refinance (STR) by NABARD in Himachal Pradesh

Year	HPSCB (₹ in Crores)	Growth (in %age)	RRB (₹ in Crores)	Growth (in %age)
2006-07	NA		11.37	
2007-08	35		9.7	-14.69
2008-09	50	42.86	12.53	29.18
2009-10	85	70.00	35	179.33
2010-11	140	64.71	58	65.71
2011-12	225	60.71	96	65.52
2012-13	282	25.33	121	26.04
2013-14	360	27.66	175	44.63
2014-15	520	44.44	200	14.29
CAGR	34.96		37.52	

Source: NABARD, various issues of State Focus Paper Himachal Pradesh.



Annual growth shows a mixed trend. In the year 2008-09 the annual growth rate over the previous year was 42.86 per cent which increased to 70.00 per cent in the year 2009-10. Since 2009-10 the growth rate have shown a decreasing trend and decreased to 25.33 per cent in the year 2012-13. Then again the growth rate shows an increasing trend. In the year 2014-15 it become 44.44 per cent. On the other hand the data related to Regional Rural Banks depicts that in the year 2006-07 the total disbursement by the RRB was Rs. 11.37 crores which decreased to Rs. 9.7 crores in the year 2007-08. Since then the total disbursement by the RRB has shown an increasing trend and increased to Rs. 200 crores in the year 2014-15. The annual growth rate over the previous year has shown a fluctuating trend during the period under study. In the year 2007-08 the annual growth rate was found negative that is -14.69 per cent. While in the year 2009-10 the annual growth was highest that is 179.33 per cent. After 2009-10 the growth rate decreased to 14.29 per cent in the year 2014-15. The analysis of compound annual growth rate reveals that the disbursement of short term refinance by HPSCB grew at the rate of 34.96 per cent while that of RRB it grew at a rate of 37.52 per cent over the period under study (2006-07 to 2014-15).

Long Term Refinance

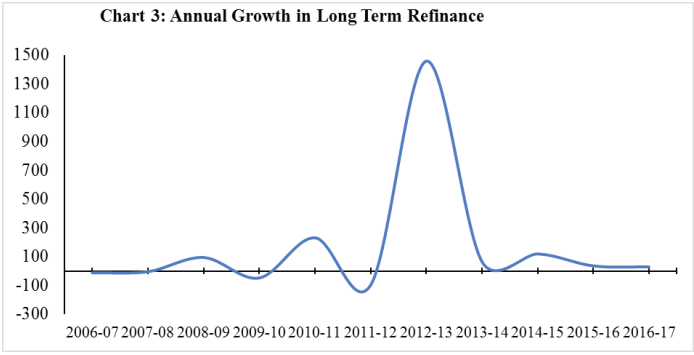
Along with short term refinance it is important that there should be the provision for long term and medium term refinance facility show that agriculture production and productivity could be enhanced. In this investment credit can play a major role, as it leads to capital formation through asset creation. NABARD provides long term and medium term refinance for banks providing adequate credit for taking up investment activities. The year wise detail of long term refinance has been enumerated in Table 3 and growth rate has shown in Chart 3.

Table 3: Long Term Refinance (LTR) by NABARD in Himachal Pradesh

Years	Refinance Disbursement (₹ in Crores)	Growth (in %age)
2005-06	167.28	
2006-07	146.18	-12.61
2007-08	138.76	-5.08
2008-09	269.07	93.91
2009-10	139.43	-48.18
2010-11	461.06	230.67
2011-12	7.5	-98.37
2012-13	116.83	1457.73
2013-14	192.14	64.46
2014-15	420.44	118.82
2015-16	568.89	35.31
2016-17	728.92	28.13
CAGR	13.05	

Source: NABARD, various issues of State Focus Paper Himachal Pradesh.

Figures in Table 3 reveals that the total disbursement (long term refinance) during the year 2005-06 was Rs. 167.28 crores which decrease to Rs. 138.76 crores during the year 2007-08. Then with some fluctuations the amount of disbursement has increased to Rs.461.06 crores. In the year 2011-12 the amount was Rs. 7.50 crores, which increased to Rs. 728.92 crores in the year 2016-17. Annual growth rate reveals both negative and positive trend during the period under study. In the year 2006-07, 2007-08, 2009-10, 2011-12 the annual growth was found negative (-12.61, -5.08, -48.18 and -98.37) respectively, while in the remaining year the positive growth rate was register.



In the year 2012-13 the growth rate over the previous year was found highest that is 1457.73 per cent. Compound annual growth rate with regard to long term refinance reveals that the disbursement grew at the rate of 13.05 per cent over the period of time (from 2005-06 to 2016-17).

Purpose-Wise Disbursement of Refinance

NABARD is making provision for refinance in different area such as minor irrigation, land development, farm mechanization, plantation and horticulture, animal husbandry, non farm sector and others. Therefore purpose wise disbursement of refinance in Himachal Pradesh has been analyzed in Table 4.

Table 4 shows that non-farm sector is getting more priority in the state. During the year 2005-06 the total disbursement in non-farm sector was Rs. 12.75 crores which increased to 42.14 crores in the year 2007-08. In the year 2008-09 the disbursement came down to Rs. 24.14 crores, which again increased to Rs. 298.66 crores in the year 2010-11. Whereas the disbursement in other activities comes at the second place. In the year 2005-06 the total disbursement to other activities was Rs. 6.66 crores which increased to Rs. 120.52 crores in the year 2010-11. Data related to other purposes also shows an increasing and decreasing trend.

Table 4: Purpose-wise Disbursement of Refinance in Himachal Pradesh

Purpose	Year						
	2005-06	2006-07	2007-08	2008-09	2009-10	2010-2011	CAGR
Minor Irrigation	8.7	5.97	2.98	6.76	0	9.9	2.18
Growth (in %age)		-31.38	-50.08	126.85	-100	0	
Land Development	6.66	19.59	4.51	8.47	0	14.6	13.98
Growth (in %age)		194.14	-76.98	87.8	-100	0	
Farm Mechanization	7.76	3.3	2.44	8.69	0.75	15.12	11.76
Growth (in %age)		-57.47	-26.06	256.15	-91.37	1916	
Plantation and Horticulture	2.12	1.39	1.55	2.74	0	1.09	-10.49
Growth (in %age)		-34.43	11.51	76.77	-100	0	
Animal Husbandry	9.63	5.03	2.67	4.42	1	1.16	-29.72
Growth (in %age)		-47.77	-46.92	65.54	-77.38	16	
NFS	12.75	25.22	42.14	24.14	26.15	298.66	69.15
Growth (in %age)		97.8	67.09	-42.71	8.33	1042.1	
Other	6.66	85.68	82.47	21.13	111.53	120.52	62.03
Growth (in %age)		1186.49	-3.75	-74.38	427.83	8.06	
Total	167.28	146.18	138.76	269.06	139.43	461.05	18.41

Source: NABARD, various issues of State Focus Paper Himachal Pradesh

The analysis of annual compound growth rate shows that the disbursement in minor irrigation grew at a rate of 2.18 per cent, in land disbursement it grew at a rate of 13.98 per cent, in farm mechanization it is 11.76 per cent, in non farm sector the disbursement grew at a rate of 69.15 per cent and in other activity it grew at a rate of 62.03 per cent. The CAGR related to the disbursement of refinance in plantation and horticulture and animal husbandry was found negative that is -10.49 per cent and -29.72 per cent respectively.

Conclusion

NABARD not only provides loan opportunities to the rural people but also make provision for refinancing their ventures. It reflects that NABARD is an important institution for meeting short term need of rural farmers, artisans, small entrepreneurs etc. The study indicates that though the amount disbursed by RRB is less than HPSCB, yet the CAGR of RRB is higher than HPSCB. Further, it can be said that HPSCB and RRB are the most important agencies that helps NABARD in fulfilling its objectives in Himachal Pradesh. The analysis clearly indicates that the disbursement of long-term refinance in Himachal Pradesh is showing a good trend. It helps the rural people in the creation of assets required for their well-being. Furthermore, it can be said that non-farm sector and other activities are the most flavored areas for refinancing by the financial agency in Himachal Pradesh. Whereas plantation and horticulture and animal husbandry seem to be in the neglected areas. In other

words, most of the investments was done in non-farm sector followed by other activities in Himachal Pradesh. In nutshell, it can be said that NABARD is playing an important role in the lives of rural people of Himachal Pradesh.

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