

The study of Telangana agriculture: the challenges and issues.

A thesis submitted to the University of Hyderabad in partial fulfilment of the Requirements for the Award of the Degree of

Doctor of Philosophy

In

School of Economics

By

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October-2021

CERTIFICATE

This is to certify that the thesis entitled “The study of Telangana Agriculture: The challenges and issues” submitted by AAULA DASTAGEER bearing Reg. No.14seph07 in partial fulfillment of the requirements for the award of Doctor of Philosophy in Economics is a bonafide work carried out by him under my supervision and guidance. The thesis is free from plagiarism and has not been submitted previously in part or in full to this or any other University or Institution for the award of any degree or diploma. The candidate has satisfied the UGC regulation of publication and conferences before the submission of thesis. Details are given below:

A. publication

Dastageer aaula & R.V.Ramanamurthy(2020): “structure and growth of Telangana agriculture(1981-2015): an economic analysis of the principal crops” in: south India journal of social sciences vol.XVIII no.1 ISSN: 0972-8945, UGC care list journal. Second journal:R.V Ramanamurthy&Aaula.Dastageer (2020) “changing perspectives in development economics: A critical appraisal” in:Desh Vikash ISSN 2394-1782 RNI:APENG/2014/57359, impact factor:2.2376, Volume6 issue4 jan-march2020 UGC approved journal.

B. Presentation in conferences:

1. Presented paper: “Telangana’s agriculture [1971-2015]: A preliminary analysis of land use pattern and production” in: 1st annual conference of Telangana economics association (TEA) held on 8th-9th, April 2017 at centre for economic and social studies, Hyderabad.
2. Presented paper: “surplus production of paddy production in Telangana: an estimation” in: the fourth annual conference of Telangana economic association (TEA) held on 15th -16th, February 2020 at department of economics, Kakatiya university, Warangal.

Further, the student has passed the following courses towards fulfillment of coursework requirement for Ph.D.degree in economics.

Course code	Course title	credits	Pass/fail
EC701	Advanced Economic Theory	4	passed
EC702	Social accounting and data base	4	passed
EC703	Research methodology	4	passed
EC751	Study area	4	passed
EC752	Dissertation submitted on 30/6/2014	16	passed

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DECLARATION

I AAULA DASTAGEER hereby declare that this thesis entitled “The study of Telangana agriculture: The challenges and issues” Submitted by me under the guidance and supervision of Professor R.V. Ramana Murthy, School of Economics is a bonafide research work. I also declare that it has not been submitted previously in part or in full to this University or any other University or Institution for the award of any degree or diploma.

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Dedicated to
My Supervisor

Acknowledgments

I express my deepest gratitude to all the people who have helped me in completing this thesis from PH.D in Economics.

Firstly, I express my sincere gratitude to my supervisor prof. R.V. Ramana Murthy for his guidance and whole hearted support for the completion of my thesis.

I am deeply indebted to all the faculty and staffs of the school of Economics of University of Hyderabad for providing necessary aid and information.

I would like to express my heartfelt gratitude to my family members. My friend G. Vijay kumar without his support this thesis would not have been materialized.

I am deeply indebted to all seniors like, Turangi. Satyanarayana for his advice and suggestion and all friends, and acquaintances for their support and cooperation. I am grateful to all individuals who directly were contributory in completion of my course in the University of Hyderabad.

Aaula Dastageer

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Chapter 1

1. Introduction

1.1 Introduction

Telangana is the 29th new state of India formed on 13th Feb 2014. Even though it is relatively a new state, as a region it existed a distinct one for hundreds of years. It was the major part of the Nizam Dominion until 1949; it was a separate state by name Hyderabad state during 1949-56, before it was merged with greater Andhra state to form Andhra Pradesh. The united state of Andhra Pradesh state had formed over several written understandings and terms between prominent leaders of Congress party, called *Pedda Manushula Oppandam* (Gentlemen's Agreement 1956). The basic spirit behind these terms of the Agreement was based on non-usurpation of Telangana resources by the people from Coastal Andhra, who were thought to be more advanced, financially and culturally. However, the terms as feared, were disrespected by successive leadership of Andhra, which led to periodic agitations for bifurcation to precious state. The separate agitation of 1969 articulated these concerns, which was successfully placated, with some assurances. The perception of growing economic differences, political-social-cultural marginalization of Telangana people, and the neoliberal growth model that was adopted since 1993 led to feeling that interests of the Telangana people were adversely affected under the Andhra leadership and a massive public agitation has begun since 1997. As a part of this articulation, agricultural development became the center of the discourse. The problems of Telangana agriculture, beginning with that of mass farmers' suicides since 1997, indebtedness growing out of failing bore wells, hunger deaths during droughts of 2002-04, etc were all attributed to the policy negligence of the Andhra leadership of ruling parties. Thus this led to the massive agitation which yielded the Telangana state, with the all-party consensus in the Parliament, barring a few. Such a Telangana state will naturally have agricultural development at the focus. This thesis is an effort to understand the Telangana agriculture, its structure and nature from the tools of economics. By teasing out the data of the regions, it analyses the structure, cropping pattern, irrigation, and production in major crops for the period 1970-2018. This would be useful to

understand the nature of challenges for the transformation of agriculture of Telangana, which is at the heart of developmental transformation.

We know that the per capita income of a region can be increased only through structural transformation, a process that sees growth of non-farm sector which has higher productivity than agriculture. Hence, workers need to get livelihood in the non-farm sector, in order to prosper. However, this proved to be more difficult than said, and this is precisely constituting the developmental challenge. Development theories, like Lewis Model, suggested that regions or nations were which begin industrialization with a vast pool of surplus labour has enormous scope for achieving high rates of industrial growth. A constant push in industrial investment, through raising the savings is suggested as way forward. The experience is again is harder than the precept. Even though Lewis proposes that the increasing savings rate, after the migration of surplus labour would increase agricultural investment, hence productivity, there is criticism that he did not give the importance to agriculture that it deserved. Fei and Ranis (1974) in their model, which is modified version of Lewis, postulated that certain agricultural rate of growth is necessary for the real wage stability in the industry. Particularly, assuming the population rate increase in mind, which is ignored by Lewis model. A strong agricultural sector would have supply and demand side support to the non-farm sector growth. A growing agricultural surplus would prove capital for the non-farm sector; would keep prices in check, therefore, real wages; and can supply raw materials to agro industries. For a good number of non-farms labour, a farm economy link can ensure some food security. Therefore, the importance of agriculture cannot be denied for overall development, Telangana being no exception. This study assumes the salience from this theoretical understanding.

Telangana, as a region, is historically an agrarian economy and continues to be from the occupational dimension. Even today, about 55 percent of people depend on it, and 44 percent of workforce directly depends on it. However, it is also noted by several scholars that agriculture in India in general is no longer the sole livelihood provider to the majority rural masses. Some studies such as Rawal (2017) and Ramanamurthy (2015) suggested that only about 17 percent of the rural labour directly depends exclusively on agriculture, 75 percent of them also derive income from non-farm activities. This when read along with fact that share of agriculture falling to 18 percent of SGDP may look like importance of agriculture has fallen. While it is true and natural that the role of agriculture in overall development declines, its substantive and catalytic role for the growth of non-farm sector continues to be important.

What is worrying is the employment elasticity's in agriculture have been falling and thereby employment availability in agriculture has been falling. This is not being compensated by a complimentary growth in labour productivity, including in Telangana. The total working population in the state is about 143 lakhs and those engaged in agriculture is about 62.9 lakhs. Telangana state still in the Rostow's take off stage because agriculture labor force more than 20% for drive to maturity stage less than 20% agriculture labor force required. Probably, it is impossible to reach the drive maturity state, since taking 24 percent of labour out of agriculture would mean creating 33 lakh jobs outside agricultural sector, which do not appear an easy job by any stretch of imagination.

1.2 Agriculture and Development: A Theoretical Understanding

Is agricultural development important for the economy? We all know that all societies undergo certain historical course of development. Globally, societies have progressed from hunter gathering stage to animal rearing nomadic societies, to settled agricultural communities to urbanized societies to industrial societies to post-industrial societies [Rostow (1966)]. It is about 8000 years ago, civilizations have learnt agriculture. But from there development proceeded to different stages. Rostow described this as traditional, pre-take off, take-off, age of mass consumption to knowledge societies. Marx had given an alternative version of progress from primitive communist societies, to slave societies to feudal societies to capitalist societies to socialist societies to communist society [*Collected Works*, Marx and Engels (1956)]. The most relevant stage of development for us is how our traditional/agrarian society moves to industrial society. In this context let us refer to two different viewpoints, namely the Marxian and the other liberal view.

Liberal Development Theories

The most prominent mainstream theory of development, the Lewis model, argued that the existence of surplus labour is boon to the backward societies. Now with an investment shock to the urban modern sector, it has higher wage rates due to positive marginal product, rural surplus labour whose marginal product is zero, would migrate to the modern sector. This would enable modern sector to produce profits, which are reinvested for further expansion. This would constantly attract the transfer of rural surplus labour. Meanwhile the exit of surplus labour from the rural households will improve their savings and hence investment,

thus even agricultural productivity will begin to improve. Thus, this process would enable a constant accumulation until all the surplus labour exhausted in the traditional sector. Thus, what is needed is to mop up the savings in the country and direct them into the investment of modern sector. Lewis did not mind whether it is public or private sector it does it [Todaro (2005)]. While Lewis model could be right in several ways, certain things have not been predicted by Lewis which becomes hindrances. For example, population growth, highly capital-intensive technology in modern sector and absence of a developmental state are.

Lewis theory extended by was the ranis- Fei theory. They tried to focus on the neglected part of Lewis model, i.e., the role of agriculture which remained passive in Lewis model. They argued that at the end of the stage two, where there is no surplus labour, the wages would tend to rise if agriculture does not respond with increased production. Hence, from there a rise in.

This model divided by the 3 stages phase one of lewis model again separate the two stages. These two stages in ranis and fei model are phase one and phase two. In ranis and fei model phase one is the break point and stage two is the shortage point. Stage two of labour shortage point in the lewis model is the commercialization of agriculture phase three in ranis and fei theory in the under developed countries.

Ranis and fei (1961) formalized the Lewis theory and defined three phases of dualistic economic development by subdividing the first stage in the Lewis into two phases. Thus, the second labor scarce stage of the Lewis model corresponds to phase three stage of the Ranis-fei model. They have added the third phase which witnesses a rise in retrieve price of agricultural prices accompanied by the rise in investment. The rider is that if agricultural sector fails to respond in producing the surplus, then the industrialization process would hit a grinding halt.

Neoclassical model of Jorgenson

Neoclassical model developed by Jorgenson does not assume any surplus labour. It assumes that agricultural output is a function of labour and land, while industrial output is function of capital and labour. Industrial labour is function of wage rate determined via agricultural terms of trade and agricultural surplus. If industrial output has to expand, then the industrial wage rate to remain stable, it in turn depends up the relative growth of agricultural output. If rural population increases, the industrial growth is further constrained. On the whole, the industrial

output depends on the agricultural surplus. This model thus compels a prior agricultural development to begin with rather than to follow an industrial development [Ghatak (1987)]. Neoclassical theories have emphasized on comparative advantage theory and market forces to guide the course of development rather than to hurry an industrial growth by neglecting agricultural sector.

Marxian View of Agrarian Transition

The Marxian view states that society is organized into classes like the class of proprietors capitalists that own and control productive resources like land and inputs, while the other class being agricultural labour who depend on the formers for not having means of production. When agriculture lives in a feudal mode of production, the moments of crisis arising from internal and external factors often intensifies the exploitation of the labour. The sharpened class conflict makes labour to resist the feudal extraction in terms of migration to open revolt. Feudal modes of production are also lack efficiency to respond to rising demand from the growth of non-farm sectors like artisanal production and factory production. The monetization of all transactions, increasing migration, technological developments and state actions historically reduced feudal powers and feudal lords have taken to become capitalist farmers, called transition from above [Lenin (1906), Bernstein (1997), Byres. In some society's revolutions have toppled the feudal power and transferred land to the peasants. These events largely gave incentives to the actual peasants who would transform themselves into capitalist farmers, who would employ modern technology to increase production.

In most countries such transformation has helped industrialization by forming backward and forward linkages between the agriculture and industry, may it be Japan after Meiji Restoration in 1860, or western Germany after unification or northern United States of America [Bernstien (1987)]. Byres argued that agriculture had to supply cheap food grain surplus and provide capital in the growing industry, with falling term of trade. Thus, it helped the capital formation in the modern sector. In Soviet Union also, after the October Revolution in 1917, the modernization program did not succeed until all the farms were forcefully collectivized and nationalized in 1936. Thus, squeezing the agricultural terms of trade had been the strategy followed for rapid industrialization [Ashok Mitra (1977)].

Byres argued that India also tried this strategy. It had to introduce green revolution over an unequal agrarian structure, which made big farmers to benefit most. Though green revolution has succeeded in producing food grain surplus needed by the growing population

and urban industrial demand, the rural society remained highly unequal. The landlordism in some places increased and the democratic struggles had to be waged against the unequal power of landless and small peasantry.

An issue that concerns the capitalist transition of agriculture in India is about the continued survival of small peasants, despite the transition to market oriented production. In the normal course they should disappear, as Marx thought (Vol.3, *Das Capital*, 1956). But this is not just the case in India but in several countries where small peasants have become petty commodity producers, and even though are unable to compete with medium and big farmers, they continued to survive. Karl Kautsky (1894), in his classic book *Die Agrarfrage* or *The Agrarian Question* offered the best explanation for the late 20th century phenomenon that he too observed in Germany. He concluded that small peasants, despite being inefficient and loss making they continue to survive for several reasons. First, they continued to be managing to earn subsistence. Second, they have nowhere gone. Third, they starve, under consume and overexploit themselves to reduce costs and survive. Fourth, big farmers do not usurp their lands as they are key source of supply of agricultural labor that the former do not wish to cut off. Fifth, they will be under continuous distress and indebtedness, yet they persist. For Kautsky, there is no clear resolution towards one hundred percent proletarianization. The same this was also told by Frederick Engels (1896) in his essay *Peasant Question in France and Germany*. Engels argued that small peasants will be damned in the capitalist market competition, they can protect if and only if they are reorganized into farmers cooperatives. Even cooperatives are an intermediate solution, which would generate internal economies, but would face the problem of falling terms of trade. The final solution, according to Marx, who mentioned in his essay *The Land Question*, is to nationalize the land the give every farmer his share in the national income [Ramana Murthy (2020)].

Now after the globalization, when governments have reduced budget allocations to agriculture and public investment in the sector, what would take forward the issue of transformation of agriculture? The post-globalization period, the agrarian question is argued to be dissolved as industry neither longer depended on financial surplus of the rural India nor the agricultural surplus, given the access to the global market [Bernstein 2012, Akram-Lodhi and Kay (2015)]. Now farmers are increasingly linked to global markets through agribusiness chains. What would bring further transformation in India agriculture to take the agricultural production to a next level remains a billion-dollar question [Ramana Murthy (2020)].

1.3 Telangana's Agriculture: A Historical Backdrop

For any region, the level and the nature of development largely come from its historical location. Telangana was historically before Independence was a part of Nizam Dominion, which was allowed to as a Princely state under the British was the largest Princely state in India with regions spread into Telangana, Marathwada and northern Karnataka. Nizam had to secede Coastal Andhra and Rayalaseema, and central India districts to the British for their support against French and later Marathas in 1776. Nizam introduced several modernization measures in administration, quickly learning from the English. As a part of this, under the Prime Ministership of Mir Turab Ali Khan or Salar Jung I in 1853-81 efforts began towards modernization of land, revenue, judicial and general administration. The reforms were aimed at out reducing arbitrariness. Salarjung II had abolished Collection of tax revenue through revenue contractors. Village, Taluq, District and State administration were streamlined for revenue collection, administrative accountability and dispute resolution. Some of the reforms also backfired as it gave too many sweeping powers to Deshmukhs and Zagirdars, probably on the lines Zamindars in British counterpart. Nizam also introduced ryotwari settlements in the Diwani Khas (Nizam's areas) in 1875. But the Samsthanams within Nizam Dominion were exempted. Under Zagirdars and Princely states feudal practiced continued. Nizam also had a sophisticated state with separate departments of revenue, judiciary, police, finance, public works, forests, customs, and education, and health, military and political affairs with such employees. City courts were set up while judicial officers were appointed at all the different levels. Hence, it was far less feudal state as popularly conceived. But a modern state of that time yet did not have a democratic system as aspired by the citizens and did not address the tyranny of its rural kulaks and semi-feudal lords, which led to public outrage against the Nizam state towards 1946 (Khan, 1972, 62-70; Prasad, 2015: 35-54; Subba Rao, 1997, 23-33)¹.

¹ Khan, Md. Waheed ed., A Brief History of Andhra Pradesh, State Archives, Government of A.P, Hyderabad, 1972; Rajendra Prasad (2015) Awakening in Hyderabad State: Salar Jung Reforms in Comprehensive History and Culture of Andhra Pradesh Vol.,7 ed. By Keshava Narayana, Emesco, 2016, pp.35-54. Land Survey department was set up in 1875 with a Settlement Commissioner to arrive at the assessment of revenue in a scientific manner. P.41, Prasad, Rajendra (2015).

Coming to the agriculture, it is a popular perception that agriculture in Telangana historically is dominated by dry land crops like Jowar, Bajra, red gram, small millets, groundnut, etc. and that it lagged behind cultivation of wet land crops like rice, sugarcane, tobacco etc. Further, it is often thought that agriculture in Telangana remained feudal and not commercialized. Also, there is another opinion that there is no modern development in agriculture in terms of introducing scientific methods in cultivation, as compared to regions in British India. All these are not borne an empirical scrutiny.

A special agriculture department was set up in Nizam Dominion by 1911, which recruited more than 750 extension officers. The department had made field trial on new varieties in cotton, groundnut, castor, rice, turmeric, potato, and tobacco in different regions. Nizam had constructed the Nizamsagar dam in 1938 on Manjeera River and encouraged sugar cultivation. Farmers from Coastal Andhra were encouraged to migrate to cultivate sugarcane, so that local farmers can learn. Similarly, turmeric was started in Kamareddy, cotton in Parbani,

In each region one crop was chosen for introducing seeds, inputs, and other support. For e.g., cotton in Parbhani, sugarcane in Kamareddy, fruits in Aler. Farmers were given demonstrations on manure use, pest control etc. In addition to seeds, department used supply ammonium sulphate, super phosphate, amorphous like fertilizers. Nizam government aimed at increasing the cotton crop which had the highest foreign currency value. Similarly, railway lines were expanded during 1889-1894 into cotton, castor and groundnut growing areas connecting them to port cities like Bombay for overseas trade. After construction of Nizamsagar reservoir, the sugarcane construction was expanded from 7996 acres since 1934-35 to 29055 acres in 1944-45. in two different regions, namely, in Nizamabad and Zahirabad and three sugar mills were set up, and Nizam Dominion not only became self-sufficient in sugar, but even exported. Similarly, groundnut was also encouraged, in Mahabubnagar and Raichur, its acreage increased from 3000 acres in 1922 to 14.14 lakh acres 1943-44.

The most significant share of area in Nizam's agriculture went for castor production, it occupied nearly 50 percent of the arable land, and it was cultivated in nearly 7.76 lakh acres. In fact, in the pre-World War I period, castor became the major lubricant in motor vehicles that were just invented. This led a major boom in the castor demand that led to a massive opportunity for the growth of the crop in Telangana to which the crops suit the best in rain fed conditions. However, by 1931, over expansion of castor was worldwide led to

collapse of castor prices, and several farmers lost their lands not being able to pay land taxes besides being hurled into debt trap.

Cotton acreage was concentrated traditionally in Marathwada region of Nizam Dominion. Nizam, in close collaboration with the British did a lot to encourage cotton cultivation, including introducing the Cambodian variety seed, which apparently became an instant success. Later Nizam established Azam Jahi Mills and D.B.R Mills in Telangana in 1930s. Cotton area expanded from 2.20 lakh acres in 1928 to 4.84 lakh acres in 1944.

Usury and moneylending

Like in British India, in Telangana too rural banking has not developed. Therefore, all the commercialization that took place was under the financing of informal financier caste, namely Komatis. Other powerful people like landlords also used to indulge in usury. Absentee land lords prevalent in the state they gave land to the tenancy took rent and also gave loans with interest with condition of repay principal and interest by crop product. Land lords gave loans with interest rates 18 to 24% in money and by seeds it was 25 to 125 %. Money lending disposed with seeds or money but land lords' interest in repay with seeds. Land lords gave seeds rate was less than market rate. Land lords huge benefited from loan taker by principal, interests and seeds rate Rs 5 less than market price. Once take loan from landlords difficult repay loans necessary selling lands to the land lords.

Usurious money lending was practiced recklessly. Nizam government had to pass an anti-usurious law in 1940, stipulating maximum interest rate to 6-9 percent per annum. However, it is difficult to know how strictly this was implemented. There was also and Co-operative Law was promulgated in 1913, with once again poor implementation. The post-1930 economic depression had broken back of the peasants, as global prices collapsed and farmers defaulted to moneylenders, landlords and state in paying rents, interests and taxes. Then they lost their lands to the landlords, Deshmukhs, patels and patwaries, became tenants in their own lands by 1943. The government-imposed 60 percent levies as a part of World War II support to the British, and the consecutive droughts during 1945-47 led to extreme conditions of hunger and poverty. Communist Party of India organized famines raids on stock piles of landlords and transporting goods trains and distributed food grains. This made it hugely popular. Absence of Congress party activities, due to national policy of the Party in the Princely states, Communist Party became the sole opposition party. It was subsequently

banned under anti-state activities. However, Communist Party of India operated under the banner of cultural organization *Andhra Maha Sabha*.

When agricultural prices crashed on one hand, the money-lenders and local merchants like sow cars prevented the farmers in going to the markets to sell their agricultural products. Since the farmers had to repay the debts the money-lenders the cultivators were forced to sell their commodities to the local merchants at a rate which was less than the market price. The conditions of the labor in the Telangana region were even more miserable. The Rural Economic Enquiry Report 1930 showed that one third of the population of Warangal Subah was landless laborers. The inability of the laborers to get freed from the hereditary debt burden, and the weak bargaining power of the rural proletariat due to their poverty and ignorance to first against the unilateral fixing of the wages by the landlords had accounted very much for the low agricultural wage rates in the Telangana region.

Agricultural Development

There were three types of lands existed in Nizam Dominion, namely, Diwani lands, Atrafi Balda and Inams/Jagirs. Taxes from Diwani lands were used for running the state, taxes from Atrafi-Balda were for the personal expenses of the King and taxes from Inams/Jagirs for to be shared between the Inamdar's and the state.

Out of the total number 22,457 villages in the state Diwani villages numbered 13,961 or 61.9% villages, 62 percent were Diwani lands, 29 percent were Atrafi-Balda and 9 percent were under Jagirdaris. There was no regulation on the Jagir lands by the state, and the Jagirdars indulged in imposing arbitrary taxes on farmers, and people in general. They also imposed bonded labour *vetti* on defaulters constituted 95 percent.

The taxation system in Nizam Dominion was as bad as in the British India; rack renting and usury by money lenders marginalized many peasants. The agrarian structure was considerably unequal. The 30 percent of farmers owned less than 10 acres owned 6 percent of the land. Big owners holding 100-150 acres owned 50 percent of the land. Thus, agricultural structure under Nizams led to an extremely unequal ownership structure at the time of the Independence. Jagirdars owned from 5000 acres to 10,000 acres, who were vicious in their methods of dealing with their subjects. Visnur Ramachandra Reddy, the Deshmukh of Jangaon acquired 40,000 acres; Jannareddy Pratap Reddy of Jangaon had 150,000 acres. Deshmukh of Madhira acquired 50,000 acres.

The irrigated area by 1949 was about 10.8 percent of the total cultivated land. The main sources of irrigation were open wells, tanks and canals. Telangana had many ancient tanks like Ramappa, Laknavaram, Pakala, Laxminarayana cheruvu etc. During the 1942-47 the tank irrigation got neglected. The effect of this was noted in a dramatic rise in fallow land.

Agricultural Production and Yields

From 1934-35 commercial crops gave more revenue to the state than food grains. To discourage food crops, Nizam State in 1943 implemented cereals seed tax that began creating serious food shortage. As a result, the Hyderabad state was purchasing one lakh tons of rice per annum from Madras province.

Equally important was the fact that the yield per acre of most crops was one third of that of same in rest of India. The major reason was that the amount of effort that went in tax collection did not go into improving farm management practices. The spending on irrigation has gone up until 1935 and progressively declined.

The agricultural department was allotted only 1.57 percent of total state budget.

Hyderabad state exported skins, hides, sesame, and grain of castor, groundnut and groundnut oil. For a very long time, commercial crops like cotton, linseed, sesame, groundnut, seed of castor were sent out to England for import of finished goods. Industries finished goods like cloths, spinning, ginning, yarn, and oils came only towards late 1930s.

Agricultural Decline and the Post-Depression Crisis in Telangana

Life expectancy was mere 25.9 years and had increased little over the forty years since 1891. Tribal had an even lower average lower life expectancy. But if health services were poor, infrastructural development was worse. Warangal boasted just 443 miles of metal led road until 1950. Adilabad sprawling over 7000 square miles had 307 total miles of roadway. Nalgonda had merely 300 miles metaled roads (Iyengar 1951). These roads probably extended from one commercial center to another almost certainly they led to the big train junctions that were the main vertical links through which trade was conducted. The entire state that had just 64 telegraph and telephone services (Iyenger 1951). But the

countryside not a self-contained rural utopia, it was connected to the industrial and merchant economy (Iyengar 1951). In the latter half the nineteenth century a series of administrative reforms was undertaken by salar jung I, then prime minister of Hyderabad state. Among them were as shift from indirect revenue collection through tax farmers like Deshmukh's and Deshpande's to direct collection from farmers, under ryotwari.

The adverse effect of Nizam's agricultural policy led to a rise in landlessness and tenancy. After twelve years on the same plot of land, asami-shikmis (tenants) were entitled to shikmidari (ownership) rights but they were rarely allowed to stay for more than allowed to land stay for more than three or four years (dhanagare 1974 Iyengar 1951 pavier 1981 quereshi 1947). When direct revenue collection was introduced were granted vatans (gifts of 5-10 villages) or Mash (annuities; compared as a percentage of past return) (Sundarayya 1972, Dhanagare 1974). Besides, taking advantage of low literacy rates and their own substantial knowledge of land records they were able to take possession of large areas of the most fertile land. It seems that registration of land-titles was usually done without the knowledge of the peasant who was cultivating it (Sundarayya 1972).

The question still remains, "why did the Deshmukh's allow their power to corrode always". In the absence of any evidence to the contrary, one explanation can be suggested. Our assessment so far has been "behind the actors backs" their actions however would depend on how perceived matters. The landlords' perception of his own power was likely to be systematically biased: his increased power over the villagers could be substantiated in day to day life; however, the loss of power involved in his dependence on the trading class was likely to be veiled. This could be for two reasons relations of exchange, being "free and equal" are seldom perceived otherwise. Secondly, the landlord was interested in selling his produce and could be scarcely be expected to appreciate the qualitative difference between selling food crops for a local market and crops for the world market. The Deshmukh's were losing power while thinking that they were gaining it that explains why jumped into cash-crop market so enthusiastically.

1.4 Telangana Agriculture in the Post-Independent Period: An Overview

1. Land Use Pattern

Telangana's total geographical area is about 112 lakh hectares in 2014-15, after losing about 2 lakh hectares from alienation of 6 mandalas during the formation of the state. Out of this, about 25.4 lakh hectares is forest land (22.6 percent), which is slightly higher than the national average [table1.1]. Net sown area is about 43.7 lakh hectares in 2014-15 (39 percent). In the previous 35 years, it roughly remained same, even though it lost marginally in between. It lost some 5 lakh hectares during 1980-2006 and recovered 3.7 lakh hectares in the last one decade during 2006-15. The current fallows and other fallows form about 17.7 percent, (constituting 12.5 & 7.18 percent respectively) shows that there is a potential to increase the net sown area in the future by some appropriate policy. The current fallows show a tendency to fluctuate between 12-16 percent, for having a greater share of well irrigation. Interestingly, the increase in other fallows is outweighed by a fall in forest land and barren land, thus making overall net sown area almost constant. Most important fact is that the area sown more than once has increased from 3.8 lakh hectares to 9.7 lakh hectares. As percentage of net sown area, this has increased from 8.4 percent to 21.4 percent during 1981-2015. The net addition to gross sown area is approximately 6 lakh hectares. On the flip side, we also observe that about 2.3 lakh hectares of commons are lost, the pasture and grazing land came down from 5.2 lakh hectares to 2.9 lakh hectares during 1980-15. Similarly, about 1.2 lakh hectares of cultivable waste has come down. About 2.1 lakh hectares is agricultural land converted to non-agricultural use. Thus, with an appropriation of forest land, cultivable waste land and pastures & grazing land, appear to have contributed to a stable net sown area and a rise in gross sown area, besides area sown more than once, in spite of a rise in current and other fallows and land put to non-agricultural use. The coefficient of variation of gross cropped area is about 9.14 percent; that of net sown area is 7.5 percent and that of area sown more than once is about 33.4 percent. Thus, with a greater reliance on well irrigation as we will show later, area sown more than once will tend to show wide swings along with fluctuations in rainfall, producing nearing 10 percent variation in gross sown area, to have similar variation on the agricultural output.

Table 1.1 Land utilisation.

Years	1980-81	1990-91	1998-99	2006-07	2014-15
Total Geographical Area	11477000 (100)	11477000 (100)	11477000 (100)	11484100 (100)	11207810 (100)
Forest	2780000 (24.22)	2810000 (24.48)	2745000 (23.92)	2743476 (23.89)	2540101 (22.66)
Barren and uncultivable land	659000 (5.742)	532000 (4.64)	621000 (5.41)	603453 (5.25)	607430 (5.42)
Land put to non-agriculture uses	679000 (5.92)	702000 (6.12)	772000 (6.73)	794860 (6.92)	884596 (7.89)
Cultivable waste	214000 (1.86)	161000 (1.4)	203000 (1.77)	183747 (1.6)	182511 (1.63)
Permanent pastures grazing lands	518000 (4.51)	457000 (3.98)	348000 (3.03)	327260 (2.85)	298597 (2.66)
misc tree crops and groves	76000 (0.66)	77000 (0.67)	72000 (0.63)	113789 (1)	112180 (1)
Other fallow lands	567000 (4.94)	545000 (4.75)	843000 (7.35)	803504 (7)	805150 (7.18)
Current fallows	1459000 (12.71)	1804000 (15.72)	1568000 (13.66)	1910593 (16.64)	1400669 (12.5)
Net sown area	4525000 (39.43)	4366000 (38.04)	4305000 (37.51)	4003418 (34.86)	4376576 (39.05)
Area sown more than once	381000 (8.4)	670000 (15.34)	870000 (7.58)	938035 (20.2)	938793 (21.4)
Total cropped area	4906000 (42.75)	5036000 (43.88)	5173000 (45.07)	4941449 (43.03)	5315333 (47.43)

Sources: Directorate of economics and statistics of Telangana.

We can also see this in terms of compound rates of growth. The net sown area during 1980-15, has declined at -0.1 percent. When divide the 35 years into three sub-periods, broadly as pre-reform period (1980-1991, first phase of reform (1992-04), and second-phase of reform (2004-15), we observe that the net cropped area was lost sharply during the first phase, but recovered in the second two periods. Similarly, the gross sown area has declined at -0.35 percent, but recovered at 1.8 percent rate during the last phase, making overall growth positive. The area sown more than once has grown faster during 1980-91 and 2004-15 at 2.2 & 2.05 percent respectively. The gross sown area has increased for overall period at 2.89 percent.

While, rise of gross sown area appears brighter side of the story, the flip side has two aspects. One, there could be lot more scope for increasing cultivated land. And second, loss of commons would make allied activities to agriculture like dairy and livestock to have an adverse impact.

2. Irrigation

The three major sources of irrigation in the state are well, tank and canal irrigation in Telangana, an issue which remained at the heart of formation of the new state. Out of the total 43.7 lakh hectares of net sown area, the total irrigated area formed about 25.28 lakh hectares in 2014-15, which is about 57.9 percent. Out of this, a lion's share of 84 percent of irrigated area is irrigated through wells, while 9.61 percent is irrigated by canals and 4.47 percent are covered by the tanks. Overwhelming share of well irrigation, which is mostly by the bore wells, reflects the burden of private investment, compared to the declining public investment reflected by decreasing share of canal and tank irrigation.

The net irrigation in the state has increased at compound rate of 1.85 percent during the last 35 years [table1.2]. It has growth faster in the pre-reform period during 1980-92, it rose at 2.33 percent. Immediately after the reforms, net irrigation declined at rate of 0.88 percent during 1995-04, but recovered during the second phase during 2005-15, it increased by 1.74 percent per annum. However, the well irrigation that increased at 5.81 percent, while canal and tank irrigation declined in the last 35 years at -0.72 & -2.64 percent respectively. The well irrigation increased at 7.32 and 9.58 percent rates during 1980-91 and 2005-15. Because, groundwater is very closely related to rainfall, well irrigation shows greatest instability compared to surface irrigation. As observed earlier, the rainfall influences the area sown, though changes in current fallows, groundwater backed by overwhelming well irrigation are likely effect production instability.

Table1.2: Compound growth rate of Net and Gross cropped area

	1980-81 To 2014-15	1980-81 To 1991-92	1992-93 To 2004-05	2005-06 To 2014-15
Gross area	-0.02**	0.0001	0	-0.23**
Net cropped area	-0.10	-0.66	0.06	1.73*
Gross cropped area	0.32**	-0.35	0.16	1.80**
Area sown more than once area	2.89*	2.20	0.85	2.05

Source: Estimated

Table 1.3 Measures of Central Tendencies

Area	Mean	Standard deviation	Coefficient of variation
Gross area	11462315	62735	0.54
Net cropped area	4246647	322147	7.58
Gross cropped area	4982335	455438	9.14
Area sown more than once area	735688	249000	33.8

Source: Estimated

Table 1.4 Compound Growth Rates of Different Sources of Irrigation

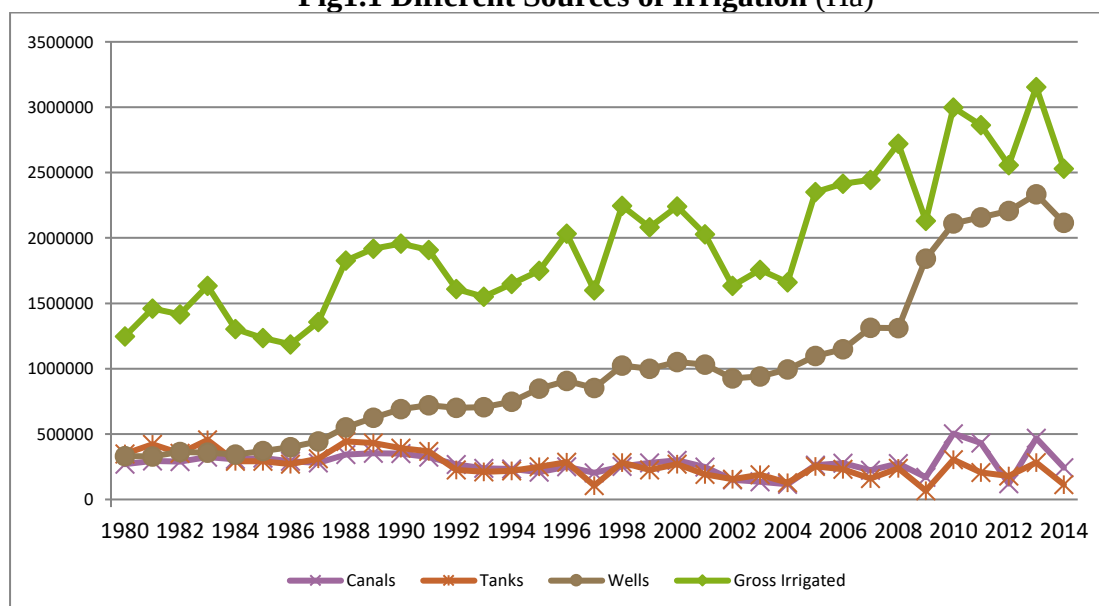
Different sources	1980-15	1980-95	1995-05	2005-15
Canal	-0.72	-0.68	-6.5***	1.41
Tank	-2.64*	-2.9***	-4.80	-2.5
Well	5.81*	7.327*	1.31	9.58*
Other sources	1.15*	4.53*	-4.38**	2.11
Net irrigated area	1.85*	2.33*	-0.88	1.74
Gross irrigated area	2.22*	2.2**	-0.97	1.98

Source: Estimated

**Table 1.5
Irrigated areas mean, Coefficient of Variation**

Irrigation source	Mean	Standard deviation	Coefficient of variation
Gross irrigated area	1955778	515191	26.34
Net irrigated area	1443362	319832	22.15
Canal irrigated area	274504	85230	31.04
Tank irrigated area	261510	96959	37.07
Well irrigated area	997110	586025	58.77
Other source	52333	10869	20.76

Source: Estimated

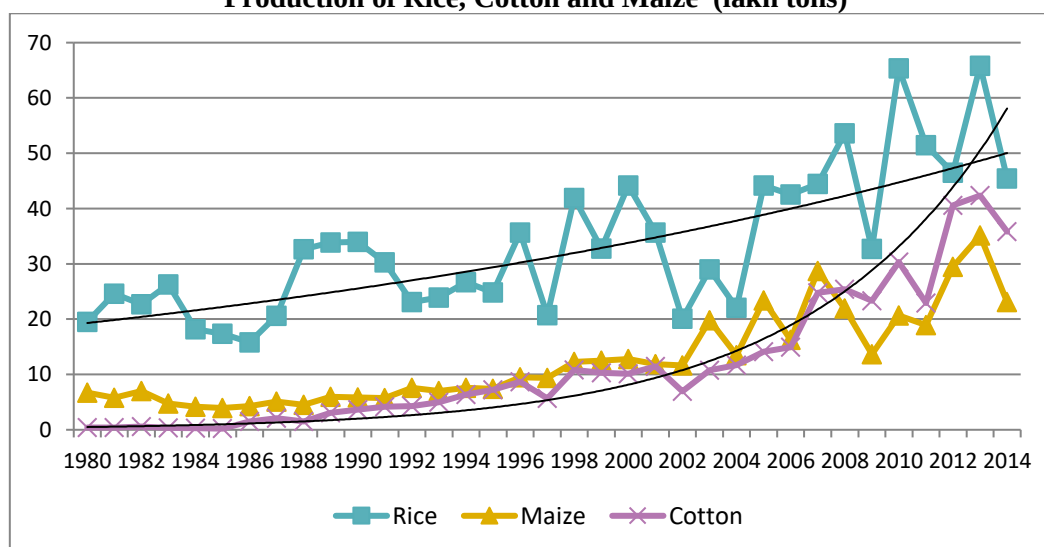
Fig1.1 Different Sources of Irrigation (Ha)

Source: Dir. of Economics and Statistics, AP

3. Growth of Production of Major Crops

As we have seen in the cropping pattern, the rice production has gradually replaced all coarse grains and millets in Telangana, became the foremost food crop in the region by 1995-96 itself. What is interesting is in the past 35 years, the rainfall fell below normal for 14 years, leading to heavy fluctuations in area, yield and production. Such fluctuations are largest cotton, followed by maize and rice [fig1. 2]. The overall rice production has increased from 19.52 lakh tons in 1980-81 to 30.26 lakh tons in 1991-92 and to a peak of 65.81 lakh tons in 2013-14. The increase in rice production in the last 35 years has particularly gone up in the last phase of 2005-15, largely contributed by growth of area under Rabi. A relatively consistent monsoon during this phase has drawn huge swaths of land under paddy. Maize production increased from 6.7 lakh tons in 1980-81 to a peak of 35.12 lakh tons 2013-14, was the second biggest crop till 2008-09, is relegated to third. Cotton that became the second biggest crop had an accelerated growth during 2007-15. Tentatively we speculate that the moderately poor growth during 1995-05 and accelerated growth during 2005-15, both produced agrarian crises of different sorts. First phase was characterized by failure of bore wells, failures of crops and indebtedness, while later phase is by rise of cost of production, fall in relative prices, rise in indebtedness, except some price corrections carried out in specific years.

Fig 1.2
Production of Rice, Cotton and Maize (lakh tons)



Source: Dir of Economics and Statistics, AP

Table1.6 : Compound growth rate of Production of Major Crops

crop	1980-15	1980-94	1995-04	2005-15
<i>Area</i>				
rice	1.07*	0.22	-2.72	1.51
maize	3.03*	-1.02*	7.5*	1.64
groundnut	-2.68*	2.4**	-8.12*	-1.35
cotton	7.44*	9.46*	0.74	11.9*
Food grains	-0.8*	-2.65*	-0.68	-0.58
<i>Production</i>				
rice	2.83*	2.38	-1.71	2.52
maize	5.89*	1.79	7.23*	3.30
groundnut	0.007	3.6**	-6.5**	2.37
cotton	13.52*	22.9*	4.36	11.6*
Food grains	2.67*	0.912	0.92	2.10
<i>Yield</i>				
rice	1.74*	2.1*	1.04	0.99***
maize	2.78*	2.8**	-0.26	1.63
groundnut	2.77*	1.2	1.81	3.7*
cotton	5.61*	12.2*	3.6***	-0.35
Food grains	3.5*	3.6*	1.62	2.7***

*1percent significance Source: Estimated

When examined the compound growth rates during different phases, the estimated growth rates once again convey that a faster phase of all the three major crops, namely, rice, cotton and maize are 1980-94 and 2005-15 [table1.6]. The total food grain production growth rate has grown at 2.67 percent in the past 35 years during 1980-15 which is fairly high rate of growth of agriculture which is larger than the national average. This is achieved despite of decline of pulses and coarse grains/millets, but totally compensated by the growth of rice which grew at 2.83 percent. Growth during this phase is supported by not only area shift but yield growth as well in this phase. At the aggregate level, this is achieved by a growth rate of yield that grew at 3.5 percent, even though it lost area at rate of 0.88 percent. The decade between 1995-04 has been generally bad all crops for having 5 poor monsoon years, with exception to maize and groundnut, which was sustained by an area shift. Otherwise, the area and yield both dropped for rice and cotton. In the last decade during 2005-15, cotton production rose at an unprecedented annual rate of 11.6 percent during 2005-15, totally contributed by a rise in area 11.9 percent, despite yield rate dropped by -0.35 percent. The yield growth for most crops, except groundnut, has been stagnant; the growth rate is sustained by area increase alone. A consistent monsoon trail tends to boost the well irrigation, thus can tremendously contribute to both Kharif and Rabi seasons, thus boosting paddy as well as cotton.

Such rainfall induced irrigation and area is likely to induce production instability. Cotton and maize, which are essentially dry land crops, show higher instability compared to rice. Cotton particularly shows a coefficient of variation of 100.73 percent, followed by maize 65 percent. Rice varies by 38.72 percent. The major source of variation for cotton and maize comes from area, by 71.9 and 35.87 percent respectively. Such large fluctuations are likely to cause large price fluctuations, making farmers lose heavily during the harvest failures as well as bumper harvests. It is important to analyze the sources of area fluctuation and stabilize it in the medium run for achieving a stable production [table1.7].

Table1.7:
Mean and Dispersion of Area, Production and Yield of Major Crops

crops	Mean	Standard deviation	Coefficient of variation
<i>Area</i>			
Rice	12.87	2.87	22.32
Maize	4.14	1.5	35.87
Groundnut	3.00	0.99	33.21
Cotton	6.6	4.75	71.97
Food grains	31.95	0.43	13.53
<i>Production</i>			
Rice	33.38	12.92	38.72
Maize	12.51	8.13	65.00
Groundnut	3.00	0.74	24.71
Cotton	11.57	11.66	100.73
Food grains	5.38	18.92	35.16
<i>Yield</i>			
Rice	2,518	476.05	18.91
Maize	2,74	89.3.7	32.53
Groundnut	1,083	374.7	34.61
Cotton	235	112.8	47.97
Food grains	1717	632.5	36.81

Source: Estimated

Concluding Remarks on Telangana Agriculture: Past and Present

Telangana region has undergone a substantial change in the past 35 years of its agricultural development. A prominent feature of this growth story is a rise in gross sown area, in spite of rise in fallows and diversion of land use to non-farm purposes. Such an increase in gross

sown area is contributed by rise in irrigated land, prominently by the well irrigation. The canal and tank irrigation have declined mostly, except there has been little revival in canal irrigation in the recent past. These changes in land use have also led to changes in cropping pattern. Most prominent change is the rise of rice, cotton and maize to dominance as the three-crop combination commanding 72 percent of area sown. Since, well irrigation is dominant source; the serious externality of this is the high area, crop and yield instability. The production rise has two important phases of growth, namely, 1980-94 and 2005-15. The phase in between is marked by a relative stagnation. Among these two phases, the first phase growth is contributed by both area as well as yield while the latter phase is marked by area shift alone. The wild fluctuations in output in these three major crops call for appropriate policy action to protect the farmers. Finally, the rice production which has grown significantly in the past one decade appears to have surpassed the domestic demand, making the Telangana state a rice-surplus state. There appears a serious need for a cropping pattern change from these three-crop combinations to more diverse crops, particularly, crops like fruits and vegetables. Maize crop acreage response depends on lagged area, irrigated area, lagged price, well irrigated and these elasticities are 1% and 5% level of significant. Cotton crop area explained variables have lagged price, yield, well irrigated area and these coefficients of elasticity's are 1percent and 5percent level significant. Paddy acreage response independent variables have been fertilizer, rainfall; lagged area and these variables elasticities are statistically significant at one percent significant level.

1.5 Research Problem and Methodology

The Telangana's agriculture is important for the region because for couple of reasons. First, good portion of the workforce depends on the sector. Second, it has significant forward and backward linkages with manufacturing and service sectors. Hence, there is a need to boost agricultural production, productivity and at the same time profitability. The large dependence on few crops like paddy, cotton and maize poses a serious problem of sustainability of incomes to the farmers. The instability of production seriously undermines the livelihoods, which lays at the bottom of farmers suicides. The structure of the agrarian holdings, where there is an increasing small and marginal holding also poses the problem of vulnerable livelihoods. Given these conditions it important to examined the problems of nature of supply response, changing cropping pattern, crop combinations and supply-demand position in the

major crops like paddy. Such as study could provide answers to the question which direction the agricultural policy should proceed.

1 Objectives

The objectives of study are as follows;

- 1 To understand the changing of cropping pattern, irrigation, land utilization in Telangana state.
- 2 To understand cropping pattern, crop combinations, and crop diversification.
- 3 To estimate the Telangana state three importance crops supply responses.
- 4 To calculate the Telangana state food grains, supply and demand, to assess the need for diversification from the food crop intensification.

2. Hypotheses

The major hypotheses these tests are:

1. The crop combination in Telangana is dynamic over period, which suggests changing institutional factors.
2. Crop concentration is growing in the state and crop diversification has reduced.
3. The food crops in the state respond to institutional factors such as technology and marketing.
4. Non-food crops respond to price factors.
5. Telangana has become a food surplus state.

The present study based on the completely secondary data collected from the government records, NSSO, statistical year books, director of economics and statistics Telangana and India, indiaastat.com, some old thesis, articles, journals. Secondary data belongs to irrigation, cropping pattern, major crops of Telangana area, production, yields, whole sales prices, farm harvesting prices Telangana state and from 1970-2014. Data availability the statistical techniques like averages, correlation, multiple regression, log multiple regression, multicollinearity triangle, standard deviation, coefficient of variation, coefficient of determination, compound growth rates, DOI crop combination method, crop concentration

ratios, crop diversification index, rice demand projection technique, t-test and software techniques like EViews and STATA have also been used in the present study.

3. Chapterization

The thesis has six chapters. Chapter I deal with the introduction, historical backdrop, and trends in land use, production, cropping pattern and production, research problem, objectives, data base and methodology. Chapter 2 surveys research studies on Indian agriculture and that of Telangana. Chapter 3 deals with trends in land use, irrigation and presents trends in cropping pattern, crop combinations, and concentration ratios. Chapter 4 deals with supply response in principal crops. Chapter 5 presents estimations on supply-demand situation for paddy in Telangana state. Chapter 6 deals with the concluding remarks.

Chapter 2

Issues of Agricultural Growth: Survey Literature survey

We know that India's agriculture had proceeded from a long journey of traditional crops, low productivity, poor marketing, output instability and price instability. By the time of Independence, India's biggest problem was domestic deficiency of production and achieving self-sufficiency. The second and Third plan had community programs to improve farm management, crop diversification, and awareness. Indian state responded with three-pronged strategy. First, it commissioned multi-purpose dams and irrigation canals to improve irrigation. Second, it has started a land-consolidation program, India wide, with varying degree of success. Third, government started agricultural universities in every state and research institutions for a modernization program. India has lost fertile lands in division of Pakistan from India. India lost wheat, cotton and jute producing areas. In second plan, India also abolished Intermediaries in 1956, probably its best implemented land reform. This has released lot of land for cultivation, thus India's first decade, and there is an improvement in food grain production, which grew at 3 percent, all due to area expansion. By 1961, area expansion came to a halt and a long stagnation set in. By 1967, India began facing back to back droughts and near famine conditions. In 1966, Indira Gandhi government had decided to launch a technical strategy of Green Revolution. India was producing mere 88 million tons, and a 10 percent of the domestic consumption depended on imports. American support was dwindling for the international relations reasons and began causing serious situation in India. Green revolution, which is introduction of new hybrid varieties in rice and wheat, began

showing quick results. By 1973 wheat and rice yields doubled and by 1976 India become self-reliant in food grains.

However, such technology adoption was made successful by a plethora of factors. First of all, all HYV seeds were given at subsidized rates, along with fertilizers. Second, canal irrigation was progressively increased with increased budget allocation for irrigation and flood control. Third, different procurement agencies like FCI, CCI, Tea Board, Coffee Board, Jute Board, and Spice Board were created besides State Civil Supplies department to procure agricultural commodities at the minimum support prices. MSPs were announced for 36 crops, based on average cost of production data. Prices included 10 percent profit margin, rent on own land and interest on fixed capital. Thus, prices were designed to be remunerative to owner-cultivators as well as tenants. Fourth, through nationalization of banks, rural banks were promoted to extend agricultural credit to farmers. Thus modernization, procurement, minimum support prices and institutional credit, Indian state tried to increase the agricultural production.

We will see what are the major issues discussed in the literature on agricultural development in India, mainly focusing on land utilization, cropping pattern changes, irrigation, new technology adoption, imperfect agricultural markets, supply response estimations etc. This gives us an idea how agricultural development is shaped in India, which is highly varied across regions and states so that we will figure out what is also important about Telangana state.

Land Utilization

Normally the issues in land utilization are that we should encourage maximum utilization of land, reducing uncultured land as much as possible, reduce fallows and increase grows cropped area through irrigation promotion. India has about 157 million hectares of net cropped area, which is about 60.3 percent of total land. This is one the highest cultivated area figures a country to have. Land utilization has been steadily growing in gross terms in most of state like Maharashtra, Haryana, Andhra Pradesh, Madhya Pradesh, Chhattisgarh and so on [Sharma (1990), Krishna et al (1991), Srivastava (1991)].

Singh and Kaur (1991) observed that launching of green revolution since 1966 to 1988 in Punjab led to increased net cropped land enlarged over duration, due to optimization of cultivation enlarged intensity of crop, aggregate sown land. Finally, radical transformed in

Punjab cultivation due to innovations like mechanization, fertilizers, hybrid seeds, farm management principals etc. this is observed by Ramana Murthy (2015) also in Telangana and Andhra Pradesh.

It is well known that surface irrigation increases land utilization. In many states, there is not scope for increasing canal irrigation. So, India almost completed rural electrification mission, which would enable farmers to utilize groundwater using electric bore wells. But this is not completed in several states. In united Andhra Pradesh, this was completed by 1987, since there is acceleration in land utilization under bore wells [Revathi and Galab (2005)]. This has made a massive increase in rabi area also, as cultivation in second crop became common. Even in complete dry regions like northern Karnataka, where oil seed cultivation is major crop, the rabi cultivation is increasing [Nagabhushan (1994)]

This is case of Tamilnadu, Padmanaban and chinnadurai (1994) noted that for Tamil Nadu gross cropped area had declined for 7. 32m.Ha to 6. 44m.Ha during the period and the area sown more than once had declined from 1. 32m.Ha to 0.90m.H. Tamil Nadu is an example for decline in GSA and increase in current fallows. This is the case in all the regions which have depended too much on groundwater exploitation. This is an important lessor for Telangana, which has disproportional dependence on ground water and 10% current fallows.

During 1950 to 1998 investigated land utilization since India. They founded during this period land of forest improved 40080000 hectares to 68650000 hectares. Considerable improved land in other than cultivation purposes during this period 93600000 hectares to 123000000 hectares. During 1951 to 1971 sown area of net increased but during 1971 to 1998 sown area of net there is no change.

Cropping Pattern Changes

In India, the major trend in the cropping pattern is influenced by the government policy of green revolution and minimum support prices are effectively implemented in rice and wheat, a couple of trends are visible. First, there has been an increase in land allocation for food crops during 1966-86. Second, there is steady rise in area under rice and wheat at the expense of coarse grains and millets in most states. And third, since 1991, once again as happened in the colonial times, there is an increase of area under non-food grains, which is up to 55 percent. Whether this desirable or not, it is a controversial area. Some argue that there is

not ample production of food crops like paddy and wheat; we should diversify to non-food grains which also have huge domestic and international markets.

Kumar and Singh (1998) study of cropping pattern in Bihar during 1970-1994, concludes wheat arrived as the dominate crop in northern Bihar, and Bihar as whole is still dominated by cereal crops. Wheat crop has emerged as a major crop among cereals. The predominance of cereal crops in the cropping pattern was credited to growing demand for food in the light of food scarcity in the sixties and the Green Revolution made of bio-chemical and genetic innovations in principal cereal crops during post green revolution period.

Several researchers have noted the displacement of other crops with rice in many states. For instance, Behura and Naik (1994) in Orissa, during 1966-1991 the area under paddy increased to 58% of aggregate area sown. Lal and Singh (1984) noted that, in Haryana, Jowar the major food grain crop before green revolution was totally wiped out of cultivation.

Only after 1991, there is a crop diversification away from rice. Kebebe et al (2000) noted a considerable diversification in Telangana towards crops like cotton, maize; chilli, vegetables and fruits were found to be relatively more diversified as compared to pulses and oilseeds among the groups. There is a diversification within non-food crops towards high – tech, innovative enterprises. Where ever there is a growth of agro-food processing and the rural non-farm sector is diversifying towards them even in a state like Telangana. All researchers have noted that food crops like rice and wheat statistically do not show significant relationship with the price, but are significantly linked to HYV seeds, fertilizer use and irrigation. Only dry land crops show higher price elasticity of output. Reddy and achoth (2000): conclude from their study that dry land such as ragi, Jowar Bengal gram were non-responsive to own price and while oilseed crops such as sunflower and groundnut are responsive.

Virender Kumar (2002) examined the changing cropping pattern in Himachal Pradesh. His study conveyed that the area under wheat crop, as a share of total cropped area increased from 34.27 percent to 37.66 percent; and that of maize went up from 28.11percent to 32.58 percent. The share of land under ragi and the other millets had declined heavily, as happened elsewhere in the country.

A study by Subrata (2007) at a micro level, on the economics of cropping pattern changes and the credit is done on West Bengal. The study conveyed that the bank credit as

well as informal credit plays an important role in the cropping pattern changes. This is more important in case of smaller holdings compared to bigger holdings, which lack most often their own capital. Profitability was also found to be higher in the case of small and marginal farmers, which supports the hypothesis of small farm-efficiency.

An attempt is made by Tingre et al (2008) to study the cropping pattern changes and crop diversification in Akola district of Vidarbha region in Maharashtra. Their study conveyed many cereal crops showed negative and low growth rates of area during the study period of 1991-2003. This period in India has shown lower agricultural growth and diversification towards soya and cotton. In that region, soybean attained an important position in the cropping pattern. It is observed that, both, the crop of diversification and cropping intensity have increased significantly.

The study conducted by Ramappa and Naidu (2009) to examine the land utilization pattern in Andhra Pradesh. The study has noted reducing crop diversity and increasing crops concentration. The study observed that since, extensive agriculture was very limited since the area under agricultural uses had by now reached the maximum level; there is every need for intensive cultivation. They also observed that the area under nonagricultural uses had been increasing over period. This is probably most natural, as the population is increasing, there would be growing demand for housing, and commercial uses. Even through this certainly reduces the size of cultivable land; this need not reduce the overall output which can be matched with increasing productivity. They thus, concluded that modification in cropping pattern is necessary to make the more efficient use of land.

Crop Productivity

Crop productivity is an important issue for the agricultural development. We know that land is a limited resource and the onus of increasing production depends on raising the productivity. Agricultural productivity depends on variety of factors, namely seed quality, improving soil quality, increasing irrigation, manure application, pest management, proper ploughing, and other farm management factors. Over and above all, weather factor still can affect negatively and positively also. India has started so many public universities and research facilities in agricultural sciences. There are several private seed and other input suppliers. What are the challenges that Indian agriculture faces is a matter of empirical research. Let us see what different scholars have contributed to this aspect.

Irrigation has been identified for several wet land crops like Rice, Sugarcane, and wheat. Particularly for absorbing the artificial manure like phosphate and nitrogen fertilizers, it needs lot of water. Anand (1960) stated that irrigation introduces positive change in intensity cropping pattern and yields. Simultaneously, it also disturbs the equilibrium conditions in agriculture in a particular command area. The new equilibrium point will fail to reach optimum limits expected

Mohan Kanda (2010): examined irrigation scenario in India during five-year plans. India's first five-year plan seeking to release the country's economy from the cycle of poverty was 206.8 billion INR was allocated to seven broad areas, with irrigation and energy according for the higher share of 27.2% including investments in dams and irrigation. India's largest area has expanded steadily during the last few decades the XIth five-year plan (2007-12) observed that the scope for new large surface irrigation projects is getting small and the focus should be therefore on completing ongoing irrigation projects and modernizing exist ones.

Ruddar Dutt and Sundaram KPM (2010): evaluated irrigation during the 50 years since independence the government had spent about Rs 2,31,400/- cores at 1996-97 prices on major, medium and minor irrigation works as a result the country's irrigation potential has increased from 23 million hectares at end of the 1996-97 with his India has the largest irrigated area among all the countries in the world. This has greatly contributed to the increase in food grains production from 51million tons in 1950-51 to 203 million tons in 2001-02 by knowing these data the production is increased.

Arun S. patel (1981) studied the command area development and its impact in Gujarat. Patel conclude that technology adoption in rice and wheat is directly determined by irrigation expansion. The employment directly depends on the yield and intensity of cropping, both these depend on irrigation. Thus, irrigation expansion determines production, productivity, and employment. Irrigation also brings changes in the cropping pattern from inferior cereals to superior cereals. HYV seeds in food grain and also nonfood grain crops were augmentation of area under double and multiple cropping which is then provides more opportunity of work to the agriculturists at the farm level all stem from irrigation expansion. Daulat Singh and Udaichand (1968) also long back found that irrigation expansion would lead to double cropped area, cropping intensity, use of labour on the farms were directly related with level of use of irrigation water from Punjab experience.

Dewett K.K et.al (2003): explains as assumed water supply will spell prosperity create employment potential, enhance income and increasing capital formation. The circular causes will have a cumulative effect. It has been estimated that in season of favorable rainfall, there may be a drop of 10-12 million tons in agricultural production. India has the highest rate of growth irrigation facilities in the world during the period of planned development. The exploitation of water resources has more than trebled the utilization of rivers has more than doubled. Similarly, the effective shortage capacity of all the reservoirs in the country has increased manifold. Like this there are plethora of studies such as Lekhi R.K (2004), Majumdar (2004), Richard Tolentino Yao (2005), and Suresh pal (2006) brought evidence for the role of irrigation. Santu Sangar (2005) examined role of irrigation for fruits and vegetables.

Indian planners often over emphasized the efficiency of large dams and most often the potential is overstated. The yield progressive declines from the head region to tail region. Ramakrishanan and Sivanathan (1989) found that in Kaaveri belt in Tambaraparani irrigation system, the difference in yield and cropping intensity between head and tail regions is 300 percent and 260 percent. The coefficient of variation of water reached in tail end of the channels was higher, indicating a higher uncertainty of water availability to farmers at the tail reach. The crop water uses efficiency and the land-water-use efficiency were higher in the tail reach due low consumption water. This means more water supplied, it is inefficiently used. The farmer in head reach had a surplus of water ranging between 21.20 percent to 33.25 between seasons. Because of this, a larger percentage of farmers in the tail reach adopted better water management practices and even formed water user's association. Desai S.N et.al (1989) in their paper, 'Role of Irrigation layout to Check Over-Irrigation', water use is going to be inefficient in the absence of appropriate land shaping and grading mechanisms, improper maintenance of field channels, improved crop production technology and knowledge of water measuring devices, all these have led to over-irrigation.

In his study, Kalyankumar G (2010) on heavy investment in irrigation and optimum water use explains India's emphasis on major irrigation sector right from independence. May it be to protect the farmers from the vagaries of monsoon, but the question is whether investment on such large dams is efficient and desirable. There are several large and medium sized irrigation works in India like the Bhakra Nangal, Nagarjunasagar, Indira Sagar and the recent Sardar Sarovar project to expanded agricultural coverage to arid regions. Since the share of

assured irrigation is still smaller, we are trying to expand the major irrigation. But due to silt age and soil erosion, the current water use efficiency of canal irrigation is only 35% which is lowest in world.

There are studies which have argued for community participation and management in irrigation. Lakshmi Narasaiah M (2007) in his work wrote on traditional and indigenous communal or people managed irrigation systems, which are invariably minor or small-scale irrigation systems, they command an area of 15000-20000 hectares in state of Andhra Pradesh. His work argued that such systems are low cost, environmentally friendly and ecologically sustainable options. Successful irrigation may support higher levels of agricultural productivity as well, enhances responsiveness to diversified and dynamic crop markets. They can reduce private cost of irrigation and thus profitability. However, the limitation of these studies is that they are not fully scientific and comprehensive and cannot be considered for a large-scale policy measure.

Even though planning mechanism has been discarded in the country, with the available data Nathan L.A.V et al (2012) analyzed the benefits of accelerated irrigation development during the last three plan periods. They observed a widening gap between irrigation potential and creation and utilization, which is a serious concern. The real question is simply not about the gap of the former, but the very usage or the gap between created potential and the actual use. There is a growing concern over declining efficiency of major irrigation. Is it rational to expand major irrigation due to falling potential of the major irrigation?

Studies like that of Krishnamurthy H.R (2012), pointed out that India has an irrigation potential of 139.89 million hectares, out of which only 108.2 million hectares (77.35%) has been utilized. At present only about, 30 percent of the net cultivated area has the benefit of second time irrigation in a year. To increase the gross irrigation, a massive investment was made on irrigation during the planning period up to seventh five year plan a sum of Rs 16,590/-crore have been spent on irrigation development. Eighth plan has created an additional potential of 13.6 million hectares by spending Rs 32,525/-cores during 9th plan period (1992-2002) a sum of Rs 55,420/- crore was allotted for irrigation tenth (2002-07) and XI plan (2007-12) have proposed to investment Rs1,03,315/- crore and Rs2,10,326/- crore respectively on irrigation and flood control. This has now has grown to more than Rs.12 lakh crores in the current period all over the country.

There are many who would support that minor irrigation is more cost-effective and more sustainable. Sebak Kumar et al (2012) studied tank irrigation in the dry zones of central India. Water availability in the region is not more than six months in a year. Hence, by improving the catchments and field channels is much better option, than bringing water from distant areas, by improving the local tanks. It was also observed that in few tanks with good tank structures, the water availability was also comparatively higher also the existing tank structures are very weak and by rehabilitating them, it is possible to improve the overall water availability in the tanks. Hence, rehabilitation program should focus on the tank storage aspects. Groupings of the tanks according to the tank productivity and then initiating the tank rehabilitation options are important in improving the tank performance in the state.

Market Imperfections

If agrarian markets are ridden with market imperfections, then the price mechanisms would not succeed in transforming the traditional systems of agriculture. This issue was examined deeply in the 1970s by the Indian scholars like Krishna Bharadwaj, Amit Bhaduri, Ashok Rudra, Utsa Patnaik and several others. Bharadwaj (1974) observed the co-existence and interaction of multiple modes of production and viewed that property relations are more complicated in semi feudal mode of production, where power is exercised through privilege as much as through markets. She has pointed out to interlocking of land, labour, credit and output markets.

Bharadwaj and Rudra (1982) have even wondered whether assumptions like profit maximization and mobility of resources guided by freely fluctuating market forces makes any sense. They have questioned the use of Cobb-Douglas production function in every region in the country, without examining character of agricultural technologies, institutional factors and government policies and the inadequate attention paid to stochastic specification of studies and their failure to establish links between theoretical constructs and observable magnitudes, inappropriate uses of statistical techniques frequently employed in research in Indian agricultural economics.

Amarty Sen's (1964) got into such critical puzzle about the small farm productivity. He found that using the data from Farm Management Studies in 1960s, there is no economics of scale, which is a puzzle. Family run farms are found to be generating more per acre output. Sen tried explain in terms of marginality terms, the small (peasant) much below of his effort

on farm up to the point where the marginal product labor is below the ruling wage rate. The large (capitalist) farms at the point where the marginal product is equal to the market wage. Many other explanations, both quantity and quality based, have been offered for the alleged inverse relationship. However, such negative farm size productivity relation has disappeared after introduction of new technology (Bharadwaj, 1974, Utsa Patnaik, 1986, Dyer 2004). This means that smaller farms have clear disadvantage in productivity and hence profitability. The current agrarian crisis since 1997 has roots in the increasing marginalization of agrarian structure [Reddy and Mishra (2008)]

Consumption Demand of Food Grains

Is India self-sufficient in food production? How do we know that we are? This requires consumption demand analysis. For country with no precise data on consumption on time series and retail trade done mostly in unregistered sector, it is a gigantic task to estimate the consumption demand. However, there has been some brilliant paper written on this issue over period. Radhakrishna and Murthy (1973) in their pioneering study analyzed the consumption pattern for broad groups of food items by the linear expenditure systems (LES) and by Frisch method. It was found that price-elasticities were computed by the LES for groups compared in urban areas and differ slightly in case of rural areas and demand projection for 1980s were provided.

Singh and Singh (1974): studied the changes in consumer behavior by analyzing NSS data of consumer expenditure for 20 commodity groups over time (1961-62, 1964-65, and 1967-68) for Punjab. The expenditure elasticities for these commodity groups were estimated and demand for the year 1973-74 at constant and current prices was projected for Punjab. The concentration of consumer of consumer expenditure was analyzed using Lorenz curves. The projections are based on certain assumptions regarding the size and distribution of the population between rural and urban areas, the rate of growth of per capita income, stability of consumption habits, parity of relative prices and the rise in the level of wholesale prices, etc. it was expected that the projections which furnish a profile of the demand for Punjab economy in 1973-74 could be usefully utilized by perspective planners and policy makers in various areas.

Kumar and Sharwan (1979) studied the consumer expenditure data from NSS reports for the period 1960-61 to 1973-74 for the rural areas in India. This is in regard to poverty issue. They

observed that the per capita expenditure at constant prices declined over that period fluctuated, indicating fall in some years. This has caused for interventionist programs for poverty reduction. The decline in per capita expenditure was attributed to decline in purchasing power of the consumers because of sharp rise in the prices of commodities. There are several studies to support such assertions. The study by George (1980) using the cross-sectional data was examined consumption levels according to the socio-economic characteristics of the population from 1961-62 to 1973-74. The study found that between 1961-62 to 1973-74 per capita monthly consumption of all cereals in rural areas declined by 13.9 percent while that in urban areas it declined by 9.2 percent. In rural areas coarse cereals accounted for about one third of cereal consumption.

Radhakrishnan et al (1979) too estimated falling consumer expenditure elasticity for the period 1961-75. The expenditure elasticity not only a decline, but showed considerable variation across the states. The expenditure elasticity's for rice varied between 0.35 in Punjab to 1.32 for Karnataka and that for cereals varied from 0.39 for Punjab to 0.70 in Assam. This means those state where food production is greater, poverty incidence is lesser.

Normally demand for fine cereals have gone up in the country and demand for coarse cereals have gone down. But studies tried to contest this. Narayan and Rao (1982) computed elasticity's for both low- and high-income group's elasticities were positive for low income groups of the rural areas in of Jowar and Barley. The indicated that the upward shift of the real income will push up the per capita demand for coarse cereals. This seems to be out of line with most other studies.

What kind of food production that should take place in the country? Demand projection studies can contribute to this answer this question. Kaman and Chakrabarthy (1983), for example made projections of consumer demand for selected food in India for the period 1985-86 to 2000-01, using NSS data on consumer expenditure. According to this study, demand for food grains on an average increased by 16 percent during the 15 years, the compound growth rate worked out to 2.5 percent annum. The total demand for food grains in 2000-01 was estimated to be between 215.17 to 221.23 million tons. The wheat demand to be increased from 20.84 million to 55.13 million tons in 2000-01 which implied a growth rate of 3.6 percent, whereas the demand for rice to increase from 57.09 million tons in 1985-86 to 90.35 million tons in 2000-01 which implied an annual growth rate of 2.8 percent. The actual production seems to have exceeded this projection in the current period. The demand for milk

was found to increase faster at 5 percent per annum than that of sugar (4.3%) meat, fish eggs (4.3% each) and edible oil (3.9percent), and the production indicates they are falling behind, which is causing an inflation of prices.

Even the international studies like that international food policy Research Institute, IFPRI, sponsored study by Rosegrant et al (1995), to make food projections for India, using demand elasticity and technical coefficients synthesized from other sources primarily from studies. It projected that the demand for total cereals projected is 237.3mt in 2020, for India while India's production has increased to 280 million tons, by now. Has India become a food grain surplus country? There are studies which support such a view, while there is which contradict (Patnaik 2005).

As for food demand projection, Praduman Kumar (1998) made some projections. He has assumed an income growth rate of 4 to 7 percent per year, a gradual in population growth with an average annual growth of 1.8 percent between 2000 and 2010 and 1.7 percent between 2010 and 2020. The rate of urbanization to be consistent with the recent historical trend and inequality in the distribution of expenditures across income groups to be the same as in 1987/88. The food grain demand in the year 2020 is suggested to grow between to 259 - 264 million tons with a break-up of about 117 mt for rice, 89-95mt for wheat, 27-29mt for coarse grains and 23-27 mt for pulses, depending on the over growth rate of GDP. The demand is worked out to be 126-183 mt for milk, 68-98 mt for fruits, 6.3 to 12.1 mt for meat and 9.5-18.3 mt for fish. They indicate the overproduction of food grains and under production of proteins.

In the same direction, the study by Radhakrishna and Reddy (2002) made projections on the assumptions real expenditure growth of 5 percent per annum between 2000 and 2020, an increase in population to 1.343 billion by 2020, the rate of urbanization and rural and urban disparity consistent with the historical trends and the inequality in the income distribution and relative prices same in the year 1998. The demand is projected to grow at 2.2 percent for cereals during 2000-2010 and 2.0 percent during 2010-2020. The production seems to have growth at 2.5 percent, which should have made a surplus production. They suggested a 3-4 percent demand growth for edible oils and pluses, and 4-5 percent for milk and milk products, meat, fish, eggs, fruits, vegetables, sugar and guar. Thus, it indicates a need to diversify food production away from a non-fine cereal dominated food production.

Radhakrishna (2005) in his subsequent study has noted the per capita cereal consumption has been declining since early 1970s despite a significant increase in per capita cereal production. The cereal consumption in rural areas fell from 15.35 kg/per capita/month in 1970-71 to 12.7kg in 1999-2000 and in urban areas from 11.4 to 10.4kg. The declining trend can be observed in most of the states, especially in Punjab and Haryana, where the decline is to as much as 6 kg per capita per month. According to the author, this sharp decline in cereal consumption can be attributed to changes in consumer taste from food to non-food items, and within the food group from cereals to non-cereal food items and from coarse cereals to fine cereals.

National Rainfed Area Authority (2011) in its report, based on a study, made demand and supply analysis using information from other studies. At the end of 11th plan (2011-12) and 2020-21, the food demand is expected to be 235 to 280.6 million tons respectively. The triennium (2002-04) production of 200.27 mt was short of the corresponding estimated demand of 207mt (2004) by six million tons. It was also found that per capita consumption of total cereals especially coarse on decline may decline by 2020-21 due to change in tastes dietary habits, preferences, urbanization and standard of living. Singh (2011), Ganesh-Kumar et al (2012), Praduman Kumar (2010), Purnamitha and Smita (2010) have done similar demand productions for range of agricultural commodities.

At state level demand-supply analysis, Hazoor Muhammad Sabir and Safelar Husain Tahir (2011) forecasted wheat requirements in Punjab province for the year 2011-12, results revealed that a quantity of 7.83 million tons wheat is the surplus in.

Ramanamurthy R.V (2012) estimated consumption demand of rice for Andhra Pradesh. He concluded that Andhra Pradesh state in 2012 has achieved self-sufficiency, and even has 10 percent surplus production. However, if rainfall declines by 20-30 percent in two successive years, his study suggests a deficit situation. Therefore, he has pointed out that production instability still an issue and we are yet to achieve all time surplus.

Supply Response Studies

Another important area of agricultural economics is on the question of supply response. Supply response studies are important to know which exact factors are responsible for area response and cropping pattern shift. The peculiarity of agriculture is that the producers cannot

choose the level of output, even if they know some things like average yield, market price etc. It is because, a farmer is never in a position to determine the production, and he can only decide the how much acreage to be planted. The actual output depends on plethora of factors such as weather, pest management, water quality, soil dynamics etc. Hence in agricultural economics, we usually study area response as proxy to supply response. The standard specification used for determining supply (area) response is done in adaptive expectation model of Nerlove type. It is assumed that current year area of a crop depends on the average area of previous two years, lagged year relative price, irrigation/rainfall of the current year, fertilizer application, HYV seed adoption, minimum support price of lagged and present year, income, and other input uses. The supply and demand functions are separately worked out, and equilibrium supply response is derived. In Indian literature, there are some thousands of supply response studies done on almost all crops in different regions. What is generally known is that food crops are more responsive to institutional factors like weather, input applications, technology and irrigation, because the demand for food remains stable and relative price factors do not influence them. Whereas, non-food grain commercial crops are like oil seeds, cotton, tobacco, sugarcane etc more influenced by price factors and other demand factors. Having realized this, Indian state had focused on institutional factors to build food security in the country (Alagh, 2004). India has borrowed Hybrid technology in rice, wheat and jowar and created market intervention paraphernalia such as Food Corporation of India, Minimum Support Prices, crop loans by banks etc. The expansion of irrigation was also part of it. Expansion of rural electrification is also part of it for groundwater exploitation. But after crossing the self-sufficiency point, the fiscal burden of further expanding surface and groundwater irrigation and rationality of promoting irrigation-intensive crops will often be questioned on various grounds. Telangana's case of recent lift irrigation and high dependence on groundwater faces similar dilemma, which raises the policy question. In this section we shall refer to some of the literature on the supply response as a testimony to the assertions made above.

The most popular method of estimating supply response used in literature is that of Nerlove. Nerlove, who created this most popular estimation method, noted in his 1979 paper the inadequacy of the model, especially context of the developing countries. His model was originally meant to study the response to price of American farmers in the production of corn, cotton, and wheat in the period prior to the introduction of price supports and acreage

allotments. US is a highly developed capitalist country with strong credit, labour and output market developments.

In India too, we have price supports and procurement programs for major crops when the programs are effective, the support price (announced at the time of sowing). And yield uncertainty highly prevalent, despite a crop insurance program. Increased provision of public credit and public investment in the rural infrastructures would make the own price supply elasticity's less elastic. Many times, empirical works do not consider these institutional aspects.

When we look at literature, there are several studies there. Raj Krishna (1965) examined the relation between the marketed supply and the price using a simple model, because they were examining whether Indian farmer would ever respond to higher market price. He found that the elasticity is positive only if own price elasticity of demand is higher (in absolute value) than the income elasticity of demand. His estimated coefficients were price and income variables which were found to be -0.3584 and 0.5216 respectively. Therefore, elasticity of marketed surplus with regard to price is negative, which is perverse. In this case, the income effect outweighs the substitution effect and therefore, still demand for food grows when the proportion consumed increases. Thus, Engels' Law is validated that as income progresses the relative demand for food grains comes down.

Raj Krishna (1963) way back used the Nerlovian adjustment model to estimate short-run and long-run elasticities of supply (acreage) response for the Punjab region, for cotton, maize, sugarcane, and rice crops for 1914-45 period. This was a pre-Green revolution study, where rainfall is found to be significant. Except for Jowar and gram, Raj Krishna obtains positive own price elasticities for all other crops. The short run price elasticities were range from 0.08 for irrigated wheat to 0.72 for cotton (cotton) while the long-run price elasticity's range from 0.14 for irrigated to 1.62 for cotton (American). Askari and Cummings (1966), one of the early studies, report low short-run supply elasticities for most crops. They conclude that magnitudes of the elasticity's depend on many factors. The kind of relative price variable used, the shift variable included, the region, the season, the crop, level of aggregations, etc.

Malathi (1985) using FMS data for Arcot districts of Tamil nadu for 1981-82, she estimated supply response to variables such as rainfall, labour input, chemical manure

application, weather risk, and relative price using a Cobb-Douglas production function. Using the FMS data for three agricultural years 1981-82 to 1983-84 was cobb-Douglas production functions with land, human labor, and size groups. She estimated the elasticities and coefficients for all.

Mythili (1991) estimated the production functions for rain fed groundnut and Jowar in the Kharif season and irrigated groundnut and paddy in the rabi season. Her estimates suggested the proportional risk premia are 20.42 percent for rain fed farms and 0.563 and 0.467 respectively.

Battese, Coelli, and Colby (1989) estimated an advanced frontier function with farm level data from ICRISAT villages for ten years. They use Cobb-Douglas function with land, labor, bullock labor, and input cost (costs of fertilizer, manures, pesticides and machinery use). The novel feature of their study is that coefficients in the linear regression of input measures such as land (unirrigated and irrigated), human labor (owned and hired) are estimated along with the elasticity coefficients. The model is estimated using maximum likelihood methods. The predicted efficiencies range from 0.66 to 0.91, the estimate for the mean efficiency being 0.837.

Kalarajan and shand (1988) estimated a normalized quadratic profit function along with supply and variable input-demand functions. They consider three variables, namely, labor, chemicals, and animal power; and two fixed inputs like land and capital flow; for three outputs namely, cotton, chilies, and pluses. Their data base is a random sample of 240 farmers in Madurai district during 1979-80. They find evidence for profit maximization hypothesis. Which means now farmer no longer grows only a traditional crop, but would shift to new crops with better prices and profitability. Cotton and chilies are said to be not mutually price comparative in supply while chilies and pulses tend to be, because they are grown in different soils.

How unbiased are the Cobb Douglas production function estimations? There is a wide variation among the estimates of different researchers. Rao (1965), Saini (1979) and Rangaswamy (1982) noted that the bias estimates for different classes of farmers since multiplicative factors. They also argued that variables have unstable signs occasionally due to multiple factors operating.

Ray (1987) examined the role of fluctuations in the market prices on supply. He that output is responding to price fluctuations and he argued that is not a desirable thing. He argued that the better buffer stock operation can moderate the excess of price and farm income fluctuations. Particularly, when expected growth rates in demand and supply are equal. Researchers were concerned with fluctuations in farm incomes. The programs can reduce the variability in price and farm income provided the demand and supply curves are inelastic. Based on a historical analysis of rain-induced production fluctuations, he considers it 'appropriate to have a maximum stock of 15 or 18 million tons of cereals and follow the storage rules aimed at stabilizing consumption with about 3 percent variation.

More sophisticated works are seen towards late 1980s onwards. Narayana and Parikh (1987): use the ARIMA process expectations for the expected revenue and shift variables. A major attention is on the use of the expected revenue and shift variables.

Conclusions

We have noted that Indian literature on agricultural development is rich. We make following four sets of observations. First: India land use pattern had seen reaching its optimum on net sown area basis by 1961. India has an arable land of 66 percent, which is one of the highest in the world. Being a tropical country, with ample sunlight, India can have two to three crops. The only constraint is irrigation. Therefore, India increased its irrigation potential to a very large extent and its percentage of net irrigated area is about 39 percent and gross irrigated area being 48 percent by canal sources. But the rest is irrigated by bore wells, which in turn depends on rainfall. The studies have shown that there are problems in big dams, where gross inefficiencies are there in water utilizations. Also, there are differences in productivity along irrigation channels. The siltation and DE capacity are another issues. However, expansion of big irrigation has enabled India to achieve food security. Probably, the next challenge is to conserve the water. Second set of findings are about cropping pattern changes. Studies have shown that there are two phases, in the initial phase the food crop area has expanded and later decreased in India. This is because, after reaching the peak production, further improvements in yields will need lesser land and hence the reduction in the second phase of land under food crops did not led to any fall in output. The non-food commercial crops increased in the later half. The coarse cereals have given way to finer cereals. This trend probably needs a reversal in the future. Third, the demand side studies

have shown that India needs about 280 million tons by 2020 and the production has exactly reached that point. In some states a perpetual surplus is leading to fall in profitability of the crop, which will call for further crop's diversification. Telangana is on a brink of marginal surplus. We need to ascertain the demand-supply situation once again. Fourth, Indian farmers are rational and respond to price signals wherever they can. In case of food crops, self-sufficiency and stability factors will determine the supply response, whereas for non-food crops the price factors are more important. There is need for greater economic intelligence to be supplied to the farmers for production not to overshoot the demand. Formation of cooperatives perhaps holds some answers to such questions.

We find that the number of studies on Telangana region is few. We need to study the agriculture of Telangana and analyze the problems it is facing. What is Telangana's cropping patterns change in the past three decades? What is its cropping intensity? What are the major principal crops of Telangana and what should be the future course? This study finds that there is a need to study these aspects.

Chapter 3

Trends in Telangana's Agriculture (1973-74 to 2014-15)

3.1 Land Use Pattern

Telangana's total geographical area is about 112 lakh hectares in 2014-15, after losing about 2 lakh hectares from alienation of 6 mandals during the formation of the state. Out of this, about 25.4 lakh hectares is forest land (22.6 percent), which is slightly higher than the national average [table3.1]. Net sown area is about 43.7 lakh hectares in 2014-15 (39 percent). In the previous 35 years, it roughly remained same, even though it lost marginally in

between. It lost some 5 lakh hectares during 1980-2006 and recovered 3.7 lakh hectares in the last one decade during 2006-15. The current fallows and other fallows form about 17.7 percent, (constituting 12.5 & 7.18 percent respectively) shows that there is a potential to increase the net sown area in the future by some appropriate policy. The current fallows show a tendency to fluctuate between 12-16 percent, for having a greater share of well irrigation. Interestingly, the increase in other fallows is outweighed by a fall in forest land and barren land, thus making overall net sown area almost constant. Most important fact is that the area sown more than once has increased from 3.8 lakh hectares to 9.7 lakh hectares. As percentage of net sown area, this has increased from 8.4 percent to 21.4 percent during 1981-2015. The net addition to gross sown area is approximately 6 lakh hectares. On the flip side, we also observe that about 2.3 lakh hectares of commons are lost, the pasture and grazing land came down from 5.2 lakh hectares to 2.9 lakh hectares during 1980-15. Similarly, about 1.2 lakh hectares of cultivable waste has come down. About 2.1 lakh hectares is agricultural land converted to non-agricultural use. Thus, with an appropriation of forest land, cultivable waste and pastures & grazing land, appear to have contributed to a stable net sown area and a tremendous rise in gross sown area, besides area sown more than once, in spite of a rise in current and other fallows and land put to non-agricultural use. The area sown more than once has tripled in the thirty years during 1980-81 to 2013-14, from 3.8 lakh hectares to 9.3 lakh hectares. The coefficient of variation of gross cropped area is about 9.14 percent; that of net sown area is 7.5 percent and that of area sown more than once is about 33.4 percent. Thus, with a greater reliance on well irrigation as we will show later, area sown more than once will tend to show wide swings along with fluctuations in rainfall, producing nearing 10 percent variation in gross sown area, to have similar variation on the agricultural output.

Table3.1 Land utilisation

Years	1980-81	1990-91	1998-99	2006-07	2014-15
Total Geographical Area	11477000 (100)	11477000 (100)	11477000 (100)	11484100 (100)	11207810 (100)
Forest	2780000 (24.22)	2810000 (24.48)	2745000 (23.92)	2743476 (23.89)	2540101 (22.66)
Barren and uncultivable land	659000 (5.742)	532000 (4.64)	621000 (5.41)	603453 (5.25)	607430 (5.42)
Land put to non-agriculture uses	679000 (5.92)	702000 (6.12)	772000 (6.73)	794860 (6.92)	884596 (7.89)

Cultivable waste	214000 (1.86)	161000 (1.4)	203000 (1.77)	183747 (1.6)	182511 (1.63)
Permanent pastures grazing lands	518000 (4.51)	457000 (3.98)	348000 (3.03)	327260 (2.85)	298597 (2.66)
misc tree crops and groves	76000 (0.66)	77000 (0.67)	72000 (0.63)	113789 (1)	112180 (1)
Other fallow lands	567000 (4.94)	545000 (4.75)	843000 (7.35)	803504 (7)	805150 (7.18)
Current fallows	1459000 (12.71)	1804000 (15.72)	1568000 (13.66)	1910593 (16.64)	1400669 (12.5)
Net sown area	4525000 (39.43)	4366000 (38.04)	4305000 (37.51)	4003418 (34.86)	4376576 (39.05)
Area sown more than once	381000 (8.4)	670000 (15.34)	870000 (7.58)	938035 (20.2)	938793 (21.4)
Total cropped area	4906000 (42.75)	5036000 (43.88)	5173000 (45.07)	4941449 (43.03)	5315333 (47.43)

Sources: director of economics and statistics Telangana.

The total cropped area has increased from 42.75 percent in 1980-81 to 47.43 percent of total land in 2014-15 [see able table no3.1]. Such 4.6 percent of land is perhaps a massive growth in area cultivated, thanks to irrigation facilities. The area sown more than once has tripled over these years. But as said the other fallows and current fallows together constitute about 17 percent, which would throw tremendous instability in area cultivated and production. Such expansion of area also seemed to have come at some expense of common lands, often exists under the name of barren and uncultivable waste. And forest land also is gone by 2 percent. These are the lands that government allowed weaker sections to occupy and cultivate.

Table3.2: Compound growth rate of Net and Gross cropped area

	1980-81 To 2014-15	1980-81 To 1991-92	1992-93 To 2004-05	2005-06 To 2014-15
Gross area	-0.02**	0.0001	0	-0.23**
Net cropped area	-0.10	-0.66	0.06	1.73*
Gross cropped area	0.32**	-0.35	0.16	1.80**
Area sown more than once area	2.89*	2.20	0.85	2.05

Source: Estimated

We can also see this in terms of compound rates of growth [see table no.3.2]. The net sown area during 1980-15, has declined at -0.1 percent. When divide the 35 years into three sub-periods, broadly as pre-reform period (1980-, first phase of reform (1992-04), and second-phase of reform (2004-15), we observe that the net cropped area was lost sharply during the first phase, but recovered in the second two periods. Similarly, the gross sown area has

declined at -0.35 percent, but recovered at 1.8 percent rate during the last phase, making overall growth positive. The area sown more than once has grown faster during 1980-92 and 2004-15 at 2.2 & 2.05 percent respectively. The gross sown area has increased for overall period at 2.89 percent.

While, rise of gross sown area appears brighter side of the story, the flip side has two aspects. One, there could be lot more scope for increasing cultivated land. And second, loss of commons would make allied activities to agriculture like dairy and livestock to have an adverse impact.

Table3.3 Measures of Central Tendencies

Area	Mean	Standard deviation	Coefficient of variation
Gross area	11462315	62735	0.54
Net cropped area	4246647	322147	7.58
Gross cropped area	4982335	455438	9.14
Area sown more than once area	735688	249000	33.8

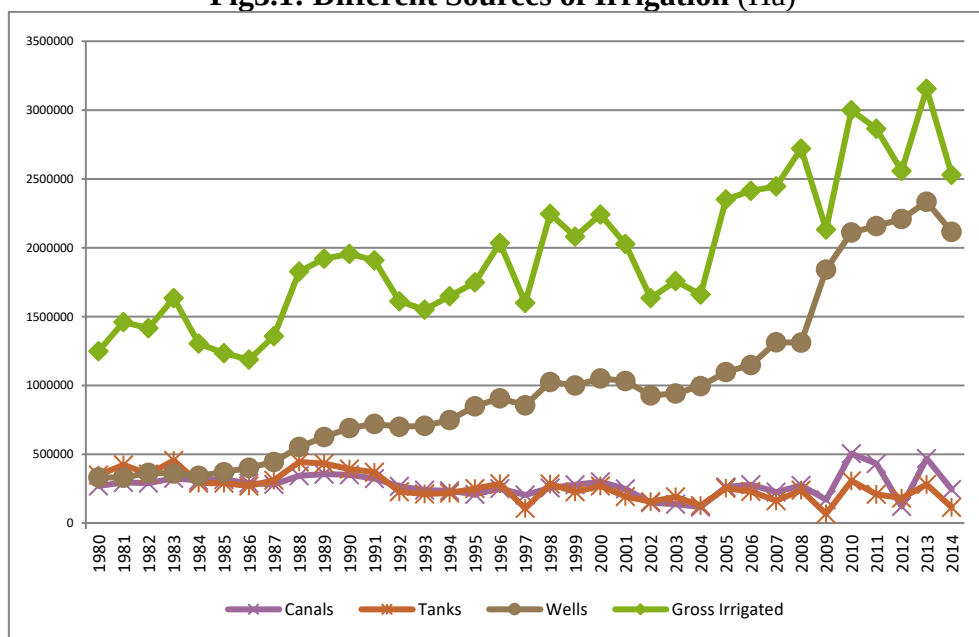
Source: Estimated

Even though the gross sown area has grown, but the fact is that the instability in area also has increased, because of excessive dependence on rainfall dependent sources of irrigation. From the above table no., we can see that gross sown area has coefficient of variation by 9.14 percent and area sown more than once fluctuated by 33.8 percent. This means that the production of rabi crop can fluctuate by 30 percent.

3.2 Irrigation

The three major sources of irrigation in the state are well, tank and canal irrigation in Telangana, an issue which remained at the heart of formation of the new state. Out of the total 43.7 lakh hectares of net sown area, the total irrigated area formed about 14.43 lakh hectares in 2014-15, which is about 33.02 percent. Out of this, a lion's share of 84 percent of irrigated area is irrigated through wells, while 9.61 percent is irrigated by canals and 4.47 percent is covered by the tanks. Overwhelming share of well irrigation, which is mostly by the bore wells, reflects the burden of private investment, compared to the declining public investment reflected by decreasing share of canal and tank irrigation. [See the graph]. By looking at the graph, we can see trends in irrigation in Telangana, in the past 35 years during 1980-2015.

Fig3.1: Different Sources of Irrigation (Ha)



Source: Dir of Economics and Statistics, AP

Table 3.4 Irrigated area compound growth

Different irrigated sources	1980-81 To 2014-15	1980-81 To 1994-95	1995-96 To 2004-05	2005-06 To 2014-15
Canal irrigation	-0.73	-0.69	-6.52***	1.41
Tank irrigation	-2.64*	-2.94***	-4.81	-2.51
Well irrigation	5.80*	7.33*	1.32	9.58*
Other sources of irrigation	1.15*	4.53*	-4.39**	2.11
Net irrigated area	1.85*	2.34*	-0.88	1.75
Gross irrigated area	2.22*	2.21**	-0.97	1.99

Source: estimated

Table3.5: Irrigated areas means, Coefficient of Variation

Irrigation source	Mean	Standard deviation	Coefficient of variation
Gross irrigated area	1955778	515191	26.34
Net irrigated area	1443362	319832	22.15
Canal irrigated area	274504	85230	31.04
Tank irrigated area	261510	96959	37.07
Well irrigated area	997110	586025	58.77
Other source	52333	10869	20.76

Source: Estimated

Table 3.6 Share of Different Sources of Irrigation (%)

Years	Canals	Tanks	Wells	Other sources
1980-81	21.65	27.99	26.54	2.566
1981-82	20.15	28.92	22.62	2.54

1982-83	20.49	25.02	25.72	2.83
1983-84	19.89	27.85	21.97	2.82
1984-85	23.62	22.32	26.30	2.91
1985-86	25.59	23.56	29.96	3.16
1986-87	24.52	22.66	33.78	3.03
1987-88	20.63	22.91	32.64	3.10
1988-89	18.82	24.23	30.20	2.90
1989-90	18.45	22.46	32.57	3.23
1990-91	17.94	20.04	35.33	3.02
1991-92	16.92	19.28	37.77	3.25
1992-93	16.58	14.04	43.48	3.48
1993-94	15.41	13.60	45.52	3.48
1994-95	14.13	13.22	45.36	3.76
1995-96	11.96	14.36	48.57	3.43
1996-97	12.30	14.07	44.61	2.85
1997-98	12.75	6.62	53.38	2.94
1998-99	11.31	12.56	45.61	2.72
1999-00	13.41	10.91	48.01	3.03
2000-01	13.39	12.05	46.85	2.72
2001-02	12.28	9.52	50.89	2.56
2002-03	9.12	9.42	56.67	2.39
2003-04	7.74	10.76	53.61	2.16
2004-05	6.99	7.65	59.88	2.59
2005-06	11.19	10.76	46.66	2.21
2006-07	11.52	9.53	47.60	2.15
2007-08	9.16	6.58	53.74	2.09
2008-09	10.07	8.78	48.18	2.24
2009-10	7.93	3.14	86.44	2.49
2010-11	16.80	10.18	70.39	2.63
2011-12	15.08	7.25	75.31	2.37
2012-13	4.7	7.02	86.32	1.94
2013-14	14.88	8.92	73.99	2.21
2014-15	9.61	4.47	83.66	2.25

Sources: Directorate of Econ and State, GoAP

The net irrigation in the state has increased at compound rate of 1.85 percent during the last 35 years [table3.4]. It has growth faster in the pre-reform period during 1980-94, it rose at 2.34 percent. Immediately after the reforms, net irrigation declined at rate of 0.88 percent during 1995-04, but recovered during the second phase during 2005-15, it increased by 1.75 percent per annum. However, the well irrigation that increased at 5.81 percent, while canal and tank irrigation declined in the last 35 years at -0.73 & -2.64 percent respectively. The well irrigation increased at 7.33 and 9.58 percent rates during 1980-94 and 2005-15. Because, groundwater is very closely related to rainfall, well irrigation shows greatest instability compared to surface irrigation. As observed earlier, the rainfall influences the area sown, though changes in current fallows; groundwater backed by overwhelming well irrigation is likely effect production instability. The coefficient of variation of well irrigation

is also found to be 58.77 percent, while canal irrigation varied at 31.07 percent. We of course, cannot deny the fact that whichever the source of irrigation, eventually depends on rainfall.

3.4 Compound Growth Rates of Production and Yields of Principal crops

Development of agriculture explained with the compound growth rates of crops so crucial for estimate the crops area, production, yield over the period.

For calculate compound growth rates purpose using formula

$$G = KL^p \quad \dots\dots\dots (1)$$

G= crop production or area or yield, K= Constant intercept of regression. L= coefficient of regression, p= time period

Take both sides log in equation 1 then $\log G = \log K + p \cdot \log L$

R =compound growth rate

$R = (\text{antilog of } L - 1) \cdot 100.$

Table 3.7 Area compound growth rate

Crop	1980-81 to 2014-15 compound growth rate	1980-81 to 1994-95 compound growth rate	1995-96 to 2004-05 compound growth rate	2005-2006 to 2014-15 compound growth rate
Rice	1.08*	0.23	-2.73	1.56
Maize	3.03*	-1.03	7.51*	1.65
Groundnut	-2.68*	2.39**	-8.13*	-1.35
Cotton	7.45*	9.46*	0.74	11.98*
Food grains	-0.80*	-2.65*	-0.68	-0.59

*1percent significance

The compound rates of growth of area shows that cotton has increased at breath taking rates 7.45 during, while maize areas grew at a remarkable 3.03 percent and paddy at a modest rate of 1.07 percent during 1980-2015. All these are at the expense of declining area under food grains. If we divide the entire period into three phases, a major change began taking place during 1980-81 to 1994-95. This is the period when the bore wells have arrived and thus area under jowar, groundnut, bajra, and several small millets is lost to cotton. Second, even though paddy as emerged as a dominant food crop, the area expansion under it was modest, while overall food grain area is lost to cotton and maize. The phase during 1995-96 to 2004-05, is a bad period for agriculture for not only whole country, but for Telangana. This area of most crops stagnated and declined, but cotton area rose very high, while maize

increased. It is the last phase of 2005-15, is a golden phase for Telangana agriculture. Cotton expanded at astonishing rate of 11.98 percent, while rice and maize had modest rates.

Table 3.8 Production compound growth rate

Crop	1980-81 to 2014-15 compound growth rate	1980-81 to 1994-95 compound growth rate	1995-96 to 2004-05 compound growth rate	2005-2006 to 2014-15 compound growth rate
Rice	2.84*	2.39	-1.71	2.52
Maize	5.9*	1.8	7.23*	3.31
Groundnut	0.001	3.61**	-6.46**	2.37
Cotton	13.53*	22.98*	4.37	11.58*
Food grains	2.68*	0.91	0.93	2.11

Source: estimated

Production of cotton has grown at a compound rate of growth of 13.53 during 1980-2015. Maize has growth at a rate of 5.9 percent and paddy at 2.84 percent during the same time. These are quite impressive on the face of it. Much of this growth has come during two periods, namely, 1980-95 and 2005-15. The decade of 1981-95 is a good decade, as for Telangana agriculture is concerned. What is cotton production exploded at a rate of 22.98percent. Paddy grew at an impressive rate of 2.39. The decade of 1995-2005, is in general not very good. This is the phase farmers' suicides began very badly. What is perhaps is the issues that cotton crop continue to grow at 4.37 percent per annum, even though it became a reason for lot of suicides as stated by several scholars (Galab and Revathi, 2011). Another silent growth is by maize, which grew at 7.23 percent. The phase during 2005-15 is the best for the production. The cotton grew at 11.58 percent, paddy grew at 2.52 percent and maize grew at 3.31 percent.

Table 3.9 Yield compound growth rate

Crop	1980-81 to 2014-15 compound growth rate	1980-81 to 1994-95 compound growth rate	1995-96 to 2004-05 compound growth rate	2005-2006 to 2014-15 compound growth rate
Rice	1.74*	2.15*	1.05	0.99***
Maize	2.78*	2.85**	-0.27	1.63
Groundnut	2.78*	1.22	1.81	3.78*
Cotton	5.62*	12.18*	3.60***	-0.35
Food grains	3.51*	3.66*	1.62	2.71***

*1percent significance, **5percent significance, *** 10percent significance

The yield improvement is the second important source for production. In Telangana, the cotton crop has recorded an impressive growth rate of 5.62 percent during 1980-2015,

followed by maize at 2.78 percent. Paddy has shown a modest growth of yield by 1.74 percent. Much of the yield improvements again have happened during 1980-95.

3.4.1 Variability in Area, production, yield mean: Standard Deviation: coefficient of variation

Area, production, yield variation measure using mean, standard deviation, coefficient of variation. Mean $\bar{X} = \frac{\sum X}{n}$ X = area or production, or yield. n = sample, Standard deviation = $SD = \sqrt{\frac{\sum (y - \bar{y})^2}{n}}$, y = area, or production, or yield n = sample coefficient of variation $CV = \frac{SD}{\bar{X}}$ SD = standard deviation, $\bar{X}$ = mean using these formulas estimated area, production, yield variations in the Telangana state during 1980 to 2014.

Table 3.10
Area mean, standard deviation, and coefficient variation

Crops	mean	Standard deviation	Coefficient variation
Rice	128773.3	287505.6	22.32
Maize	418774.5	150232.4	35.87
Groundnut	300473.9	99802.55	33.21
Cotton	660343.6	475310.2	31.97
Food grains	3195714.2	432610.38	13.58

Sources: estimated

Table 3.11
Productions mean standard deviation and coefficient of variation

Crops	Mean	Standard deviation	Coefficient of variation
Rice	3338448	1292775	38.72
Maize	1251045	813263.8	45.05
Groundnut	300500.8	74266.5	24.75
Cotton	1,157,956 bales	1166956 bales	65.77
Food grains	5382840.49	1892769.677	35.16

Table 3.12
Yields mean, standard deviation, and coefficient of variations

Crops	Mean	Standard deviation	Coefficient variation
Rice	2,518	476.438	18.91

Maize	2,747	893.7721	12.53
Groundnut	1,083	374.7132	34.61
Cotton	235	112.8834	37.95
Food grain s	1717.98	632.524	36.81

As discussed earlier, production stability is one of the most important things in agriculture, which arises largely from area and yield. Area can depend on the manure, natural factors like irrigation and rainfall, besides the relative price, the yield depends on the weather farm management and technology. When estimated the variability of production, area and yield for the period 1980-2015, we have something to say. Despite impressive rates of growth of production, Telangana production is characterized by considerable instability. See Table No 3.10, 3.11 and 3.12]. Cotton has maximum coefficient of variation of 65.77 percent. Such production variability is arising both from area as well as yield. Maize also has similar variability, though lesser than that of cotton. Paddy has lowest variation at 38 percent. Even paddy variability is caused by area as well as yield. This is largely because of considerable dependence on bore well irrigation and rabi crop. Both of them depend on rainfall, hence can show wide fluctuation.

3.5 Decomposition Analysis of Principal Crops of Telangana

In the above we have discussed the production, area and yield. It is important to understand how much area and yield have influenced the production and together how much. This is done using the standard decomposition analysis. Decomposition analysis is used to measure the relative contribution of area, yield to the total production change for the major crops. The decomposition analysis was given below. Sharma and Subramanyam (1984) and several other studies have used the following method. The method states that A_0 , Y_0 , P_0 respectively area, yield, production in initial year and P_n , A_n , Y_n are respective variables in the nth year items.

$$P_0 = A_0 Y_0 \quad 19$$

$$P_n = A_n Y_n \quad 20$$

$$P_n - P_0 = \Delta P \quad 21$$

$$A_n - A_0 = \Delta A \quad 22$$

$$Y_n - Y_0 = \Delta Y \quad 23$$

$$P_n = P_0 + \Delta P \quad 24$$

$$A_n = A_0 + \Delta A \quad 25$$

$$Y_n = Y_0 + \Delta Y \quad 26$$

Substitute 24, 25, and 26 in 20 became

$$P_0 + \Delta P = (A_0 + \Delta A)(Y_0 + \Delta Y), \quad 27$$

$$P_0 + \Delta P = A_0 Y_0 + \Delta A Y_0 + A_0 \Delta Y + \Delta A \Delta Y, \quad 28$$

Due to 19 became

$$\Delta P = \Delta A Y_0 + A_0 \Delta Y + \Delta A \Delta Y, \quad 29$$

$$1 \times 100 = \frac{\Delta A Y_0}{\Delta P} \times 100 + \frac{A_0 \Delta Y}{\Delta P} \times 100 + \frac{\Delta A \Delta Y}{\Delta P} \times 100, \quad 30$$

$$100\% = \frac{\Delta A Y_0}{\Delta P} \% + \frac{\Delta Y A_0}{\Delta P} \% + \frac{\Delta A \Delta Y}{\Delta P} \% \quad 31$$

ΔP = change in production in tons. ΔA = change in area in hectares. ΔY = change in yield in tons. Y_0 = initial yield. A_0 = initial area.

Production change = area effect + yield effect + interaction effect. Thus, the total change in production can be decomposed into three components viz. yield effect, area effect, and the interaction effect due to change in yield and area.

The study was restricted to principal crops with the assumption that the excluded crops do not affect the cropping pattern and in would not vitiate the main conclusions of the study. The selection of crops for the study was thus dictated by the availability of data. All the important crops paddy, cotton, maize, groundnut, maize, and sugarcane and total food grains were selected for the present study. Selected crops accounted for near to 80% of total cropped area. Pulses and other crops were not considered for lack of data on these crops. The study restricted to principal crops.

Table 3.13: Period-wise decomposition of the Principal crops 1980-2014.

Effects	Periods	1980 to 2014	1980 to 1991	1992 to 2004	2005 to 2014
Cotton					
Area effect		12.05	16.27	43.46	88.21
Yield effect		7.76	33.81	32.28	5.07
Interaction effect		80.24	50.2	24.11	6.87
Rice					
Area effect		26.19	48.29	440.61	-106
Yield effect		54.76	40.88	-418.9	212.44
Interaction effect		19.05	10.86	79.19	-6.63
Maize					
Area effect		52.16	38.63	111.61	-633.4
Yield effect		21.04	63.85	-6.09	676.16
Interaction effect		26.8	-3.59	-5.36	56.67

Groundnut				
Area effect	-105.12	80.31	117.65	-151.9
Yield effect	364.93	10.76	-37.22	325.36
Interaction effect	-159.7	9.02	19.56	-73.53
Sugarcane				
Area effect	-127.18	52.45	126.46	254.63
Yield effect	374.12	36.53	-20.16	-403.9
Interaction effect	-148.46	11.02	-6.3	250.44
Food grains				
Area effect	-34.33	-99.44	-181	401.69
Yield effect	198.95	238.59	319.47	-361.6
Interaction effect	-64.62	-39.15	-38.47	59.92

Source: Authors computation based on several data on important crops.

Telangana state importance crops decomposition total period 1980 to 2014 again this total time period divides into three time periods these are a. 1980 to 1991 b.1992 to 2004 and c. 2005 to 2014. For the study of decomposition of principal crops are cotton, rice, maize, groundnut, sugarcane, and total food grains.

Cotton is the top rank crop in the Telangana state in the 2014-15. Cotton growth rates only have shown the direction of crops. Decomposition of cotton explains the effect of area, yield effect and interaction effect on the change in production of cotton. Cotton area effect from 1980 to 2014 was 12.05% and from 1980 to 1991 was 16.27% and 43.46% was from 1992 to 2004 and during period of 2005 to 2014 cotton area effect has 88.21%. Cotton over all time period area effect very low just 12.05% but positive and last time period from 2005 to 2015 was high (88.21%.) compared to other time periods. Cotton yield effect on cotton production change had 7.76 percent from 1980 to 2014 and from 1980 to 1991 was 33.81% and in second period from 1992 to 2004 had 32.28 percent and 5.07% yield effect on cotton production change during 2005 to 2015. Total time period yield effect on cotton production change was very small and yield effect is positive. During 1991 to 2004 yield effect on cotton production change was high in relation with remaining periods. Cotton interaction effect (yield and area combined effect on production change) 80.24%, 50.20%, 24.11%, and 6.87% had on production change during periods 1980 to 2014, 1980 to 1991, 1992 to 2004, and 2005 to 2014, respectively. Total time period cotton interaction effect 80.24% was large comparative to other periods and positive and very small in last time period (2005 to 2014) and positive. Cotton interaction effect higher than yield and area effect during 1980 to 2014 it

is 80.24% and in 1980 to 1991 interaction effect is 50.20 percent large comparative other effect and from 1992 to 2004 area effect (43.46%) had higher than yield effect and interaction effect. Last time period area effect had 88.21 percent higher than other effects like yield and interaction effects from 2005 to 2014.

Rice production change decomposed into three parts area effect, yield effect and interaction effect. Rice decomposition estimated during period 1980 to 2014 and this period divided into three periods these are 1980 to 1991, 1992 to 2004, and 2005 to 2014. From 1980 to 2014 rice area effect 26.19 percent and yield effect 54.76% and interaction effect 19.05% had on production change. In this period mainly contribute on production change was yield effect 54.76 percent it is more than fifty percent. In time period 1980 to 1991 area effect had 48.29 percent and yield effect 40.88% and interaction effect 10.86 percent on rice production change. On this period area effect contribute more than other individual effect. On rice production area effect was 440.61% and yield effect had negative -418.93 percent and interaction effect influenced 79.19% during period 1992 to 2014. Area effect was 440.61% highest positive and very high negative in yield effect -418.93% in this period. From 2005 to 2014 area effect negative it was -105.97% and yield effect being 212.44% and interaction effect was negative -6.63 percent on rice production change. Highest yield effect 212.44% than other effect in this period. In overall period yield effect (54.76%) was high and first time period (1980 to 1991) area effect was high (48.29 percent) and area effect was very large (440.61%) in the second time period from 1992 to 2004 and third time period during 2005 to 2014 yield effect was very high 212.44% on the rice production change.

Maize crop output change contributed by area effect, yield effect, and interaction effect was called maize decomposition. From 1980 to 2014 maize area effect was 52.16% and yield effect had 21.04% and 26.80% being interaction effect on maize output change. In this period mainly contribute area effect 52.16% than other effects. In 1980 to 1991 maize area effect 38.63%, yield effect 63.85% and interaction effect -3.59% were on maize production change. During this period yield effect (63.85%) was higher than other effects and interaction effect (-3.59%) negative. From 1992 to 2004 area effect was 111.61% and yield effect had negative (-6.09%) and interaction effect being -5.36% negative on maize output change. Here maize area effect (111.61%) more than 100% remaining yield and interaction effects were negative. On maize production change area effect (-633.38%) negative, yield effect (676.16%), and interaction effect (56.67%) during 2005 to 2014. Yield effect (676.16%) more than six hundred percentage greater than other effects and yield effect more negative (-

633.38%) and interaction effect positive very small comparative area effect in this period. During 1980 to 2014 maize area effect was high and from 1980 to 1991 yield effect (63.85%) had high and area effect (111.61%) was high during 1992 to 2004 and yield effect (676.16%) was very high in 2005 to 2014.

Groundnut decomposed into groundnut area effect, groundnut yield effect, and groundnut interaction effect. From 1980 to 2014 area effect -105.12% and in 1980 to 1991, 80.31% area effect and during 1992 to 2004 area effect 117.65% and time period 2005 to 2014 area effect more than 150% negative (-151.92%) were on the output change. During 1992 to 2004 area effect more than comparative other time periods. Yield effect (364.93%) was very large in time period 1980 to 2014 and during 1980 to 1991 yield effect (10.76%) had very small and -37.22% of yield effect was negative during 1992 to 2004 and yield (325.36%) effect was very large during 2005 to 2014. Yield effect (364.93) was very high comparative other time periods and negative yield effect (-37.22%) during 1992 to 2004. During 1980 to 2014 interaction effect (-159.70%) had very high negative and from 1980 to 1991 19.56% of interaction effect was very small but positive and 19.56% of interaction effect was in 1992 to 2004 and during 2005 to 2014 interaction effect (-73.53%) has negative. Groundnut area effect (117.65%) was high more than hundred percent during 1992 to 2004 compared to other periods area effects and time periods 1980 to 2014 and 2005 to 2014 area effect had negative. Groundnut yield effect time periods 1980 to 2014 and 2005 to 2014 yield effects had very large 364.93%, and 325.36% respectively. Interaction effect 19.56 % during 1992 to 2004 was very high comparative other time periods.

Sugarcane area effect, yield effect and interaction effect on sugarcane production change is called sugar cane decomposition. From 1980 to 2014 area effect (-127.18%) and 374.12% of yield effect and interaction effect (-148.46%) were in the sugarcane production change. In this period yields effect (374.12%) was very high compared other effects and area effect and interaction effect negative. In 1980 to 1991 sugarcane area effect had 52.45% and yield effect was 36.53% and 11.02% of interaction effect on sugarcane output change. During this period area effect, yield effect and interaction effect were positive but area effect (52.45%) more than other effects. From 1992 to 2004 area effect was 126.46percentage and yield effect had -20.16% and -6.30% was interaction effect on production change. Here area effect (126.46%) more than hundred percent and remaining effects were negative. 254.63% of area effect and -403.94percentage of yield effect and interaction effect 250.44 % were during 2005 to 2014. During this period area effect (254.63%) and interaction effect (250.44

%) had very large more than two hundred percentages and yield effect (-403.94%) was negative more than four hundred negative percentage. During 1980 to 2014 yield effect (374.12%) had very high and from 1980 to 1991 sugarcane area effect being more and 126.46percentage of area effect was high in 1992 to 2004 and from 2005 to 2014 area effect (254.63%) had very high.

Total food grain production decomposition estimated during total period and three sub periods. Total period from 1980 to 2014 total food grains area effect (-34.33%) was negative and yield effect had 198.95% and interaction effect (-64.62%) on the production change. Total food grains Yield effect (198.95%) has high compared other effects and area and interaction effect were negative in this period. From 1980 to 1991 -99.44% of area effect and 238.59% of yield effect and -39.15% of interaction effect were on total food grains production change. During this period yield effect (238.59%) was very high comparative other effects more than two hundred percentage but area and yield effects were negative. During 1992 to 2004 area effect of -181.01% was negative and yield effect was 319.47% and interaction effect of -38.47 had negative on total output change. Yield effect (319.47%) was very large comparative other effects it was more than three hundred percentage thus area and yield effects were negative in this period. From 2005 to 2014 area effect of 401.69% and -361.61 of yield effect and 59.92% of interaction effect were on the total food grains production change. In this period area effect (401.69%) was very large comparative other effects more than four hundred percentage and yield effect (-361.61%) was negative. From 1980 to 2014 yield effect (198.95%) had very high and in 1980 to 1991 yield effect (238.59%) was very large and in 1992 to 2004 Yield effect (319.47%) was very high and during 2005 to 2014 area effect (401.69%) was very large.

3.6 Cropping Pattern in Telangana

In this chapter we try to trace the broad cropping pattern changes that have happened in Telangana since 1973-74 to 2016.17. The cropping pattern changes mostly occur when commercialization policies are introduced or when new irrigation facilities are introduced. We have seen in the Chapter 1 that historically the Telangana region got commercialized since late 19th century and certain cropping pattern changes have happened in that time. Namely, even though Jowar was the dominant crop, Nizam government has encouraged rice

cultivation and rice production became second most important crop. Some decline of coarse cereal and millets already happened and were replaced by rice. However, in those times lot more virgin lands and cultivable waste lands being available, there was tremendous scope for area expansion for new crops. For example, castor expansion can happen in the most infertile and dry lands, the crop can be grown even with scarce rainfall. Similarly, Nizam's commercialization bid also led to emergence of cotton, sugarcane, tobacco, groundnut, spices, chili and pulses as major commercial crops. Nizam has expanded irrigation during 1919-35 and later a period of stagnation in irrigation potential is observed. When the Great Depression has hit Telangana, not only the public investment was hit hard but a stagnation that froze Telangana's cropping pattern.

The post-Independence period do not appear to have seen any major changes in the cropping pattern of Telangana. During the brief period 1950-56, the present Nagarjunasagar Project was contemplated, as a continuation of what Nizam had planned it as Nandikonda project on Krishna River. After the unification with Andhra State, the new Andhra Pradesh state had made changes in design of Nandikonda into Nagarjunasagar Project in 1957, it was completed in 1967. The completion of canal, particularly the Left canal, later renamed as Eliminate Madhava Reddy canal with a capacity of 160 tmc that irrigates parts of Nalgonda, Khammam districts were completed in 1970. This was the time the Green Revolution is launched in the country and this region immediately underwent a cropping pattern shift to paddy.

The second important irrigation project was Sriramsagar project at Pochampad on Godavari River with a capacity of 147 tmc. This is to irrigate Nizamabad, Karimnagar and parts of Warangal. The canals were completed only towards late 1970s and early 1980s. Once again, these regions with the canal irrigation have undergone a complete shift to paddy cultivation and turmeric cultivation.

Cropping pattern, empirically speaking, is the ratio crops area divided by total cropped area in specific time. Cropping pattern tells individual crops contribution in the total cropped area. Crop rank is the relative position of total crops. In 1973-74 twenty crops were chosen from Telangana state for the study of cropping pattern. These crops are paddy, jowar, bajra, maize, ragi, small millets, pulses, food grains, spices and condiments, sugarcane, cotton, tobacco, groundnut, sesames, sunflower, castor, coconut, fruits, vegetables, and

fodder crops. In these crop's paddy, jowar, bajra, maize, ragi, small millets, pluses, spices and condiments, sugarcane, fruits, vegetables are food crops and cotton, tobacco, groundnut, sesames, sunflower, castor, coconut, fodder crops are nonfood crops. Same crops are taken from district and state.

In state level by 1973-74 first rank crop is jowar. State is occupied 32.2% of jowar so it is called jowar region in 1973-74. Second, third, fourth, fifth, six, seventh, eighth, ninth, tenth, and eleventh rank crops are paddy, pulses, castor, groundnut, maize, bajra, sesames, small millets, spices and condiments, and cotton respectively and remaining crops less than 1percent those crops are ragi, sugarcane, tobacco, sunflower, coconut, fodder crops, fruits, vegetables. By 1996-97 same crops have been taken like 1973-74 for the research of cropping pattern in Telangana state. In 1996-97 paddy is the major crop percentage of 28 from state. Pulses (13.4%), jowar (13.3%), cotton (12.9%), groundnut (8percent), maize (6.2%), castor (5%), spices and condiments (3 %), sugarcane & sunflower and fruits (2percent), bajra and sesames (1%) & vegetable (1%) crops have second, third, fourth, fifth, six, seventh, eighth, ninth, tenth rank crops respectively in the Telangana state. Twenty crops are taken for the scholarship of Telangana state agriculture cropping pattern in 2006-07 as like 1973-74 and 1996-97. In Telangana state paddy cover 30.1 percent take first place since 2006-07 and second, third, fourth, fifth, sixth, seventh, eighth, ninth, tenth, eleventh, twelfth, thirteenth order crops have cotton (14.80%), pulses (13.9%), maize (12%), jowar (5.7%), castor (3.7%), groundnut (3.6%) spices and condiments (3.1%), fruits (2.9%), sugarcane (2.2%), vegetables (1.55%), sunflower (1.5%) sesames (1.02%) respectively and remaining crops are less than one percentage.

Table 3.14 Telangana state Aggregate Cropping Pattern 1973-74 to 2014-15

Crops ²	1973-74	1996-97	2006-07	2014-15
PA	19.2	28	30.1	26.63
JO	32.2	13.3	5.7	1.49
BA	4.4	1	0.4	0.21
MA	5	6.2	12	13.01
RA	0.9	0.5	0.1	0.03
SM	2.2	0.1	0.01	0.03
PU	13.7	13.4	13.9	7.68

² Note: PA –paddy, JO-jowar , BA-bajra, MA-maize, RA-ragi, SM-small millets, PU-pulses,FG-food grains, SC-spices and condiments, SU-sugarcane, CO-cotton, TO-tobacco, GN-groundnut, SE-sesamum, SF-sunflower, CA-castor, CN-coconut, FR-fruits, VE-vegetables, FO-fodder crops. Source: *Statistical Abstracts*, Dir of Econnmics and Statistics, GoAP

FG	77.9	62.5	62.4	49.16
SC	2.1	3	3.1	2.31
SU	0.1	2	2.2	1.4
CO	2	12.9	14.8	31.35
TO	0.6	0.4	0.2	0.11
GN	5.6	8	3.6	2.91
SE	2.3	1	1.02	0.45
SF	0	2	1.5	0.35
CA	6.2	5	3.7	0.95
CN	0	0	0.02	0.01
FR	0.2	2	2.9	3
VE	0.3	1	1.55	1.9
FO	0.2	0.2	0.5	0.52

Sources: [Statistical Years Books](#), DoES

Since 2014-15 twenty crops are chosen for the investigation of Telangana agriculture cropping pattern. Cotton (31.35%) is the first rank crop in the state and other crops paddy (26.63%), maize (13.01%), pluses (7.68%), fruits (3%), groundnut (2.91%), spices and condiments (2.31%), vegetables (1.9%), jowar (1.49%), sugarcane (1.4%), are second, third, fourth, fifth, sixth, seventh, eighth, ninth, tenth rank crops sequentially and remaining crops are less than one percent. Thus, the three crops paddy, maize and cotton have 71 percent of area. 31.01 percent is allocated to cotton itself.

In Telangana state first, rank crop is jowar (32.2%) in 1973-74 main staple food and 1996-97 first rank is paddy (28%) replaced by jowar now jowar third place. In 2006-07 paddy continued first place of percentage (30.1%) and jowar fifth place. Main food crop is paddy (26.63%) but second rank crop, and cotton is the first rank crop (31.35%) and commercial crop since 2014. Jowar (1.49%) is the ninth place almost disappears in the Telangana state from 2014-15.

3.6.1 Spatial Cropping Pattern: District Wise 1973-74

After the cropping pattern changes during the Nizam period, as we noted that the irrigation potential has been enhanced from 11.6 percent to 26.7 percent of the total sown area. This would bring sufficient changes in cropping pattern. We would examine cropping pattern at three points, first being in 1973-74. The agriculture during the period between 1955-74 was dominated by open well and tank irrigation, with canal irrigation spreading in the later half. Open wells were operated either with bullock labour or diesel engines.

Table 3.15: Telangana pattern of crops 1973-74 (area percentages)

District	Rangareddy	Hyderabad	Nizamabad	Medak	Mahaboobnagar	Nalgonda	Warangal	Khammam	Karim Nagar	Adilabad	Telangana
PA	-	10.7	32.1	17.3	10.4	28.8	22	19.3	26	9.9	19.2
JO	-	38	20.4	38.6	39.4	21.8	30.5	43.3	21.4	36.5	32.2
BA	-	3	-	1.1	5.9	15.5	3.5	1.7	-	-	4.4
MA	-	2	15	9	0	0.1	8	2	14.2	4	5
RA	-	2.2	0.7	1.8	3.1	-	-	-	-	-	0.9
SM	-	4.2	0.6	2.3	8.1	0.7	0.2	0.4	0	0.1	2.2
PU	-	13	12.7	13.7	9.3	7.2	19.1	17.1	18.8	18.2	13.7
FG	-	74	82.3	84.2	76.4	74.2	83	83.8	80.6	68.8	77.9
SC	-	3	3	4	1	0.5	3.1	3	3	2.2	2.1
SU	-	0.2	7.4	2.4	0	0	0	0	0.1	0.1	0.1
O	-	-	0.7	-	1.1	-	0.2	-	0.1	14.6	2
TO	-	-	0.1	0.3	0.7	0.4	0.54	2.3	1	-	0.6
GN	-	1.7	3.7	0.9	9.6	5.9	8	6.3	6.2	2.8	5.6
SE	-	1.3	2.2	1.2	0.3	0.3	1.9	2.2	5.7	7.8	2.3
SF	-	0.1	0	0.1	0.1	0	0	0	0	0	0
CA	-	9	0.3	1.9	9.2	17.8	2.8	0.1	3.2	1	6.2
CN	-	0	0	0	0	0	0	0	0	0	0
FR	-	0.3	0.2	0.2	0.1	0.1	0.2	1.2	0.2	0	0.2
VE	-	2.2	0.3	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.3
FO	-	1	0.2	0.2	0.1	0.1	0	0.5	0	0.5	0.2

Note: PA –paddy, JO-jowar , BA-bajra, MA-maize, RA-ragi, SM-small millets, PU-pulses,FG-food grains, SC-spices and condiments, SU-sugarcane, CO-cotton, TO-tobacco, GN-groundnut, SE-sesamum, SF-sunflower, CA-castor, CN-coconut, FR-fruits, VE-vegetables, FO-fodder crops. Source: *Statistical Abstracts*, Dir of Econmics and Statistics, GoAP

The jowar continued to be the dominant crop at 32.2 percent of the area. Jowar is dominant crop in Hyderabad, Medak, Mahaboobnagar, Warangal, Khammam, and Adilabad districts. This is more or less the continuity of the trend from Nizam period. But what changed is the case of paddy. With construction of Nagarjunasagar and Sriramsagar paddy become a second dominant crop in Telangana in general and top-ranking crop in Nizamabad, Nalgonda and Karimnagar and a sizable shift, even though lesser than these three, also happened in Warangal, Khammam and Medak. The total area under paddy is now grown to 19.2 percent in 1973-74 compared to 11 percent during the Nizam period. Cotton was grown only in Adilabad as a significant crop by this period. Pulses were the fourth important crop occupying 13.7 percent of land, grown mostly in Warangal, Khamma, Adilabad, Karimnagar and Nalgonda. This was the major rabi crop, which was preferred to improve the soil fertility too. We see later how this was totally wiped out when the paddy expanded as the rabi crop which as more profitability.

3.6.1.2 Telangana cropping pattern in 1996-97

Table 3.16: Telangana pattern of crops 1996-97 (area %)

District	Rangareddy	Hyderabad	Nizamabad	Medak	Mahaboobnagar	Nalgonda	Warangal	Khammam	Karim Nagar	Adilabad	Telangana
PA	15	39.3	41	22	15	42	31.5	36	41.2	11.1	28
JO	26	0	7	20	23.2	5.3	3.5	5.2	1	29	13.3
BA	0.4	0	1.1	0.4	2	3.3	0	0.1	0.1	0	1
MA	2	0	14	12.2	1.5	0.2	6.3	3.5	17	5	6.2
RA	3	0	0	0.1	2.2	0	0	0	0	0	0.5
SM	0.4	0	0	0	1	0	0	0.1	0	0	0.1
PU	20	0	6.8	21	10	13.2	10.4	17	10.1	15	13.4
FG	66.8	39.3	71.9	75.7	54.9	64	51.7	61.9	69.4	60.1	62.5
SC	2.3	0	3.5	3.4	2	1	8	5	4	2	3
SU	0.2	0	9	8	0	0.1	0	1	1	0.1	2
CO	8.2	0	6	4	8.2	7	19.1	14.1	12	27	12.9
TO	0	0	0.1	0	1	0	0.2	2.1	0.4	0	0.4
GN	3	0	4	2	19	9	12.3	3.4	7.3	1	8
SE	1	0	0.4	1	0.2	1	4	1	1	4.4	1
SF	1	0	3	2	2	1	2	1	1.5	2	2
CA	8	0	0.1	0.4	10.3	14	1	0	0.1	0.5	5
CN	0	1	0	0	0	0	0	0.2	0	0	0
FR	2.1	3	0.4	1	1	1	1	8.4	2	1	2
VE	5	19	0.1	1.4	1	0.3	0.3	0.3	1	0.5	1
FO	1	37.5	0	0	0	0	0	1	0	0.2	0.2

Note: PA –paddy, JO-jowar , BA-bajra, MA-maize, RA-ragi, SM-small millets, PU-pulses,FG-food grains, SC-spices and condiments, SU- sugarcane, CO-cotton, TO-tobacco, GN-groundnut, SE-sesame, SF-sunflower, CA-castor, CN-coconut, FR-fruits, VE-vegetables, FO- fodder crops Source: *Statistical Abstracts*, Dir of Economics and Statistics, GoAP

3.1.3 Telangana cropping pattern in 2006-07

Table 3.17 Telangana pattern of crops 2006-07(area percentages)

DISTRICT	Rangareddy	Hyderabad	Nizamabad	Medak	Mahabubnagar	Nalgonda	Warangal	Khammam	Karimnagar	Adilabad	Telangana
PA	13.6	-	40.7	19.2	14.1	47.8	34.3	35.8	47.6	12.5	30.1
JO	15.7	-	2.8	9.2	10.5	2.3	1.2	0.9	0.1	13.1	5.7
BA	0.2	-	1.9	0.1	0.8	0.6	0	0	0	0.2	0.4
MA	10.14	-	14.4	19.6	17.2	0.5	12.4	5.5	20	4.2	12
RA	0.7	-	0	0	0.5	0	0	0	0	0	0.1
SM	0.01	-	0	0.0001	0.06	0	0	0.005	0	0	0.01
PU	26	-	11.9	25.2	16	13	8.6	11.9	5.2	15.8	13.9
FG	66.9	-	72	73.8	59.2	64.2	56.4	54.1	72.9	46.3	62.4

SC	4.4	-	3.4	2.1	1.1	1.3	6.1	5.7	3.2	2.5	3.1
SU	1.2	-	8.4	11.1	0.03	0.2	0	1.7	0.4	0.1	2.2
CO	7.1	-	1.9	3.6	6	13.5	25.2	22.1	16.7	30.3	14.8
TO	0	-	0.1	0	0.2	0	0.2	1	0.1	0	0.2
GN	1.7	-	0.5	0.4	10.7	4.6	6.1	1.1	1.9	0.8	3.6
SE	0.4	-	0.5	0.3	0	1.3	2.5	1.1	0.7	2.1	1.02
SF	0.2	-	4.7	2.4	4	0.2	0.15	0.1	0.11	1.3	1.5
CA	2.4	-	0.1	0.5	15.6	7.8	0	0.5	0.4	0	3.7
CN	0	-	0	0	0	0	0	0.2	0	0	0.02
FR	3.2	-	0.3	1	1.8	6.2	1.3	9.2	2.6	1	2.9
VE	9	-	1.4	2.7	1.03	0.63	1.3	0.63	1	1.2	1.55
FO	1.11	-	1.7	0.04	0.125	0.08	0.023	2.4	0.02	0.01	0.5

Note: PA –paddy, JO-jowar , BA-bajra, MA-maize, RA-ragi, SM-small millets, PU-pulses, FG-food grains, SC-spices and condiments, SU- sugarcane, CO-cotton, TO-tobacco, GN-groundnut, SE-sesame, SF-sunflower, CA-castor, CN-coconut, FR-fruits, VE-vegetables, FO- fodder crops.

Source: *Statistical Abstracts*, Dir of Econmics and Statistics, GoAP

By 1996-97, the major change has that happened in Telangana agriculture. By 1983-84, the completion of rural electrification was complete and in Andhra Pradesh. This made electric bore well popular and paddy cultivating began booming. This made open wells in most places dry up and farmers had to shift to groundwater up to 140 ft depth. Soon water at those levels began drying up and farming of paddy gone into a crisis by 1989. But then arrived, the submersible bore wells, with which farmers could go to 500 to 1000 ft and paddy expansion saw no bounds. In 1982, the then Chief Minister N.T Rama Rao introduced Rs.2-a kilo-rice subsidy scheme under public distribution system and expanded the scheme to all the rural areas for the first time. The progressive expansion of rice subsidy to all villages had put severe pressure on the state government to procure rice in the open market as it exceeded the central assistance. The A.P.Civil Society was roped in to procure rice from all the millers. There is was a sudden shift of consumption pattern from jowar to rice within a span of decade and two. The open market prices of rice began roaring, and state had to impose a levy and open markets were slightly liberalized to make it profitable for the millers. All these changes were transmitted to production. The liberal expansion of bank credits also enabled farmers in Telangana to buy submersible pump sets and expand paddy cultivation. By 1996-97, as we can see from the table no 3.16, paddy area expanded from previous 19.2 percent to 28 percent. But the area under total food grains has declined form 77.8 percent to 62.5 percent. Jowar sharply dropped from 32 percent to 13 percent. The fall in food grains area is gained by cotton by 5 percent, sugarcane by 1.6 percent, groundnut by 2.5 percent, turmeric by 2 percent, vegetables by 1 percent, and other miscellaneous crops. Pulses area still stood its

ground as in previous. The new paddy boom began happening in Hyderabad, Warangal, Nalgonda, Nizamabad and Karimnagar. Turmeric rose in Nizamabad and Karimnagar. Groundnut was concentrated in Mahaboobnagar, Warangal and Karimnagar. This is majorly a dry land crop.

3.6.2.3 Telangana cropping pattern in 2014-15

In the year 2014-15, the point where new Telangana state has begun we will see the cropping pattern. As can be understood, we do not expect anything dramatic at this point of time, but see the dominant trend. First, we see that there is a considerable drop in area under food grains in 1996-97, from 62.3 percent to 49.43 percent in 2014-15, a decline of 13 percent of land. The area of paddy also declined from 30.1 percent to 26.63 percent. This is so, because the gross sown area under Paddy has grown by 70 percent of net sown area under it. That is the reason; paddy net sown area has declined, as an indication of response to saturation of production. Which are the crops that have gained this area lost by rice? Single crop has namely cotton. Cotton has increased its acreage from 14.8 percent to 31.4 percent, doubling of the area. There is one percent area rise in Maize. As we see in the following, three crops namely paddy, cotton and maize occupy 72 percent of the total area under all crops. Pulses are under 7.68 percentage and ground nut by 2.91 percent.

Table 3.18 Telangana pattern of crops 2014-15(area percentages)

District	Rangareddy	Hyderabad	Nizamabad	Medak	Mahabubnagar	Nalgonda	Warangal	Khammam	Karimnagar	Adilabad	Telangana
PA	13.66	0	37.64	20.07	16.43	44.3	23.83	32.18	39.8	8.33	26.63
JO	3.15	0	1.75	2.18	2.53	0.26	0.42	0.12	0.18	3.35	1.49
A	0.03	0	1.35*	0.05	0.16	0.01	0.01	0	0.21	0.27	0.21
MA	18.88	0	12.82	23.09	18.66	0.52	18.02	7.24	15.45	3.89	13.01
RA	0.17	0	0	0	0.11	0	0	0	0	0	0.03
SM	0	0	0	0	0.01	0	0	0	0	0	0.03
PU	16.98	0	5.09	10.27	13.24	3.75	5.68	3.68	2.51	10.02	7.68
FG	53.02	0	58.91	55.89	51.15	48.84	47.96	43.22	58.15	26.36	49.16
SC	1.9	0	3.1	1	1.05	0.62	5.5	5.9	2.11	1.7	2.31
SU	0.8	0	2.6	7.2	0.4	0.3	0.0002	2.3	0.4	0.0007	1.4

CO	24.86	0	3.51	24.19	27.36	42.17	38.26	34.76	30.67	50.65	31.35
TO	0	0	0.21	0	0.24	0.01	0.07	0.5	0	0	0.11
GN	2.42	0	0.2	0.15	9.96	1.97	3.83	0.96	1	0.16	2.91
SE	0.09	0	1.15*	0.11	0.11	0.08	0.48	0.25	1.04	0.8	0.45
SF	0.1	0	1.52	1.31	0.3	0.01	0.003	0.02	0.1	0.1	0.35
CA	0.3	0	0	0.18	4.9	0.07	0.06	0	0.01	0.02	0.95
CN	0	0	0	0	0	0	0	0.1	0	0	0.01
FR	3.6	0	0.4	1.9	2.2	5.1	2.6	7.4	3	1.1	3
VE	9.8	0	1.6	3.8	2.14	0.62	1.03	0.66	1	1.4	1.9
FO	1.33	0	4.71	0.01	0.11	0.14	0.02	0.1	0	0.04	0.52

Source: seasonal crop report, directorate of economics and statistics of Telangana.

Paddy cultivation is concentrated in Nalgonda, Nizamabad, Karimnagar and Khammam. Cotton is concentrated in Adilabad, Nalgonda, Khammam, Warangal and Mahaboobnagar. Maize is grown in Medak, Ranga Reddy and nizamabad. What we observe the crop diversification has come down, and cropping pattern is centered on only three crops. This is bad in terms of production running the risk of outstripping the demand. This is good, as internal economies of scale will happen.

3.7 Crop Combination

The geography of crops regionally is an important aspect. This mapping of the cropping in terms of dominant combination would can be useful to policy makers for crop planning and supply chains. Crop colonies can be made. To do that one can estimated the

Any regions or country or state cannot have single crop but cultivated multiple crops normally crop combination. We have used K.DOI'S method for crop estimating combination.

DOI's method= ΣD^2 D= Average crop area percentage – actual crop area percentage.

One crop = $(100 - x)^2$ x=actual crop area of highest percentage,

Two crops = $[(50 - x)^2 + (50 - y)^2]/2$ y= actual second highest area crop percentage,

Three crops = $[(33.3 - x)^2 + (33.3 - y)^2 + (33.3 - z)^2]/3$ z= actual third highest area crop percentage.

Four crops = $[(25 - x)^2 + (25 - y)^2 + (25 - z)^2 + (25 - a)^2]/4$ a= fourth highest percentage area crop. Etc

For instance, one crop > two crops > three crops < four crops, so this region three crop combination. After placing the cumulative area from ordering area of each crop in an increasing order, the value is calculated by taking different combinations. Whichever has the least value, owing to the squaring of the deviations from the average that combination is chosen as a combination of the highest area.

In Telangana state crop combination change depicts in the Table3.19, Table3.20, Table3.21, and Table3.22, respectively from 1973-74, 1996-97, 2006-07, and 2014-15 in below by state wise and districts wise.

Table3.19: Crop-combination in 1973-74 using Doi method

Serial number	Districts and state	Crop combination	Crop combination crops	No. of crop combination
1	Hyderabad	JO-PU-PA-CA	Jowar, Pulses, Paddy, and Castor.	4
2	Ranga reddy	-	-	
3	Nizamabad	PA-JO-MA-PU	Paddy, Jowar, Maize, and Pulses	4
4	Medak	J0-PA-PU-MA	Jowar, Paddy, Pulses, and Maize	4
5	Mahaboob Nagar	JO-PA-GN-PU-CA-SM	Jowar,Paddy,Groundnut,Pulses, Castor, and Small millets	6
6	Nalgonda	PA-JO-CA-BA	Paddy, Jowar, Castor, and Bajra	4
7	Warangal	JO-PA-PU	Jowar, Paddy, and pluses	3
8	Khammam	JO-PA-PU	Jowar, Paddy, and Pulses	3
9	Karimnagar	PA-JO-PU-MA	Paddy, Jowar, Pulses, and Maize	4
10	Adilabad	JO-PU-CO-PA	Jowar, pulses, Cotton, and Paddy	4
State	Telangana	JO-PA-PU-CA	Jowar, Paddy, Pluses, and Castor	4
Source:Estimated				

Region or state or country cultivated not a single crop but combination of multiple crops this called crop combination. In 1973-74 Telangana state and districts estimated crop combination using K.DOI's formula. Telangana state had four crops combination with jowar, paddy, pulses, and castor since 1973-74. Crops combination calculated district wise also. Hyderabad district crop combination (JO-PU-PA-CA) is four and that crops have jowar, pulses, paddy, and castor. Four crops combination (PA-JO-MA-PU) in the Nizamabad district and those crops have been paddy, jowar, maize, pulses. Jowar, Paddy, Pulses, and Maize crops have in the crop combination (J0-PA-PU-MA) from Medak district JO-PA-GN-PU-CA-SM crop combination in Mahaboobnagar district has six crops jowar, paddy, groundnut, pulses, castor, and small millets. Nalgonda district has four crops combination (PA-JO-CA-BA) with crops paddy, jowar, castor, bajra. Jowar, paddy, pulses crops have been three crops combination (JO-PA-PU) by Warangal district. Three crops combination (JO-PA-PU) in Khammam district have been crops Jowar, paddy, pulses. Karimnagar district four crops combination (PA-JO-PU-MA) have crops paddy, jowar, pulses, maize. JO-PU-CO-PA

crop combination crops have been jowar, pulses, cotton, and paddy since Adilabad. Larger crop combination conveys heterogeneity and lesser one homogeneity and specialization. We can see that a crop combination was the norm in most districts.

Table3.20 Crop combination in 1996-97 using K.DOI's method

Serial number	Districts and state	Crop combination	Crop combination crops	No of crops
1	Hyderabad	-	-	5
2	Rangareddy	JO-PU-PA-CO-CA	Jowar,Pulses,Paddy,Cotton, and Castor	5
3	Nizamabad	PA-MA-SU-JO-PU	Paddy,Maize,Sugarcane,Jowar, and Pulses	5
4	Medak	PA-PU-JO-MA-SU	Paddy,Pulses,Jowar,Maize, and Sugarcane	5
5	Mahaboobnagar	JO-GN-PA-CA-PU	Jowar,Groundnut,Paddy,Castor, and pulses	5
6	Nalgonda	PA-CA-PU-GN	Paddy,Castor,Pulses, and groundnut	4
7	Warangal	PA-CO-GN-PU-MA	Paddy,Cotton,Groundnut,Pulses, and Maize	5
8	Khammam	PA-PU-CO-FR	Paddy,Pulses,Cotton, and Fruits	4
9	Karimnagar	PA-MA-CO-PU	Paddy,Maize,Cotton, and Pulses	4
10	Adilabad	JO-CO-PU-PA	Jowar,Cotton,Pulses, and Paddy	4
State	Telangana	PA-PU-JO-CO-GN	Paddy,Pulses,Jowar,Cotton,and Groundnut	5
Source: estimated				

By 1996-97, this situation has led more heterogeneity as most districts have entered crop combinations from crop combinations. This could be the phase of diversification. Since 1996-97 crop combination calculated using K.DOI's method same as in 1973-74. Five crop combination (PA-PU-JO-CO-GN) from Telangana state having crops paddy, pulses, jowar, cotton, and groundnut in 1996-97. Rangareddy district has five crop combination (JO-PU-PA-CO-CA) with crops Jowar, pulses, paddy, cotton, and castor in 1996-97. Five crop combination (PA-MA-SU-JO-PU) in the Nizamabad district crops are paddy, maize, sugarcane, jowar, and pulses. Paddy, Pulses, Jowar, Maize, and Sugarcane crops are five crops combination (PA-PU-JO-MA-SU) since Medak district. From Mahaboobnagar district crops combination (JO-GN-PA-CA-PU) is five crops jowar, groundnut, paddy, castor, pulses. (PA-CA-PU-GN) four crops combination has crops paddy, castor, pulses, and groundnut by Nalgonda district. Five crops combination has been crops (PA-CO-GN-PU-MA) paddy, cotton, groundnut, pulses, and maize in the Warangal district. (PA-PU-CO-FR) paddy, pulses, cotton, fruits have five crops combination since Khammam district. Khammam

district four crops combination crops are (PA-PU-CO-FR) paddy, pulses, cotton, fruits. Karimnagar district has been four crops combination (PA-MA-CO-PU) crops paddy, maize, cotton, pulses. Four crops combination (JO-CO-PU-PA) has crops Jowar, cotton, pulses, paddy in the Adilabad district. At least one new crop entered every district. Even the region as a whole had 5 crop combination from 4 in the previous period.

Table3.21 Crop combination in 2006-07 using K.DOI's method

Serial number	Districts and state	Crop combination	Crop combination crops	Number of crops in crop combination
1	Hyderabad	-	-	-
2	Rangareddy	PU-JO-PA-MA-VE-CO	Pulses,Jowar,Paddy,Maize,Vegetables, and Cotton	6
3	Nizamabad	PA-MA-PU-SU	Paddy,Maize,Pulses, and Sugarcane	4
4	Medak	PU-MA-PA-SU-JO	Pulses,Maize,Paddy,Sugarcane, and Jowar	5
5	Mahaboobnagar	MA-PU-CA-PA-GN-JO	Maize,Pulses,Castor,Paddy,Groundnut, and Jowar	6
6	Nalgonda	PA-CO-PU	Paddy, Cotton, and Pulses	3
7	Warangal	PA-CO-MA	Paddy, Cotton, and Maize	3
8	Khammam	PA-CO-PU-FR	Paddy,Cotton,Pulses, and Fruits	4
9	Karimnagar	PA-MA-CO	Paddy, Maize, and Cotton	3
10	Adilabad	CO-PU-JO-PA	Cotton, Pulses, Jowar, and Paddy	4
State	Telangana	PA-CO-PU-MA	Paddy, Cotton, Pulses, and Maize	4

Source: Estimated

2006-07 is the consolidation period for Telangana's agriculture towards more commercial agriculture, diversified towards more profitable crop. At least a great private drive through private investments had created euphoria on the country side. We observe that the crop combination in the region as whole had come back to 4 crop one, (PA-CO-PU-MA) with crops paddy, cotton, pulses, maize. Rangareddy, Nizamabad, Medak, Mahaboobnagar, Nalgonda, Warangal, Khammam, Karimnagar, Adilabad districts are six, four, five, six, three, four, four, three, four crops combination respectively. Rangareddy is six crops (PU-JO-PA-MA-VE-CO) Pulses, Jowar, Paddy, Maize, Vegetables, and Cotton. (PA-MA-PU-SU) paddy, maize, pluses, sugarcane crops have been since Nizamabad and Medak district has crops (PU-MA-PA-SU-JO) pulses, maize, paddy, sugarcane, jowar and Maize, Pulses, Castor, Paddy, Groundnut, Jowar (MA-PU-CA-PA-GN-JO) have been crops from Mahaboobnagar district and three crops are (PA-CO-PU) paddy, cotton, pulses in the Nalgonda district and Warangal district has been crops (PA-CO-MA) paddy, cotton, maize. And (PA-CO-PU-FR) paddy, cotton, pulses, fruits are crops in the Khammam district and in the Karimnagar, district has crops (PA-MA-CO) Paddy, Maize, Cotton and Adilabad district four crops have (CO-PU-JO-PA) cotton, pulses, jowar, paddy in the crops combination.

Karimnagar, Nalgonda, Warangal and Adilabad converged to 3 crop combination. Nalgonda became 3 crops district, between its wet and dry regions.

Table 3.22 Crop combination in 2014-15 using K.DOI's method

Serial number	Districts and state	Crop combination	Crop combination crops	No. crop combination
1	Hyderabad	-	-	-
2	Ranga reddy	CO-MA-PU-PA-VE	Cotton, Maize, Pulses, Paddy, and vegetables	5
3	Nizamabad	PA-MA-PU-FO-CO-SC	Paddy, Maize, Pulses, Fodder crops, Cotton, and Spices&Condiments	6
4	Medak	CO-MA-PA-PU	Cotton, Maize, Paddy, and Pulses	4
5	Mahaboobnagar	CO-MA-PA-PU-GN	Cotton, Maize, Paddy, Pulses, and Groundnut	5
6	Nalgonda	PA-CO	Paddy, and Cotton	2
7	Warangal	PA-CO-MA	Paddy, Cotton, and Maize	3
8	Khammam	PA-CO-PU-FR	Paddy, Cotton, Pulses, and Fruits	4
9	Karimnagar	PA-CO-MA	Paddy, Cotton, and Maize	3
10	Adilabad	CO-PU-PA	Cotton, pulses, and Paddy	3
State	Telangana	CO-PA-MA	Cotton, Paddy, and Maize	3
Source: Estimated				

By 2014-15, the crop combination even reduced to 3 crops at the state level, (CO-PA-MA) cotton, paddy, and maize. Five districts converged to 3 crop combination regions. Nizamabad remained highly diversified crop region because it is a major seed producer. Otherwise, it has three major crops. Groundnut in the Mahaboobnagar and Paddy, Cotton by Nalgonda and Paddy, Cotton, Maize with Warangal and Paddy, Cotton, Pulses Fruits for Khammam, and Paddy, Cotton, Maize from Karimnagar and Cotton, pulses, Paddy since Adilabad district crops have crop combination crops.

The results indicate that Telangana agriculture had been quite dynamic. The crop combination began with four in 1973-74, increased to five in 1996-97, declined to four in 2006-07 and further to three in 2014-15. The progressive decline of diversity of crops towards the end is the issue to be discussed. Particularly when the state essentially growing three crop combination region suggests certain policy imperatives. This suggests that farmers have lost wider opportunity and therefore at the end of high risk in each crop.

3.8 Crop concentration index

Index of concentration of crop study the particular crop region dominance in the total region. Concentration indices estimated using Jasbir Singh concentration index.

$$CCI = \frac{A_{xs}}{A_{xt}}$$

CCI =index of crop concentration. A_{xs} = ratio of crop grown survey region and total cropped area in that survey region, A_{xt} = ratio of crop grown in total region and total cropped area in the total region. The value of the CCI can range from zero to infinity.

It explains thickness of the crop in that total region and also changes of crop thickness in total region lengthy of period. Estimated index of concentration of crops shown in the Table3.23, Table3.24, Table3.25, and Table3.26 respectively from 1973-74, 1996-97, 2006-07, and 2014-15.

Table 3.23: Crop concentration index in 1973-74

DISTRICT	Rangareddy	Hyderabad	Nizamabad	Medak	Mahaboobnagar	Nalgonda	Warangal	Khammam	Karimnagar	Adilabad	Telangana
PA	-	0.557	1.67	0.9	0.54	1.5	1.15	1	1.35	0.52	1
JO	-	1.2	0.63	1.2	1.22	0.7	0.95	1.34	0.7	1.13	1
BA	-	0.68	-	0.25	1.341	3.52	0.8	0.39	-	-	1
MA	-	0.4	3	1.8	0	0.02	1.6	0.4	2.84	0.8	1
RA	-	2.4	0.8	2	3.4	-	-	-	-	-	1
SM	-	1.91	0.3	1.05	3.7	0.32	0.1	0.2	0	0.05	1
PU	-	0.95	0.93	1	0.68	0.53	1.4	1.25	1.37	1.33	1
SC	-	1.43	1.43	1.9	0.5	0.24	1.48	1.43	1.43	1.05	1
SU	-	2	74	24	0	0	0	0	1	1	1
CO	-	-	0.35	-	0.55	-	0.1	-	0.05	7.3	1
TO	-	-	0.17	0.5	1.17	0.67	0.9	3.83	1.67	-	1
GN	-	0.3	0.66	0.16	1.7	1.05	1.43	1.13	1.11	0.5	1
SE	-	0.57	0.96	0.52	0.13	0.13	0.83	0.96	2.48	3.4	1
SF	-	-	-	-	-	-	-	-	-	-	-
CA	-	1.45	0.05	0.031	1.48	2.87	0.45	0.02	0.52	0.16	1
CN	-	-	-	-	-	-	-	-	-	-	-
FR	-	1.5	1	1	0.5	0.5	1	6	1	0	1
VE	-	7.33	1	1	0.67	0.33	0.33	0.33	0.33	0.33	1
FO	-	5	1	1	0.5	0.5	0	2.5	0	2.5	1

Source: Estimated

In 1973-74 paddy cultivated all districts concentrated index 0.52 least Adilabad to highest 1.67 Nizamabad but index not exceeds two in any district. Jowar mainly growing districts were Khammam, Mahaboobnagar, Hyderabad, Medak, and Adilabad but this crop distributed evenly in all districts because it is main staple food in the state index not exceeds any district 1.5. Nalgonda occupied Bajra top index. Maize occupied mainly Nizamabad, Karimnagar, Medak, and Warangal. Nizamabad occupied two top index crops one is sugarcane and another is maize but in Nizamabad sugarcane concentration index is very high it was 74 this

means sugarcane concentrated in this district only. Sugarcane occupied only two districts these were Nizamabad and Medak. Mahaboobagar has three top concentration index crops these are small millets, ragi, and groundnut. Pulse crop evenly distributed in all districts and top district is Kariminagar but index is less than 1.5. Vegetables and fodder crops occupied in Hyderabad. Adilabad district is concentrated in cotton. Spices and condiments crop are distributed evenly in all districts. But Medak is top index district. Castor is mainly concentrated in Nalgonda, Mahaboobnagar, and Hyderabad. Fruits and tobacco occupied in Khammam district. Sesames crop was cultivated mainly in Adilabad and Karimnagar. Sunflower and coconut did not cultivate in all districts.

The important points are that by 1973-74 paddy had concentrated slightly in Nizamabad, Jowar in Khammam, Mahabubnagar and Hyderabad. Cotton is concentrated in Adilabad, fruits were in Kammam district and vegetables in Hyderabad.

Table 3.24: Crop concentration index in 1996-97

S.NO	District	PA	JO	BA	MA	RA	SM	PU	SC	SU	CO	TO	GN	SE	SF	CA	CN	FR	VE	FO
1	Rangareddy	.5 4	1. 95	.4	.3 2	6	4	1. 5	.7 7	0. 1	.6 4	0	.3 75	1	.5	1. 6	-	1. 05	5	5
2	Hyderabad	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Nizamabad	1. 46	.5 3	1. 1	2. 26	0	0	0.5 1	1. 17	4. 5	.4 7	0. 25	0. 5	.4	1. 5	0. 02	-	.2	.1	0
4	Medak	.7 9	1. 5	.4	1. 97	0. 2	0	1. 57	1. 13	4	.3 1	0	0.2 5	1	1	0. 08	-	.5	1. 4	0
5	Mahabubnagar	.5 4	1. 74	2	.2 4	4. 4	10	.7 5	.6 7	0	.6 4	2. 5	2. 38	.2	1	2. 06	-	.5	1	0
6	Nalgonda	1. 5	.4	3. 3	.0 3	0	0	.9 9	.3 3	0. 05	.5 4	0	1. 13	1	.5	2. 8	-	.5	.3	0
7	Warangal	1. 13	.2 6	0	1.0 2	0	0	.7 8	2. 67	0	1. 48	0. 5	1. 54	4	1	0. 2	-	.5	.3	0
8	Khammam	1. 29	.4	0. 1	.5 6	0	1	1.2 7	1. 67	0. 5	1. 1	5. 25	. 43	1	.5	0	-	4. 2	.3	5

9	Karimnagar	1.47	.1	0.1	2.74	0	0	.75	1.33	0.5	.93	1	.913	1	0.75	0.02	-	1	1	0
10	Adilabad	.4	2.2	0	.81	0	0	1.12	.67	0.05	2.1	0	0.125	4.4	1	0.1	-	.5	.5	1
	Telangana	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	1	1	1

Source: Estimated

Since 1996-97 paddy crop cultivated in all districts highest crop concentration index 1.5 Nalgonda district replaced by Nizamabad district. Jowar cultivated in mainly Adilabad, Rangareddy, and Mahaboobnagar. Bajra occupied districts were Nalgonda, Mahaboobnagar, and Nalgonda. Karimnagar, Nizamabad, Medak and Warangal districts cultivated maize. Ragi and vegetables top index crops in Rangareddy district. Small millets and groundnut continue to top index crops in Mahaboobnagar but both crop indices increase. Pulse crop spread in all districts Medak top index replaced by Karimnagar district. Spices and condiments cultivated in all districts but top occupied district is Warangal before Medak. Sugarcane concentrated still Nizamabad and Medak continue top index Nizamabad but index decline drastically from 74 to 4.5. Cotton spread in all districts Adilabad continue top district index decline. Tobacco and fruits continue to concentrate in Khammam district. Sesames crop occupied in mainly Adilabad and Warangal districts Adilabad continue top district. Sunflower first time spread into all districts before it did not cultivate single district top district is Nizamabad. Coconut still did not cultivate any district. Castor concentrated in Nalgonda, Mahaboobnagar, and Rangareddy. Fodder crop concentrated districts are Khammam and Rangareddy.

Table 3.25 Crop concentration index in 2006-07

DISTRICT	Ranga reddy	Hyderabad	Nizamabad	Medak	Mahaboobnagar	Nalgonda	Warangal	Khammam	Karimnagar	Adilabad	Telangana
PA	0.45	-	1.4	0.64	0.47	1.59	1.14	1.19	1.58	0.42	1
JO	2.75	-	0.5	1.6	1.84	0.4	0.21	0.16	0.02	2.3	1
BA	0.5	-	4.75	0.25	2	1.5	0	0	0	0	1
MA	0.845	-	1.2	1.63	1.43	0.04	1.03	0.46	1.67	0.35	1
RA	7	-	0	0	5	0	0	0	0	0	1
SM	1	-	0	0.01	6	0	0	0.5	0	0	1
PU	1.9	-	0.86	1.8	1.2	0.94	0.62	0.86	0.4	1.1	1
SC	1.4	-	1.1	0.7	0.4	0.42	2	1.8	1	0.81	1
SU	0.55	-	3.82	5.05	0.01	0.1	0	0.8	0.2	0.05	1
CO	0.48	-	0.13	0.24	0.41	0.9	1.7	1.5	1.13	2.05	1

TO	0	-	0.5	0	1	0	1	5	0.5	0	1
GN	0.47	-	0.14	1.1	3	1.3	1.7	0.31	0.53	0.22	1
SE	0.39	-	0.49	0.29	0	1.27	2.45	1.07	0.69	2.06	1
SF	1.13	-	3.13	1.6	2.67	0.13	0.1	0.066	0.07	0.87	1
CA	0.65	-	0.03	0.14	4.2	2.2	0	0.14	0.11	0	1
CN	0	-	0	0	0	0	0	10	0	0	1
FR	1.1	-	0.1	0.34	0.62	2.1	0.45	3.2	0.9	0.34	1
VE	5.8	-	0.9	1.7	0.66	0.41	0.84	0.41	0.65	0.77	1
FO	2.2	-	3.4	0.1	0.3	0.2	0.05	4.8	0.04	0.02	1

Source: Estimated

In table 3.25 all crop concentration indices estimated by jasbir singh concentration index in 2006-07. Paddy crop mainly concentrated in Nalgonda, Kariminagar and Nizamabad but concentrated indices less than two. In Ragareddy four crops are concentrated these are ragi, vegetables, Jowar and pulses and cotton in Adilabad and Karimnagar and Sugarcane in Medak and Nizamabad. Sunflower and bajra were concentrated in Nizamabad and Mahaboobnagar. Small millets, Groundnut and castor crops have occupied by Mahaboobnagar district. In Kammam district five top concentration index crops were spread these are coconut, tobacco, fodder, fruits and Spices & Condiments. Maize crop was spread in Karimnagar, Medak, Mahaboobnagar, Nizamabad and Warangal districts. Sesames occupied districts were Warangal, Nalgonda, and Kammam.

Table3.26 Crop concentration index in 2014-15

DISTRICT	Rangareddy	Hyderabad	Nizamabad	Medak	Mahaboobnagar	Nalgonda	Warangal	Khammam	Karimnagar	Adilabad	Telangana
PA	0.51	-	1.4	0.75	0.62	1.7	0.9	1.2	1.5	0.31	1
JO	2.1	-	0.73	1.5	1.7	0.2	0.3	0.1	0.12	2.2	1
BA	0.14	-	6.4	0.24	0.76	0.05	0.05	0	1	1.3	1
MA	1.5	-	0.99	1.8	1.4	0.04	1.4	0.56	1.2	0.3	1
RA	5.6		0	0	3.6	0	0	0	0	0	1
SM	0	-	0	0	0.33	0	0	0	0	0	1
PU	2.2	-	0.66	1.3	1.7	0.5	0.74	0.48	0.33	1.3	1
SC	0.8	-	1.3	0.43	0.45	0.27	2.4	2.6	0.91	0.74	1
SU	0.6	-	1.9	5.1	0.3	0.2	0	1.6	0.3	0	1
CO	0.8	-	0.1	0.77	0.9	1.3	1.2	1.1	0.99	1.6	1
TO	0	-	1.9	0	2.2	0.1	0.64	4.5	0	0	1
GN	0.8	-	0.1	0.05	3.4	0.7	1.3	0.33	0.34	0.06	1
SE	0.2	-	2.6	0.24	0.24	0.18	1.1	0.56	2.3	1.8	1

SF	0.3	-	4.3	3.7	0.86	0.3	0.01	0.06	0.3	0.3	1
CA	0.32	-	0	0.2	5.2	0.07	0.06	0	0.01	0.02	1
CN	0	-	0	0	0	0	0	10	0	0	1
FR	1.2	-	0.13	0.63	0.73	1.7	0.87	2.5	1	0.37	1
VE	5.2	-	0.84	2	1.1	0.33	0.54	0.35	0.53	0.74	1
FO	2.6	-	9.1	0.02	0.21	0.27	0.04	0.19	0	0.08	1

Sources: Estimated

In 2014-15 concentration indices of crops change in districts compared to 2006-07. Paddy mainly occupied districts were Nalgonda, Karimnagar, and Nizamabad but in Nalgonda district top crop concentration index increased. In Rangareddy top crop concentration indices continue are ragi, vegetables, pluses but Jower top crop concentration index replaced by Adilabad district. Maize crop occupied districts are Medak, RangaReddy, Mahaboobnagar, Warangal and Karimnagar these districts maize crop concentration indices are above one and less than two. Sunflower concentration districts are Nizamabad and Medak and indices are more than three in both districts. Bajra spread districts were Nizamabad, Adilabad, and karimnagar but Nizamabad continue to top index and index increased above six. Sugarcane continued top indiex in Medak district index above 5 and sugarcane occupied district is Nizamabad index near to two. Fodder crop concentrated in Nizamabad district index is above nine before Kammam top district. Cotton evenly spread all districts except Nizamabad above one index districts are Adilabad, Nalgonda, and Adilabad continue top index but decline to less than two. Castor, groundnut, small millets continue to concentrated in Mahaboob nagar district but small millets disappear in all districts expect in Mahaboobnagar district. Coconut, tobacco, spice and condiments and fruits spread in Kammam district and top concentration index crops. Sesames occupied districts are Nizamabad, Karimnagar and Adilabad.

Main important points of the above estimates are that by 1973-74, Jowar is the dominant food crop. Paddy was cultivated slightly in Nizamaband, Jowar in Khammam, Mahbubnagar and Hyderabad. Cotton is concentrated in Adilabad, fruits were in Hyderabad. This is was the period where irrigation was sparsely spread. By 1996-97, the bore wells have arrived; paddy cultivation began expanding and concentrating in Nalgonda, Nizamabad, Karimnagar and Warangal. Sugarcane is in Medak. But Jowar is to still to be found in Rangareddy, Medak,

Warangal and Khammam. Mirchi is in Khammam. Cotton has in dry belts of Adilabad, Warangal, Khammam. Groundnut concentrates in Mahabubnagar. By 2006-07, paddy concentration grips Nalgonda, Karimnagar and Nizamabad. By 2006-07, paddy began increasing in Nalgonda, Karimnagar, and Nizamabad. Cotton continues to concentrate in Adilabad, Warangal, and Khammam. Turmeric concentrates in Nizamabad and Karimnagar. By 2014-15, crop concentration ratios have not changed much. We still find that paddy in the three districts of Nizamabad, Karimnagar, and Nalgonda. Sugarcane has in Medak. Cotton has in Warangal, Khammam and Adilabad. Spices have in Khammam and Nizamabad.

3.9 Crop Diversification Index

Diversification of crop defined different crops produce in same lands depending on situation of the economy, demand, seasonal fluctuations. Index of diversification of crop estimated using Gibbs Martin index.

Gibbs Martin index = $DI = 1 - \frac{\sum z^2}{(\sum z)^2}$ z = percentage of crop in total sown area. DI = diversification of index.

Directly proportional to index value more is the index value means more diversification, less index value less diversification. Index value maximum one. Estimated index value shown below Table 3.27, Table 3.28, Table 3.29, Table 3.30 respectively 1973-74, 1996-97, 2006-7, 2014-15.

Table 3.27 Crop diversification index in 1973-74

District	Rangareddy	Hyderabad	Nizamabad	Medak	Mahabubnagar	Nalgonda	Warangal	Khammam	Karim Nagar	Adilabad	Telangana
PA	-	10.7	32.1	17.3	10.4	28.8	22	19.3	26	9.9	19.2
JO	-	38	20.4	38.6	39.4	21.8	30.5	43.3	21.4	36.5	32.2
BA	-	3	-	1.1	5.9	15.5	3.5	1.7	-	-	4.4
MA	-	2	15	9	0	0.1	8	2	14.2	4	5
RA	-	2.2	0.7	1.8	3.1	-	-	-	-	-	0.9
SM	-	4.2	0.6	2.3	8.1	0.7	0.2	0.4	0	0.1	2.2
PU	-	13	12.7	13.7	9.3	7.2	19.1	17.1	18.8	18.2	13.7
SC	-	3	3	4	1	0.5	3.1	3	3	2.2	2.1

SU	-	0.2	7.4	2.4	0	0	0	0	0.1	0.1	0.1
CO	-	-	0.7	-	1.1	-	0.2	-	0.1	14.6	2
TO	-	-	0.1	0.3	0.7	0.4	0.54	2.3	1	-	0.6
GN	-	1.7	3.7	0.9	9.6	5.9	8	6.3	6.2	2.8	5.6
SE	-	1.3	2.2	1.2	0.3	0.3	1.9	2.2	5.7	7.8	2.3
SF	-	0.1	0	0.1	0.1	0	0	0	0	0	0
CA	-	9	0.3	1.9	9.2	17.8	2.8	0.1	3.2	1	6.2
CN	-	0	0	0	0	0	0	0	0	0	0
FR	-	0.3	0.2	0.2	0.1	0.1	0.2	1.2	0.2	0	0.2
VE	-	2.2	0.3	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.3
FO	-	1	0.2	0.2	0.1	0.1	0	0.5	0	0.5	0.2
SSQX		1863.5	191676	2095.5	2036	1949	1940	2607	1780	2065	1727
SQSX		8445.6	9920.	9082.0	9721.	9860.	10028.2	9900.5	10000	9564.4	9447
DI		0.78	0.80	0.76	0.790	0.80	0.81	0.73*	0.82	0.78	0.81

Sources: Estimated

Crop diversification index in 1973-74 estimated from Telangana state districts by Gibbs martin index. Since Telangana state diversification index has a (.82) high value. That means Telangana state crops are highly diversified. Karimnagar (.82), Nizamabad district (0.80), Warangal (0.81), Nalgonda (0.80) have high crop diversification indices. These districts are highly crop diversified. Mahaboobnagar (0.79), Adilbad (0.78), Hyderabad (0.78), Medak (0.76) have been medium crop diversified indices these districts are medium crop diversification. Khammam district (0.73) has low crop diversification because low diversification index.

Table 3.28 Crop diversification index in 1996-97

District	Rangareddy	Hyderabad	Nizama bad	Medak	Mahaboobnagar	Nalgonda	Warangal	Khammam	Karim Nagar	Adilabad	Telangana
PA	15	-	41	22	15	42	31.5	36	41.2	11.1	28
JO	26	-	7	20	23.2	5.3	3.5	5.2	1	29	13.3
BA	0.4	-	1.1	0.4	2	3.3	0	0.1	0.1	0	1
MA	2	-	14	12.2	1.5	0.2	6.3	3.5	17	5	6.2
RA	3	-	0	0.1	2.2	0	0	0	0	0	0.5
SM	0.4	-	0	0	1	0	0	0.1	0	0	0.1
PU	20	-	6.8	21	10	13.2	10.4	17	10.1	15	13.4
SC	2.3	-	3.5	3.4	2	1	8	5	4	2	3
SU	0.2	-	9	8	0	0.1	0	1	1	0.1	2
CO	8.2	-	6	4	8.2	7	19.1	14.1	12	27	12.9
TO	0	-	0.1	0	1	0	0.2	2.1	0.4	0	0.4
GN	3	-	4	2	19	9	12.3	3.4	7.3	1	8
SE	1	-	0.4	1	0.2	1	4	1	1	4.4	1

SF	1	-	3	2	2	1	2	1	1.5	2	2
CA	8	-	0.1	0.4	10.3	14	1	0	0.1	0.5	5
CN	0	-	0	0	0	0	0	0.2	0	0	0
FR	2.1	-	0.4	1	1	1	1	8.4	2	1	2
VE	5	-	0.1	1.4	1	0.3	0.3	0.3	1	0.5	1
FO	1	-	0	0	0	0	0	1	0	0.2	0.2
SSQ X	1492.3	-	2128.0 5	1577.6 9	1420.7	2307.36	1754.5 8	1938.78	2312.17	1973.1 2	1458.7 6
SQS X	9721.96	-	9312.2 5	9781.2 1	9920.16	9682.56	9920.1 6	9880.36	9940.09	9761.4 4	10000
DI	0.85	-	0.77	0.84	0.86	0.76	0.82	0.80	0.77	0.80	0.85

Source: Estimated

In 1996-97 crop diversification index also shows reasonably wide crop diversification with highly crop diversification index (0.85). Great crop diversification index districts have been Mahaboobnagar (0.86), Rangareddy (0.85), Medak (0.84), Warangal (0.82), Khammam (0.80), Adilabad (0.80). Nizamabad (0.77), Karimnagar (0.77), Nalgonda (0.76) districts are middle crop diversification. Mahaboobnagar district has highest crop diversification. Sometimes high diversification also means that there is no extensive cultivation of crop.

Table 3.29 Crop diversification index in 2006-07

DISTRICT	Rangareddy	Hyderabad	Nizama bad	Medak	Mahaboobnagar	Nalgonda	Warangal	Khammam	Karim Nagar	Adilabad	Telangana
PA	13.6	-	40.7	19.2	14.1	47.8	34.3	35.8	47.6	12.5	30.1
JO	15.7	-	2.8	9.2	10.5	2.3	1.2	0.9	0.1	13.1	5.7
BA	0.2	-	1.9	0.1	0.8	0.6	0	0	0	0.2	0.4
MA	10.14	-	14.4	19.6	17.2	0.5	12.4	5.5	20	4.2	12
RA	0.7	-	0	0	0.5	0	0	0	0	0	0.1
SM	0.01	-	0	0.0001	0.06	0	0	0.005	0	0	0.01
PU	26	-	11.9	25.2	16	13	8.6	11.9	5.2	15.8	13.9
SC	4.4	-	3.4	2.1	1.1	1.3	6.1	5.7	3.2	2.5	3.1
SU	1.2	-	8.4	11.1	0.03	0.2	0	1.7	0.4	0.1	2.2

CO	7.1	-	1.9	3.6	6	13.5	25.2	22.1	16.7	30.3	14.8
TO	0	-	0.1	0	0.2	0	0.2	1	0.1	0	0.2
GN	1.7	-	0.5	0.4	10.7	4.6	6.1	1.1	1.9	0.8	3.6
SE	0.4	-	0.5	0.3	0	1.3	2.5	1.1	0.7	2.1	1.02
SF	0.2	-	4.7	2.4	4	0.2	0.15	0.1	0.11	1.3	1.5
CA	2.4	-	0.1	0.5	15.6	7.8	0	0.5	0.4	0	3.7
CN	0	-	0	0	0	0	0	0.2	0	0	0.02
FR	3.2	-	0.3	1	1.8	6.2	1.3	9.2	2.6	1	2.9
VE	9	-	1.4	2.7	1.03	0.63	1.3	0.63	1	1.2	1.55
FO	1.11	-	1.7	0.04	0.125	0.08	0.023	2.4	0.02	0.01	0.5
SSQ X	1383.3 32	-	2130. 19	1627.6 22	1277.2 11	2766.2 93	2124.8 03	2072.6 17	2994.1 43	1528.7 1	1550.4 13
SQS X	9420.6 44	-	8968. 09	9494.5 73	9949.0 65	10002	9874.9 93	9967.0 27	10006	7243.7 12	9467.2 9
DI	0.85	-	0.76	0.83	0.87	0.72	0.78	0.79	0.70	0.79	0.84

Source: Estimated

The crop diversification by 2006-07 marginally declined to (0.84). Mahaboobnagar (0.87), Rangareddy (0.85), Medak (0.83) districts have been giant crop transformation. Mid-crop change indices districts have Khammam (0.79), Adilabad (0.79), Warangal (0.78), and Nizamabad (0.76). Low change crop indices districts Nalgonda (0.72) Karimnagar (0.70) have low crop diversification.

Table 3.30 Crop diversification index in 2014-15

DISTRICT	RANGAREDDY	HYDERABAD	NIZAMABAD	MEDAK	MAHABOONAGAR	NALGONDA	WANRANGAL	KHAMMAM	KARIMNAGAR	ADILABAD	TELANGANA
PA	13.66	0	37.64	20.07	16.43	44.3	23.83	32.18	39.8	8.33	26.63
JO	3.15	0	1.75	2.18	2.53	0.26	0.42	0.12	0.18	3.35	1.49
BA	0.03	0	1.35	0.05	0.16	0.01	0.01	0	0.21	0.27	0.21
MA	18.88	0	12.82	23.09	18.66	0.52	18.02	7.24	15.45	3.89	13.01
RA	0.17	0	0	0	0.11	0	0	0	0	0	0.03
SM	0	0	0	0	0.01	0	0	0	0	0	0.03
PU	16.98	0	5.09	10.27	13.24	3.75	5.68	3.68	2.51	10.02	7.68
SC	1.9	0	3.1	1	1.05	0.62	5.5	5.9	2.11	1.7	2.31
SU	0.8	0	2.6	7.2	0.4	0.3	0.0002	2.3	0.4	0.0007	1.4

CO	24.86	0	3.51	24.19	27.36	42.17	38.26	34.76	30.67	50.65	31.35
TO	0	0	0.21	0	0.24	0.01	0.07	0.5	0	0	0.11
GN	2.42	0	0.2	0.15	9.96	1.97	3.83	0.96	1	0.16	2.91
SE	0.09	0	1.15	0.11	0.11	0.08	0.48	0.25	1.04	0.8	0.45
SF	0.1	0	1.52	1.31	0.3	0.01	0.003	0.02	0.1	0.1	0.35
CA	0.3	0	0	0.18	4.9	0.07	0.06	0	0.01	0.02	0.95
CN	0	0	0	0	0	0	0	0.1	0	0	0.01
FR	3.6	0	0.4	1.9	2.2	5.1	2.6	7.4	3	1.1	3
VE	9.8	0	1.6	3.8	2.14	0.62	1.03	0.66	1	1.4	1.9
FO	1.33	0	4.71	0.01	0.11	0.14	0.02	0.1	0	0.04	0.52
SSQ X	1580.3	0	1669.2 26	1704.0 1	1682.5 12	3785.9 8	2441.8 35	2406.3 35	2786.4 72	2768.37 7	1952.3 72
SQS X	9617.7	0	6029.5	9122.1	9982.0	9986.0	9962.6	9248.6	9502.	6696.2	8900.0
DI	0.84	#DIV/ 0!	0.72	0.81	0.83	0.62	0.75	0.74	0.71	0.59*	0.78

Sources: Estimated

Crop diversification index has sharply declined to (0.78) by 2014-15. Great crop diversification districts have been Rangareddy (0.84), Mahaboobnagar (0.83), and Medak (0.81). Only one district Warangal (0.75) is middle crop diversification index. Low crop diversification districts have been Khammam (0.74), Nizamabad (0.72), Karimnagar (0.71), Nalgonda (0.62), and Adilabad (0.59).

For crop diversification index in 1973-74, has a (.82) high value. That means Telangana state crops are highly diversified. Karimnagar (.82), Nizamabad district (0.80), Warangal (0.81), Nalgonda (0.80) have high crop diversification indices. These districts are highly crop diversified. Mahaboobnagar (0.79), Adilbad (0.78), Hyderabad (0.78), Medak (0.77) have been medium crop diversified indices these districts are medium crop diversification. Khammam district (0.74) has low crop diversification because low diversification index.

In 1996-97 crop diversification index slightly increased to (0.85). Great crop diversification index districts have been Mahaboobnagar (0.86), Rangareddy (0.85), Medak (0.84), Warangal (0.82), Khammam (0.80). Adilabad (0.80), Nizamabad (0.77), Karimnagar (0.77), Nalgonda (0.76) districts are middle crop diversification. Mahaboobnagar district has highest crop diversification. Sometimes high diversification also means that there is no extensive cultivation of crop.

The crop diversification by 2006-07 marginally declined to (0.84). Mahaboobnagar (0.87), Rangareddy (0.85), Medak (0.83) districts have been giant crop transformation. Mid-crop

change indices districts have Khammam (0.79), Adilabad (0.79), Warangal (0.78), and Nizamabad (0.76). Low change crop indices districts Nalgonda (0.72) Karimnagar (0.70) have low crop diversification.

Crop diversification index has sharply declined to 0.78 by 2014-15. Great crop diversification districts have been Rangareddy (0.84), Mahaboobnagar (0.83), and Medak (0.81). Only one district Warangal (0.75) is middle crop diversification index. Low crop diversification districts have been Khammam (0.74), Nizamabad (0.72), Karimnagar (0.70), Nalgonda (0.62), Adilabad (0.58).

To sum up, in Telangana, Rangareddy district has the highest crop diversification index at 0.82. This is more because Rangareddy has vegetable production as well as others, as being close to Hyderabad city. This is followed by Medak and Mahabubnagar, which have diversified portfolio of crops. Medak has sugarcane, maize, paddy, pulses, cotton and vegetables. Mahabubnagar is diversified into paddy, cotton, maize, groundnut, jowar, fruits and vegetables. Similarly, Nizamabad is diversified between paddy, maize, and pulses, besides turmeric. Adilabad has the lowest diversification at 0.58, where cotton is cultivated in 50 percent of the land, followed by Nalgonda (0.62), where the two crops namely cotton and paddy consumes 82 percent of the area. The three principal crops paddy, maize and cotton are distributed in such a way that paddy is concentrated in Nalgonda, Nizamabad, Karimnagar, Khammam. Cotton is concentrated in Mahabubnagar, Nalgonda, Warangal, Adilabad. Maize is concentrated in Medak, Nizamabad, Karimnagar, Mahabubnagar and Rangareddy. By 1973-74, paddy confined to Nalgonda, Nizamabad and thinly spread into other districts. But by 2014-15, paddy expanded massively in Karimnagar and Khammam, besides in the traditional districts. Further, cotton which was totally absent in 1973-74, appear as dominant crop by 2014-15. Many traditional crops such as jowar, bajra, sugar cane, oilseeds have declined relatively. On the whole, the saga of crop diversification is that it began increasing from 1973-74 from 0.81 to 0.85 in 1996-97 and declined to 0.83 in 2006-07 and sharply declined to 0.78 in 2014-15.

3.10 Conclusion:

The net sown area has marginally declined in growth rates, what has significantly increased is the area put to non-agricultural use. What a declined in forest area, cultivable waste. What is

interesting is that while other fallows declined, current fallows have declined significantly; this could be due to expansion of bore well irrigation.

The total cropped area has increased from 42.75 percent in 1980-81 to 47.43 percent of total land in 2014-15 [see table no 3.1]. Such 4.6 percent of land is perhaps a massive growth in area cultivated, thanks to irrigation facilities. The areas sown more than once have tripled over these years. But as said the other fallows and current fallows together constitute about 17 percent, which would throw tremendous instability in area cultivated and production. Such expansion of area also seemed to have come at some expense of common lands, often exists under the name of barren and uncultivable waste. And forest land also is gone by 2 percent. These are the lands that government allowed weaker sections to occupy and cultivate.

The three major sources of irrigation in the state are well, tank and canal irrigation in Telangana, an issue which remained at the heart of formation of the new state. Out of the total 43.7 lakh hectares of net sown area, the total irrigated area formed about 14.43 lakh hectares in 2014-15, which is about 33.02 percent. Out of this, a lion's share of 84 percent of irrigated area is irrigated through wells, while 9.61 percent is irrigated by canals and 4.47 percent is covered by the tanks. Overwhelming share of well irrigation, which is mostly by the bore wells, reflects the burden of private investment, compared to the declining public investment reflected by decreasing share of canal and tank irrigation.

Production of cotton has grown at a compound rate of growth of 13.5 during 1980-2015. Maize has growth at a rate of 5.59 percent and paddy at 2.83 percent during the same time. These are quite impressive on the face of it. Much of this growth has come during two periods, namely, 1980-95 and 2005-15. The decade of 1995-05 is somewhat lost decade, as for Telangana agriculture is concerned.

The cropping pattern at the aggregate in Telangana shows a drastic change in terms of crop combinations and cropping pattern over the last fifty years. In 1973-74, food grains which were sown in 77.9 percent area have declined to 49.16 percent in 2014-15. This is a positive development in one sense, because, despite the area reduced, the overall production of food grains massively increased. Jowar as the principle food crop is replaced with paddy. Paddy increased from 19 percent to 30 percent in the last 40 years. Pulses have declined in the recent period, otherwise was steady. Cotton has increased from 2 percent to 30 percent. Maize increased from 5 percent to 13 percent. All oil seeds have declined. All small millets

have declined. The three-crop dominance is perhaps not necessarily good for farming prospects.

The yield improvement is the second important source for production. In Telangana, the cotton crop has recorded an impressive growth rate of 5.61 percent during 1980-2015, followed by maize at 2.77 percent. Paddy has shown a modest growth of yield by 1.74 percent. Much of the yield improvements again have happened during 1980-95.

The compound rates of growth of area shows that cotton has increased at breath taking rates 7.44 during, while maize areas grew at a remarkable 3.03 percent and paddy at a modest rate of 1.07 percent during 1980-2015. All these are at the expense of declining area under food grains.

The crop combination of Telangana, which is a measure of a combination that takes majority of the area sown, estimated showed that its number began with four in 1973-74, increased to five in 1996-97, declined to four in 2006-07 and further to three in 2014-15. The progressive decline of diversity of crops towards the end is the issue to be discussed. Particularly when the state essentially growing three crop combination regions was suggests certain policy imperatives. This suggests that farmers have lost wider opportunity and therefore at the end of high risk in each crop.

As for crop concentration, the important trends are that by 1973-74, Jowar is the dominant food crop. Paddy was cultivated slightly in Nizamabad, Jowar in Khammam, Mahabubnagar and Hyderabad. Cotton is concentrated in Adilabad, fruits were in Hyderabad. This is was the period where irrigation was sparsely spread. By 1996-97, the bore wells have arrived; paddy cultivation began expanding and concentrating in Nalgonda, Nizamabad, Karimnagar and Warangal. Sugarcane is in Medak. But Jowar crop is still to be found in Rangareddy, Medak, Warangal and Khammam. Mirchi has in Khammam. Cotton has in dry belts of Adilabad, Warangal, and Khammam. Groundnut concentrates in Mahabubnagar. By 2006-07, paddy concentration grips Nalgonda, Karimnagar and Nizamabad. By 2006-07, paddy began increasing in Nalgodna, Karimangar, and Nizamabad. Cotton continues to concentrates in Adilabad, Warangal, and Khammam. Turmeric concentrates in Nizamabad and Karimnagar. By 2014-15, crop concentration ratios have not changed much. We still find that paddy in the

three districts of Nizamabad, Karimnagar, and Nalgonda. Sugarcane is in Medak. Cotton has in Warangal, Khammam and Adilabad. Spices were in Khammam and Nizamabad.

Coming to crop diversification, in Telangana, Rangareddy district has the highest crop diversification index at 0.82. This is more because Rangareddy has vegetable production as well as others, as being close to Hyderabad city. This is followed by Medak and Mahabubnagar, which have diversified portfolio of crops. Medak have sugarcane, maize, paddy, pulses, cotton and vegetables. Mahabubnagar is diversified into paddy, cotton, maize, groundnut, jowar, fruits and vegetables. Similarly, Nizamabad is diversified between paddy, maize, and pulses, besides turmeric. Adilabad has the lowest diversification at 0.59, where cotton is cultivated in 50 percent of the land, followed by Nalgonda (0.62), where the two crops namely cotton and paddy consumes 82 percent of the area. The three principal crops paddy, maize and cotton are distributed in such a way that paddy is concentrated in Nalgonda, Nizamabad, Karimnagar, and Khammam. Cotton is concentrated in Mahabubnagar, Nalgonda, Warangal, and Adilabad. Maize is concentrated in Medak, Nizamabad, Karimnagar, Mahabubnagar and Rangareddy. By 1973-74, paddy confined to Nalgonda, Nizamabad and thinly spread into other districts. But by 2014-15, paddy expanded massively in Karimnagar and Khammam, besides in the traditional districts. Further, cotton which was totally absent in 1973-74, appear as dominant crop by 2014-15. Many traditional crops such as jowar, bajra, sugar cane, oilseeds have declined relatively. On the whole, the saga of crop diversification is that it began increasing from 1973-74 from 0.81 to 0.85 in 1996-97 and declined to 0.84 in 2006-07 and sharply declined to 0.78 in 2014-15.

Chapter 4

Supply Response of Principal Crops in Telangana

4.1 Introduction

The Supply response studies study the factors that determine the acreage response and thus indirectly factors that influence the production. We have seen that there are three major crops that have emerged in Telangana in the past 30 years, as dominant crops that occupy more than 71percent of the acreage. It is important and customary to examine the factors that influence the three crops, namely paddy, cotton and maize. The rise in production is examined via acreage, because farmers cannot directly decide how much to produce, they can only decide how much acreage to allot a particular crop they are interested to grow. Then the soil conditions, inputs, weather conditions would determine the actual output. A commercial farmer is usually influenced by the price factor, if the production conditions are stable. Hence for crops like maize, cotton, turmeric, chilli, fruits and vegetables, the current year acreage is influenced by price in the lagged year. Then, of course, the supply side factors such as technology, manure, procurement support, support prices in the current year are the determining factors. The distinction between food and non-food crops is that market price is generally found to be the dominant factor in acreage response of non-food crops, where food crops are more influenced by rainfall, irrigation, fertilizer, etc. than the price, since price is a stable factor in food crops, owing to several institutional and policy matters. In this chapter, we would present the results of supply response estimation for the said three crops and an interpretation.

4.2.1 Nerlovian Supply Response Model

Nerlovian model explains when the previous year's relative price how it changes in the area through the area production function.

Farmers cultivate land on the basis of lagged prices of their product. They cropped potential level of land in the longer period and come to potential level of land step by step successive decision making over period. The potential level of current year acreage depends on previous prices.

This function is derived for the long period, using adoptive expectations model of partial adjustment. This partial adjustment is often called Nerlovian adjustment process. The change in the current year acreage is a function of change in acreage of the previous year. Notation ally,

$$X_t - X_{t-1} = \lambda(X_t^* - X_{t-1}) \quad 1$$

Here X_t = acreage of the crop in the present year.

X_{t-1} = crop acreage of previous year. λ = speed of adjustment, $0 < \lambda < 1$. X_t^* = potential level of crop acreage it is unknown.

$[X - X_{t-1}]$ = crop acreage potential difference.

The long-run linear supply response function will be specialized as follows.

Function of long period production as given under.

$$X_t^* = a_0 + a_1 P_{t-1} + e_t \quad 2$$

Here X_t^* = acreage of potential level. P_{t-1} = previous mean price of crop. e_t = error term.

For long period production function, statement 2 apply in statement 1 will get function of short period.

$$X_t - X_{t-1} = \lambda((a_0 + a_1 * P_{t-1} + e_t) - X_{t-1}) \quad 3$$

$$X_t = X_{t-1} + \lambda a_0 + \lambda a_1 * P_{t-1} + \lambda e_t - \lambda X_{t-1} \quad 4$$

$$X_t = a_0 + \lambda a_1 * P_{t-1} + (1 - \lambda) X_{t-1} + \lambda e_t \quad 5$$

Thus, the final form of the specification is:

$$X_t = a^* + a_1^* P_{t-1} + \lambda a_2^* X_{t-1} + \lambda e_t \quad 6$$

$$e^* = \lambda e_t, \quad a_0^* = \lambda a_0, \quad a_1^* = \lambda a_1, \quad a_2^* = 1 - \lambda, \quad \lambda = 1 - a_2^* \quad 7$$

a_1^* One unit change in lagged price how much units change in acreage.

i.e $\partial X_t / \partial P_{t-1} = a_1^*$.

Therefore, short period area elasticity with respect to previous price is

$$\begin{aligned}\frac{\partial X_t}{\partial P_{t-1}} * \frac{\overline{P_{t-1}}}{\overline{X_t}} &= \frac{\partial X_t}{\partial P_{t-1}} * \frac{\overline{P_{t-1}}}{\overline{X_t}} \\ &= a_1^* * \frac{\overline{P_{t-1}}}{\overline{X_t}}\end{aligned}\quad 8$$

$\overline{P_{t-1}}$ =mean of previous prices, $\overline{X_t}$ = mean of area of crop.

In short period cannot attain potential level of acreage because less time to attain potential period completely when prices changes. In short period elasticity its value higher than one compared to high elasticity and inelasticity when its value less than one and unitary area elasticity with respect to price when its value equal to one.

Potential level of acreage attained in the long period because higher time to change acreage when price change. Long period elasticity is short period elasticity divided by speed of adjustment.

$$[\lambda] = a_1^* * \frac{\lambda P_{t-1}}{X_t} = a_1^* * \frac{P_{t-1}}{X_t} * \frac{\lambda}{1}$$

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Adjustment of speed is normally shorter than one and so elasticity of long period became bigger than elasticity of short period. Increasing outcome prices changes on acreage crop changes indicating the elasticity of long period. The difference in area divided by potential difference in area called speed of adjustment (λ). Adjustment speed is one, when there is abrupt transformation during a year because area potential difference is equal to area real difference and real difference is shorter than potential difference when adjustment speed determent shorter than one. It is possible only when variables power is one in Nerlovian models.

4.2.2. The nerlovian log-linear supply response function

Log specification model previous year price coefficient directly give the elasticity of short period.

Nerlovian model of log regression:

$$\log X_t^* = a_0 + a_1 \log P_{t-1} + e \quad 10$$

For long period production elasticity potential level of area is unknown so need to calculate using process of partial adjustment.

$$[\log X_t - \log X_{t-1}] = \lambda [\log X_t^* - \log X_{t-1}] \quad 11$$

$$\log X_t = [\log X_t^* - \log X_{t-1}] + \log X_{t-1} \quad 12$$

For short period production regression statement 10 apply in statement 12.

$$\log X_t = \lambda (a_0 + a_1 \log P_{t-1} + e) - \log X_{t-1} + \log X_{t-1} \quad 13$$

$$\log X_t = \lambda a_0 + \lambda a_1 \log P_{t-1} + \lambda e - \log X_{t-1} + \log X_{t-1} \quad 14$$

$$= \lambda a_0 + \lambda a_1 \log P_{t-1} - \log X_{t-1} + \log X_{t-1} + \lambda e \quad 15$$

$$= \lambda a_0 + \lambda a_1 \log P_{t-1} + (1 - \lambda) \log X_{t-1} + \lambda e \quad 16$$

Here $a^* = \lambda a_0$, $a_1^* = \lambda a_1$, $a_2^* = 1 - \lambda$, $\lambda = 1 - a_2^*$, $e^* = \lambda e$

a_1^* = one percent change in previous year price how much percentage changes in crop acreage

$$a_1^* = \partial \log X_t / \partial \log P_{t-1} \quad 17$$

The long period elasticity is short period elasticity divided by speed of adjustment.

$$a_1^* / \lambda = \partial \log X_t / \partial \log P_{t-1} \quad 18$$

$$= a_1^* / \lambda .$$

Determinant of speed of adjustment is shorter than one normally so long period elasticity greater than short period elasticity.

4.3 Limited Supply Response Function

Here, by limited supply response function, we mean to take only two variables, namely, lagged price and lagged area, we regress it over the area of the crop in the current year. We estimate them for the three major crops, i.e. Cotton, paddy, and maize, in Telangana state for the period 1980-81 to 2014-15.

4.3.1 Paddy

Rice is the Telangana state people staple food and second rank crop since 2014-15. The regression estimates of supply response are given in table 4.1. Paddy area is regressed by lagged price and lagged area. Coefficients of lagged price and lagged area have expected positive sign and coefficient of lagged price significant at 5% level and lagged area coefficient is insignificant. Speed of adjustment is one minus coefficient of lagged rice area, it calculated that is 0.82. Short run elasticity of lagged rice price was coefficient of lagged price it was 0.14 this means one percent increases lagged price rice area rises 0.14% in short run. Desired area and actual area gap removed by 0.82% in each year. Long run elasticity defined short run elasticity divided by speed of adjustment. It is 0.17, this means one percent hike lagged price 0.17 percent developed rice area in present period changes in the prices over period time in the long run. Farmers adjusted desired area in long run than short run. Long run price elasticity (0.17) higher than short run elasticity (0.14). Paddy long run price elasticity very small compared to cotton. Between lagged price and lagged area correlation coefficient was 0.50 it was more than multiple regression determinant (R^2) (0.25) so it is multicollinearity problem because lagged area insignificant. Multiple regression coefficient (R^2) is 0.25 this means 25% explained both independent variables remaining 75% explained residual term. Durbin –Watson statistic was 1.98 near to two. There is no autocorrelation problem.

Table 4.1: Paddy Area Regression estimates

Ind Variables	Coefficient	Std. Error	t-Statistic	Prob.
Constant	10.61	2.33	4.54	0.0001

Ln Price _{t-1}	0.14	0.066777	2.10	0.0434
Ln Area _{t-1}	0.18	0.178889	1.03	0.3112
R-squared	0.25	Mean dependent var		14.05
Adjusted R-squared	0.199590	S.D. dependent var		0.22

Note: Speed of adjustment $\lambda = 0.82$, (1-0.18)
Long run elasticity $a_1 = 0.17$, (0.14/0.82),
Short run elasticity $a_1^* = 0.14$, $a_2^* = 0.18$

4.3.2 Cotton

Cotton is the first rank crop in 2014-15 in Telangana state. The supply response function for the cotton area is estimated using Nerlovian's model. In the estimation process, the cotton area is dependent variable and independent variables are lagged prices and logged area. Cotton area response is estimated by using natural log-linear regression and it is because coefficients give elasticities. By this method, cotton area speed of adjustment, short-run and long-run elasticity's has been calculated. The estimates are given in the following table No.4.2.

Table No.4.2

Variable	Coefficient	Std. Error	t-Statistic	Probability.
Constant	2.04	0.61	3.34	0.002
Log Price _{t-1}	0.45	0.12	3.66	0.0009
Log Area _{t-1}	0.60	0.11	5.53	0.0000
Sample	34			
R-squared	0.97	Durbin-Watson stat		1.84
Adjusted R-squared	0.968			

Source: estimated

Speed of adjustment (λ) = 0.40, (1-0.60); Long-run elasticity (a_1) = 1.12, (0.45/.40)

Short-run lagged price elasticity (a_1^*) = 0.45; Lagged area elasticity (a_2^*) = 0.60

table 4.3: Correlation Matrix for Cotton area.

Lncoach	Ln area	Ln area_1h	Ln price_1q
Ln area	1.00		
Ln area_1h	0.98	1.00	
Ln price_1q	0.97	0.96	1.00

Source: estimated.

In **Table 4.2**, the analysis shows that all coefficients are significant at 1% and have an expected positive sign. The cotton area short-run elasticity of lagged price is 0.45. This means that by one percent increase in lagged price, cotton area improves by 0.45% in the short-run. Cotton area elasticity by lagged area is 0.6, meaning that one percent development

in the lagged area enhances cotton area by 0.6% in the short-run. Speed of adjustment for cotton area is 0.40. This explains that the gap between potential change and actual change removes by 0.40% in every year. The long-run elasticity of cotton area by lagged price (1.124) is more significant than short-run elasticity (0.45). One percent positive change in lagged price will increase in the cotton area by 1.124% in the present year when cotton crop prices change over a specified period in the long-run. The correlation coefficient is between independent variables less than regression determinant (R^2), so there is no multicollinearity problem. Durbin-Watson statistics is 1.84 near to two; therefore, there is no autocorrelation. The coefficient of regression is 0.97 means lagged price and lagged area independent variables explained 97% and the remaining 3% explained by residual term.

4.3.3. Maize

In Telangana, maize was the third rank crop in 2014-15. Maize area has been used as a dependent variable whereas, lagged price and lagged area are explanatory variables in the Nerlovian model. All variables are in natural log. Using this model maize area elasticity with respect lagged price and lagged area are estimated. Speed of adjustment and long-run elasticity is calculated by using short-run elasticity. In maize area regression, all coefficients are significant and have an expected positive sign at 5% and 1%. Maize area short-run elasticity of lagged price was 0.11. This means due to 1 percent increase in lagged price, the maize area increases by 0.11% in the short run. Maize area elasticity with respect to the lagged area was 0.81, meaning that in short-run 1 percent rises in lagged maize area, maize area improved by 0.81 percent.

Long-run elasticity of maize area with respect lagged maize price is the short-run coefficient of lagged price divided by the speed of adjustment. It was 0.19; this means that gap between the desired area and the actual area eliminated by 0.19% each year. The long-run price elasticity was 0.57. Due to one percent change in logged price, the maize area increases by 0.57 percent in the current year when prices change over a period of time in the long run. Long run elasticity (0.57%) was greater than short-run elasticity (0.19%). The correlation coefficient between independent variables maize lagged price and lagged area is 0.84, which is less than the coefficient of multiple regression (0.93) suggest that there is no multicollinearity problem. No autocorrelation because of Durbin- Watson statistic (2.13) was near to two. Multiple regression coefficients (R^2) was 0.93, and this means that independent

lagged price and lagged area both presents 93% remaining and 7% explained error term respectively.

Table 4.4: Regression results for Maize area

Variable	Coefficient	Std. Error	t-Statistic	Probability.
C	1.86	0.95	1.95	0.06
LN Price _{(maize)t}	0.11	0.05	2.38	0.02
LN Area _{t-1}	0.80	0.09	8.88	0.00001
Sample	34		Durbin-Watson stat	2.127910
R-squared	0.93			
Adjusted R-squared	0.92			

speed of adjustment $\lambda = 0.19$, $(1-0.80)$

Long run elasticity $a_1=0.57$ $(0.11/0.19)$

short run elasticity $a_1^* = 0.11$, $a_2^* = 0.81$

Table 4.5: Correlation Matrix for Maze area.

Ln Area	Ln Area	Lagged Price	Ln Lagged Area
Ln Area	1.00		
Ln Price _{t-t}	0.86	1.00	
LnLagged Area	0.96	0.84	1.00

4.4 Extended Area Supply Response Function

Here we present the estimates of an extended supply response function. The extended supply response function is an alternative model, in which we will add some additional institutional variables like irrigation, rainfall, fertilizer, beside the standard variables like price and lagged area. These can improve the explanatory power of the estimations. The results are provided in table no.4.6.

Table 4.6: Acreage response of various Products

Independent Variable	coefficient	t- value	R square
Maize Area			
Constant	5.23	4.15*	0.97
Lagged area	0.42	4.82*	

Irrigated area	0.53	5.77*	
Lagged price	0.23	2.25**	
Cotton area			
Constant			0.98
Lagged price	0.41*	7.25	
Yield	0.11**	2.42	
Well irrigated area	0.70*	28.47	
Paddy area			
Constant	2.52***	1.78	0.84
Lagged price	0.11	1.25***	
Fertilizer	0.40*	7.28	
Rainfall	0.72*	9.17	
Lagged area	0.335*	3.78	

*1% significant, ** 5% significant, ***10% significant

4.4.1 Interpretation:

The maize area estimation overall result found to be meaningful. Lagged area, irrigated area, lagged price variables are positive sign and well irrigated area is negative. All coefficients are significant at 1% level except lagged price significant at 5% level. The maize area elasticities of irrigated area, lagged area, well irrigated area, and lagged price are consequently 0.53, 0.42, -0.38, and 0.23. Maize irrigated area increases 1% maize area rises .53 percent. Maize area improved 0.42 percent when 1% increases in lagged area. 1percent increase in well irrigated area 0.38% decrease maize area. Maize area rises 0.23 percent if lagged price increase 1%. These estimated coefficients null hypotheses are rejected and alternative hypotheses are accepted.

Cotton area regression is explained by lagged price, yield and well irrigated area. All coefficients are positive sign. Lagged price and well irrigated area are significant at 1% level and yield is significant at 5% level. Cotton area elasticities are well irrigated area (0.70), Lagged price (0.41), and yield (0.11). One percent increases well irrigated area 0.70% improved the cotton area. Cotton area raises 0.41% when lagged price hike 1%. Yield increase 1 percent cotton area rise 0.23%. Coefficients of null hypotheses to be not accepted and alternative hypotheses are accepted.

Rice area regression area is influenced by fertilizer, rainfall, and lagged area. Surprisingly only rainfall variable found meaningful relation, while irrigation variable could not, which is the reason we included the rainfall. All coefficients are expected sign and positive. All coefficients are significant at 1% level. Rice area elasticities are rainfall (0.72), fertilizer (0.405), and lagged area (0.335). One percent increase in rainfall 0.72% rise in rice

area. Rice area is improved 0.405% by one percentage increase in fertilizers. Lagged area is increase 1% rice area increase 0.335 percentage. These coefficients of null hypotheses are rejected so alternate hypotheses are accepted.

4.5 Acreage Response Function specifications.

While traditional method of estimating rational behavior of farmers, whether they are responding rationally to price signals and other supply variables, there are scholars who tried to estimate production directly using Cobb Douglas Production function [Raj Krishna (1964), C.H.Hanumantha Rao (1968)].³ The specification normally used is:

This specification is tested for the three principal crops, namely maize, cotton and paddy for Telangana for the period 1970-71 to 2014-15. The estimated results are provided in table 4.7. The lags are selected appropriately and the relative prices are chosen within the three crops. Cotton and maize are substitute crops, while paddy does not have an easy substitute, being a wet crop. The results of area functions are in specifications, explained as followed.

Table 4.7: area function for various products using Acreage response

Maize				
LN area _{maize} = 5.23+0.42 LN Area _{t-1} + 0.53LN Irrigation + 0.23 LN Relative Price _{t-1} - 0.38 LN Well Irrigation				
(4.15)*	(4.82)*	(5.77)*	(2.25)**	(-3.72)*
R ² = 0.97				
Cotton				

³ Raj Krishna (1964), "Some production Functions for Punjab" Indian Journal of Agricultural Economics, Nos. 3 and 4. July –December, pp-87-97 86 . C.H.Hanumantha Rao (1968): "Production Function for Hyderabad Farms", A.M.Khusro ed: Readings Readings in Agricultural Development, Allied Publishers, Bombay pp-160-172.

LN area _{cotton} = 2.21+ 0.41 LN Area _{t-1} +0.11 LN Relative Price + 0.70LN Well Irrigation				
(2.6)	(7.25)*	(2.42)**	(28.4736)*	
R ² = 0.98				
Rice				
LN area _{paddy} = 2.52 + 0.4 LN Area _{t-1} + 0.72LN Rainfall + 0.335 LN Fertilizer + 0.04 Relative Price _{t-t}				
(1.78)***	(7.28)*	(9.17)*	(3.78)*	(1.02)
R ² = 0.84				

*1% significant, ** 5% significant, ***10% significant

4.5.2 Interpretation:

4.5.2.1 Maize:

The independent variables are lagged area, irrigated area, lagged price and well irrigated area, the coefficients are significant at 1% and 5% level. Maize lagged area coefficient is 0.42 and t-value (4.82) is more than 1% critical value that means one percent increase in lagged area raise 0.42% maize area. Irrigated area coefficient is 0.53 and t-value is 5.77 more than 1% critical value explains that 1% rise in irrigated area maize area move to 0.53 percent. Maize lagged price coefficient is 0.23 and t-value is 2.25 more than 5% critical value this interpret 1 percent increase lagged price shift to the maize area 0.23%. Well irrigated area coefficient is -0.38 and t-value is -3.72 more than 1% critical value this describe 1% increase well irrigated decrease 0.38 % maize area. Multiple regressions coefficient (square of R) is 0.97 explains independent variables 97% another three percent explains error term not included factors in the regression. Correlation coefficients between independent variables are less than multiple regression coefficient (R²) no multicollinearity. Durbin- Watson statistic is 2.13 near to the 2 there is no autocorrelation. Akaike information criterion, Schwarz criterion, Hannan-Quinn criterion values are very low compared to other regression models indicating this regression estimation is good.

4.5.2.2 Cotton

The independent variables are relative price, lagged area, and well irrigated area. These independent variables all are significant at 1% and 5% level. Lagged cotton price coefficient is 0.45 and t-value is 4.02 more than 1% critical value this interpret one percent increase

lagged price 0.45% rise cotton area. Cotton responds to price well. Well irrigated area coefficient is 0.72 and t-value is 5.17 more than 1% critical value means one percent increase in well irrigated area 0.72% increase in cotton area. This suggests that well irrigation prompted the faster growth of cotton area. R^2 coefficient of multiple regressions is 0.98. Correlation coefficients between independent variables are less than multiple regression coefficient (R^2) there is no multicollinearity. Durbin-Watson statistics is 2.2 close to 2; hence there is no auto correlation problem. Akaike information criterion, Schwarz criterion, Hannan-Quinn criterion values are very low compared to others regressions models so this regression good regression.

4.5.2.3 Rice

The independent variables are fertilizers, rainfall, lagged area and price. These coefficients are significant at 1% level. Fertilizer coefficient is 0.405 and t-value is 7.28 more than 1% critical value means 1% increase in fertilizer 0.405 percent increase in rice area. Rainfall coefficient is .72 and t-value is 9.17% more than 1% critical value interpret that one percent increase rainfall 0.72% rice area increases. Lagged area coefficient is 0.335 and t-value (3.78) is more than 1%critical value explains lagged rice area increase 1% rice area increase 0.335%. Price variable is not significant. This is typical of food crops in India. Coefficient of multiple regression R^2 is 0.84 means 84% explains independent variables in the regression remaining 16% explains random variable. Correlation coefficients of between independent variables are less than R^2 multiple regression coefficient so avoid the multicollinearity—Durbin-Watson statistics in 2.5 near to 2 less autocorrelation. Akaike information criterion, Schwarz criterion, Hannan-Quinn criterion values are low compared to other regression estimations this regression best regression.

4.8 Log linear multiple regressions for maize, cotton, and paddy.

Production	Constant	Acreage	Irrigated area	Yield
Maize	-6.91* (-790.2)	1.001* (-671.67)	0.0014 (-1.04)	1.0* (-1107.62)
Cotton	-5.11* (-73.52)	0.99* (-116.78)	0.013** (-2.61)	0.99* (-97.68)

Paddy	-6.91* (-1990.36)	0.999 (-2998.82)		1 -2584.668
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Note: t values are shown in brackets and R square for each dependent variable is 0.99.

*1% significant, ** 5% significant, ***10% significant

Table 4.9: Production function models for various products.

Maize				
LNMot= -6.92+1.001 LNMACH-0.00145 LNMAIH+1.0 LNMYPH				
t- value	(-790.28)*	(671.67)*	(-1.04)	(1107.62)*
R²	0.99			
Cotton				
LNCOOTB=-5.11+0.99 LNCOACH+0.013 LNCOAIH +0.99 LNCOLYPH +u				
t- value	(-73.52*)	(116.78*)	(2.61)**	(97.68*)
R²	0.99			
Rice				
LNROT=-6.905867+0.999 LNRACH+1.0LNRYPH				
t- value	(-1990.36*)	(2998.824*)	(2584.668*)	
R²	0.99			

Significance level: * 1percent, ** 5 Percent, *** 10 percent.

Note: LNMot= log maize production in tones, LNMACH = log maize area in hectares, LNMAIH = log maize irrigated area in hectares, LNMYPH = log maize yield in kgs and ln =natural logarithm

LNCOOTB= log cotton production in bales, LNCOACH= log cotton area in hectares, LNCOLYPH= log cotton yield in kgs, LNCOAIH= log cotton irrigated area in hectares.

LNROT= log rice production in tones, LNRACH= log rice area in hectares, LNRYPH=log rice yield in kgs,

Crop production is influenced by many factors like economic factors and non-economic factors like price, lagged price, relative price, irrigation, fertilizers, fixed capital, infrastructures, marketing, government intervention, government policy, yields, technology, area, lagged area, farm size, rainfall, crop type, soils, geographical area, weather, human resources, population size, caste, etc. In Telangana, three important crops are maize, cotton, rice. Maize and cotton are commercial crops, but rice is a food crop. Since 2014-15 these three crops are crops combination crops by DoI's method in Telangana state and Cotton is the first rank, Rice is second rank crop and Maize is the third rank crop. Even though Rice as a

second rank crop it is the main staple food crop for Telangana state people. The production function is the relation between output and input. Three crop production functions had an estimated log-linear regression method. These three crops production functions are

Maize production = f (maize area, maize irrigated area, maize yield)

Cotton production = f_1 (cotton area, cotton yield, cotton irrigated area)

Rice production = f_2 (rice area, rice yield)

Maize production mainly depends on the maize area, maize irrigated area, maize yield and cotton production influenced by three factors that are cotton area, cotton yield, cotton irrigated area. Rice production independent variables are rice area and rice yield. These three crops independent variables chosen method first we take interested independent variables in regression ($y=f(x_1, x_2, \dots, x_{10})$) then regress each individual independent variable with dependent variable ($y_1=f(x_1), y_2=f_2(x_2), \dots, y_{10}=f_{10}(x_{10})$). For example, $y_3=f_3(x_3)$ regression x_3 coefficient t-value is highest in all individual independent variables. Take x_3 independent variable in second step regress two independent variables regressions like ($y_a=f_a(x_3, x_1), y_b=f_b(x_3, x_2), y_c=f_c(x_3, x_4), \dots, y_i=f_i(x_3, x_{10})$) in second step we get x_2 coefficient t-value is highest in two variables regressions. In third step take x_3, x_2 variables regress three variables regressions like ($y_m=f_m(x_3, x_2, x_1), y_n=f_n(x_3, x_2, x_4), \dots, y_t=f_t(x_3, x_2, x_{10})$) take highest t-value coefficients of $x_1, x_4, x_5, x_6, x_7, x_8, x_9, x_{10}$. But we get x_7 coefficient t-value is highest we regress four independent variables regressions like done up to where coefficients of remaining x variables t-values higher than 5 percent level. For example, x_3, x_2, x_7 independent variables are highest t-value coefficients each step remaining coefficients of independent variables regressions t-values less than 5 percent level next step. We take x_3, x_2, x_7 independent variables we estimated regression.

We estimated three crops regression independent variables selected using above method. Maize production regression independent variables are maize area, maize irrigated area, and maize yield. These coefficients are 1% significant expect maize irrigated area. Maize irrigated area coefficient (-0.00145) is an insignificant t-value (-1.04) less than even 10 percent level critical value. Maize area coefficient is 1 (one) and t-value is 671.67 more than 1% critical value. This means one percent increase maize area, maize production increases 1.001 percent. Maize yield coefficient is 1 and t-value (1107.62) is very more than 1% critical value. This explains that one percent rise maize yield 1% increases maize output.

Maize irrigated area coefficient is insignificant negligible and negative. One percent increase maize irrigated area maize output decline 0.00145%. Maize multiple regression coefficient (R^2) is .99 this means 99 percent explains independent variables remaining 1% explains error term means not included factors in the regression. Adjusted R^2 approximately same as R^2 because independent variables are less only three in the maize regression. Between Independent variables correlation coefficients are less than multiple regression coefficient of determent so avoids the multicollinearity problem. Durbin-Watson statistic (1.713) is so near to the 2-autocorrelation problem very less. Akaike information criterion, Schwarz criterion, Hannan-Quinn criterion values are very low compared other model's regression models so this maize regression is very good model.

Cotton production response depended on variables cotton area, cotton yield, cotton irrigated area. These independent variables coefficient values are all significant at 1%, 5% levels. Cotton area coefficient is 0.99 and t-value (116.78) very more than 1% critical value so this explains that 1% increase cotton area .99 percent increase cotton production. Cotton yield coefficient is .99 and t-value (97.6) is more than 1% critical value this means 1percent increase in cotton yield .99% increase in cotton output. Cotton irrigated area coefficient is 0.013 and t-value is 2.61 more than 5% critical value this means 1% increase in cotton irrigated area 0.013 percent increase in cotton production. Cotton multiple regression coefficient squire R in 0.99 this means that independent variables explain 99% remaining 1% explains random variable. Correlation coefficients between independent variables are less than multiple regression coefficient so no multicollinearity problem. '2.5' is Durbin- Watson statistics near to 2 much less autocorrelation. Akaike information criterion, Schwarz criterion, Hannan-Quinn criterion values are very low compared other regression models so this best regression model.

Rice production dependent variable influenced by independent variables is rice area and rice yield. Rice area and rice yield coefficients are significant at 1 % level. Rice area coefficient is 0.999 and t-value is 2998.824 very more than 1% critical value means one percent increase in rice area 0.999 percent increase in rice production. Coefficient of rice yield is 1 and t-value (2584.668) is very more than 1percent critical value explains 1% rice yield rise 1percent increase rice output. Coefficient of determent(R^2) is 0.99 this means 99% explains independent variables in regression remaining 1% explains error term that means not included variables in the regression. Between independent variables correlation coefficients is less than the coefficient of determent of multiple regression there is no multicollinearity.

Durbin–Watson statistics (2.01) is approximately equal to 2 so there is no autocorrelation. Akaike information criterion, Schwarz criterion, Hannan-Quinn criterion values are very low compared to other regression models so this regression model very good.

4.6 conclusions

In this chapter we have provided three types of estimates to understand the relation between production and its determinants namely market price, expectations, irrigation, rainfall and fertilizers. We have estimated three types of specifications, all fashioned in Nerlovian methodology. The three specifications are a limited and simple area response function, an extended area response and a production function. The first two are based on the idea that farmer decides the area under a crop and the last one as farmer able to exercise production decision directly. The idea is to check whether farmers are rational responding to supply and market signals.

The results of the three models are more or less consistent. The cotton and maize are responsive to price and well irrigation, while paddy is responsive to rainfall and fertilizer. Cotton is most responsive to price and well irrigation. Maize is relatively less responsive to price. Paddy is responsive to price in a limited specification, while not significant in the extended specification and the production function. This validates our hypotheses that food crops are responsive to institutional variables while non-food crops responsive to price variable. However, irrigation in some forms whether surface or underground is important. And the technology variable, namely fertilizer is important for a crop like paddy.

Chapter 5

Supply and Demand Situation for Paddy in Telangana

We have seen that until 1980 in Telangana about 19 percent of net sown area under paddy. It is from 1980s, the area under paddy began increasing. There are reasons for this shift. There a cultural value to eat rice compared to coarse grains, historically, including Telangana. But the irrigation placed a hard constraint. We all know that the open wells began to dry up in 1970s, when diesel engines were used to pump water from open wells, from the overexploitation. Then came the open bore wells, which made farmers to do as deep as 150 ft through these. But this required rural electrification to be completed. It is by 1984, the rural electrification is completed in the united Andhra Pradesh. The open bore wells began proliferating and the area under rice began increasing almost to 55 percent, most of the jowar and bajra area is lost to paddy. On demand side, state began procuring rice from millers to meet the revamped public distribution system along with the new subsidized rice scheme introduced by the then Chief Minister N. T Rama Rao. 3 kilos per head rice was given at Rs.2 per kilo to every poor household. There is an oversubscription to the below poverty line ration cards, almost 90 percent of rural households claimed the BPL status, thus state had to meet a much larger demand under the scheme than the Central Government was prepared to supply from the central pool. The state government began procuring rice from its own budget. Interestingly, several new market yards in Telangana were formed and official procurement by Food Corporation of India and A. P. Civil Supplies Corporation began procuring paddy from farmers and rice from millers [Radhakrishna (1987), Ramana Murthy et al (2012)]. The minimum support price created a stable market for paddy for farmers and there is an increasing preference to paddy cultivation among farmers, because of stable returns. This prompted a greater demand to increase irrigation in Telangana from farmer groups and political parties to balance the returns between canals and bore well irrigation areas. During 1987-97, there is an increase in canal irrigation as well. But it is the submersible pumps sets that have arrived in 1994 that have created a new wage in the expansion of paddy cultivation under bore wells. Of course, this also influenced cotton and maize cultivation. Thus, lot of rabi production, which is based on bore well irrigation increased.

Having seen an impressive growth paddy production in Telangana, particularly in the last two decades, it's a legitimate question how to appraise its necessity of the level of production and its growth now. The question is whether Telangana is rice surplus state or deficit state, which is important for market prospects to the farmers. An elementary comparison is always with demand for rice in the paddy for its simple implication. This chapter presents an estimation of consumption demand for rice, using per capita consumption figure for rice from NSS data⁴ and blowing it for the population. This exercise produces some very interesting results. The production of rice in Telangana has been below its consumption during 1991-2004. From 2005-06, rice production distinctly and almost consistently surpasses the consumption levels of the region, except for exceptionally bad year of 2009-10 [see fig 3]. From 2010-11 onwards, it is way above the consumption. This means Telangana has emerged as rice surplus state and less dependence from the central pool. This also means, the market prices may tend to fall unless active procurement is undertaken by the state agencies. Therefore, it is not wise to promote paddy production in the state, which would only create problem of prices in the future.

5.1 Rise of paddy Production in Telangana

We have seen earlier that paddy became a dominant food crop during 1980-91. This trend kept increasing till 2000. The absolute production increased from 19.3 lakh tones to 65.81 lakh tons in 2013. However, Telangana's per capita rice consumption declined as everywhere. Telangana rice per capita consumption in the year has been calculated by Telangana's total consumption in that year divided by Telangana total population in that year.

⁴The per capita consumption figure estimated for united Andhra Pradesh were used to estimate the same for Telangana, as no separate figures for the latter are not available. The time series data on consumption was generated using the data from the various NSS rounds since 1993-94. Some interpolations were done for certain years using the income elasticities of consumption. Monthly Per Capita Consumer Expenditure and Average Monthly Rice Consumption are taken from various rounds of NSSO. Expenditure (as a proxy for income) elasticity of consumption, between every quinquennial round, is calculated as the ratio of the percentage change in quantity of rice demand to the percentage change in total monthly per capita expenditure. The monthly per capita rice consumption is applied to population to obtain total demand for rice. The demand projection for the rice is obtained through: $D_t = [D_0(1 + ye)^t] \times 12 \times N_t$, where, D_t is demand of rice in year t , D_0 is per capita demand of the commodities in the base year; y is growth in monthly per capita expenditure; e is the expenditure elasticity of demand for rice, N_t is the projected population in year t . The population is taken from Census of India,

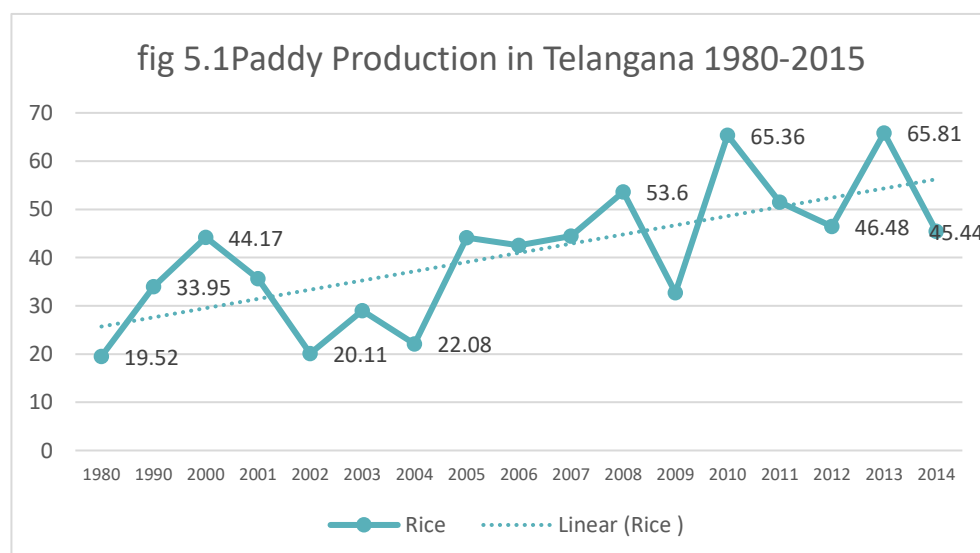
The estimations had following steps. First, expenditure elasticity is estimated (considering average expenditure elasticity). Second, considering two scenarios assuming the MPCE growth rates to be 9 per cent, the per capita rice demand was arrived at (i.e. growth of projected MPCE multiplied by expenditure elasticity) by applying the growth of rice.

We can see in the table, that the per capita rice consumption has declined by 10 kg from 1993 (134.23kg) to 2014 (124.41).

Table 5.1: Telangana food grains surplus or deficit:

Sl. No.	Year	AP _p	AP _{fc}	AP _{fc} /AP _p	TS _p	TS _{fc}	TS _{fp}	TS _{fp} -TS _{fc}
1	1993	69.28	9.30	134.23	274.71	3.69	3.99	0.30
2	1994	70.23	9.05	128.86	279.48	3.60	4.16	0.56
3	1995	71.19	9.61	134.98	284.33	3.84	3.98	0.14
4	1996	72.17	9.73	134.82	289.26	3.90	5.31	1.41
5	1997	73.16	9.86	134.77	294.28	3.97	3.53	-0.44
6	1998	74.16	9.69	130.66	299.39	3.91	6.09	2.18
7	1999	75.18	10.10	134.35	304.58	4.09	5.25	1.16
8	2000	76.21	9.52	124.92	309.87	3.87	6.46	2.59
9	2001	77.01	9.71	126.09	313.67	3.96	5.53	1.58
10	2002	77.81	9.85	126.58	317.52	4.02	3.95	-0.07
11	2003	78.63	9.98	126.92	321.41	4.08	5.80	1.72
12	2004	79.45	10.09	126.99	325.35	4.13	4.17	0.04
13	2005	80.29	10.27	127.92	329.34	4.21	7.53	3.32
14	2006	81.13	10.22	125.98	333.38	4.20	6.52	2.32
15	2007	81.98	10.38	126.62	337.47	4.27	8.13	3.86
16	2008	82.84	10.57	127.60	341.61	4.36	8.25	3.89
17	2009	83.70	10.67	127.47	345.80	4.41	5.19	0.78
18	2010	84.58	10.71	126.63	350.04	4.43	9.26	4.83
19	2011	85.47	10.71	125.31	354.33	4.44	7.50	3.06
20	2012	86.36	10.79	124.94	358.68	4.48	8.24	3.76
21	2013	87.27	10.88	124.68	363.08	4.53	10.69	6.16
22	2014	88.18	10.97	124.40	367.53	4.57	7.22	2.65

Note: AP_p = Population for Andhra Pradesh, AP_{fc} = food Grain Consumption for Andhra Pradesh, PC_{fc} = AP_{fc}/AP_p = Per Capita food grain Consumption, TS_p = Population for Telangana, TS_{fc} = food grain Consumption in Telangana = PC_{fc} / TS_p, TS_{fp} = food grain Production in Telangana.



This is because, according to Engel Curve hypothesis, when people income increases, food grains expenditure decline. Telangana's total consumption in year estimated Telangana per capita consumption in a year multiplied by Telangana total population in that year it was. 3.69 million tons in 1993 to 4.57 million tons in 2014. It increased due to population increased. Production of rice in Telangana increased 2.39 million tons to 4.54 million tons from 1993 to 2014. Rice deficit state was from 1993 to 2004 except 1998 and 2000 years, and rice surplus state was from 2005 to 2014 except 2009 and 2014 years.

The per capita consumption figure estimated for united Andhra Pradesh were used to estimate the same for Telangana, as no separate figures for the latter are not available. The time series data on consumption was generated using the data from the various NSS rounds since 1993-94. Some interpolations were done for certain years using the income elasticities of consumption. Monthly Per Capita Consumer Expenditure and Average Monthly Rice Consumption are taken from various rounds of NSSO. Expenditure (as a proxy for income) elasticity of consumption, between every quinquennial round, is calculated as the ratio of the percentage change in quantity of rice demand to the percentage change in total monthly per capita expenditure. The monthly per capita rice consumption is applied to population to obtain total demand for rice. The demand projection for the rice is obtained through: $D_t = [D_0(1 + ye)^t] \times 12 \times N_t$, where, D_t is demand of rice in year t , D_0 is per capita demand of the commodities in the base year; y is growth in monthly per capita expenditure; e is the expenditure elasticity of demand for rice, N_t is the projected population in year t . The population is taken from Census of India,

The estimations had following steps. First, expenditure elasticity is estimated (considering average expenditure elasticity). Second, considering two scenarios assuming the MPCE growth rates to be 9 per cent, the per capita rice demand was arrived at (i.e. growth of projected MPCE multiplied by expenditure elasticity) by applying the growth of rice.

We have taken the several rounds of NSS data on rice consumption data since 1993-94. NSS does not publish the rice consumption data every year; therefore, the time series data has been generated for the required years using interpolation and extrapolation techniques. Monthly per capita consumer expenditure and monthly average rice consumption are taken

from various rounds of NSSO. Expenditure (as a proxy for income) elasticity of consumption, between every quinquennial round, is calculated as the ratio of the percentage change in the quantity of rice demand to the percentage change in total monthly per capita expenditure. The monthly per capita rice consumption is applied to the population to obtain the aggregate demand for rice. The demand projection for the rice is obtained through

$$D_t = (D_0 (1+Ye)^{12}) * N_t \quad 1$$

Where, D_t = demand for rice in year t, D_0 = per capita demand for rice commodities in the base year, Y = growth in the per capita monthly expenditure, e = expenditure elasticity of demand for rice, N_t = projected population in year t, the population has taken from the census of India.

The estimation has the following steps:

- a. Firstly, Expenditure elasticity is estimated (considering average expenditure elasticity).
- b. Second, considering two scenarios assuming the MPCE growth rates to be 8 percent, the per capita rice demand has estimated (i.e. growth of MPCE multiplied by expenditure elasticity) by growth of rice.
- c. These estimates are based on NSS rounds up to 2004-05. When the latest 66th round NSS data of 2009-10 is considered, the per capita average consumption of rice has fallen drastically to 10.54 kg/month for rural and 8.98 kg/month for urban.

Year-wise Per capita consumption for Telangana are the ratios of the combined total Andhra Pradesh rice consumption to the total population of united Andhra Pradesh. Later, the yearly per capita consumption multiplied by Telangana state total population in each year to arrive at total consumption for Telangana in that year. Year-wise detailed consumption data for Telangana is shown in Table 5.1.

Telangana food per capita consumption, rice total consumption, total rice production, rice surplus or deficit from 1993 to 2014 shown in above table. Telangana food grains per capita consumption in year calculated by total consumption in that year divided by Telangana total population in that year. Telangana rice per capita in year from 1993 134.23 kg to 2014 124.41kg decline 10kg because according to Engel when people income increases food grains expenditure decline. Telangana total consumption in year estimated Telangana per capita

consumption in year multiplied by Telangana total population in that year it is in 1993 3.69 million tons to in 2014 4.57 million tons it was increased due to population increased. Production of food grains in Telangana increased 3.99 million tons to 7.22 million tons from 1993 to 2014.

Table 5.2: Rural and urban consumption, total surplus/deficit, rain fall deviation:(Million tons)

	Rural rice consumption	Urban rice consumption	Total Rice Consumption	Rice consumption	paddy production	Surplus/deficit	%deviation of rain fall
1993	2.67	0.98	3.65	3.69	2.39	-1.30	-32.54
1994	2.54	1.04	3.58	3.60	2.67	-0.93	-23.63
1995	2.72	1.08	3.80	3.84	2.48	-1.36	-14.27
1996	2.74	1.13	3.87	3.90	3.57	-0.33	-11.13
1997	2.77	1.17	3.94	3.97	2.07	-1.90	-28.56
1998	2.79	1.21	4.00	3.91	4.19	0.28	-3.38
1999	2.82	1.25	4.07	4.09	3.28	-0.81	-27.98
2000	2.63	1.25	3.88	3.87	4.42	0.55	-1.58
2001	2.71	1.24	3.94	3.96	3.57	-0.39	-15.08
2002	2.72	1.28	4.01	4.02	2.01	-2.01	-33.62
2003	2.73	1.34	4.07	4.08	2.90	-1.18	-5.47
2004	2.74	1.39	4.12	4.13	2.21	-1.92	-32.18
2005	2.83	1.36	4.19	4.21	4.42	0.21	23.45
2006	2.78	1.4	4.18	4.20	4.26	0.06	-11.17
2007	2.79	1.46	4.25	4.27	4.44	0.17	3.83
2008	2.82	1.52	4.34	4.36	5.36	1.00	-9.32
2009	2.83	1.55	4.38	4.41	3.27	-1.14	-24.70
2010	2.82	1.58	4.40	4.43	6.54	2.11	21.60
2011	2.82	1.57	4.39	4.44	5.15	0.71	-27.03
2012	2.83	1.61	4.43	4.48	4.65	0.17	1.27
2013	2.84	1.64	4.47	4.53	6.58	2.05	33.90
2014	2.85	1.67	4.52	4.57	4.54	-0.03	-24.65

Source: Estimated

Table 5.2 shows Telangana rural, urban, total consumption, surplus or deficit, and percentage of rainfall deviation from 1993 to 2014. From 1993 to 2004 Telangana state rice deficit state expects 1998 and 2000 and from 2005 to 2014 paddy surplus state but in 2009 and 2014 deficit. Surplus/deficit of Rice depends on the percentage deviation of rainfall. A wild fluctuation was in the rainfall data that can be observed over the years. The percentage deviation of rain fall, increases rice deficit increases or small rice surplus. But after 2005 the percentage deviation of rainfall increases rice deficit decline because irrigation facilities increased. Rice production from 1993 to 2014 wild fluctuation and rice consumption in the state constant this period slightly increases because of population increased.

Fig 5.2 Paddy Surplus/ deficit in Telangana

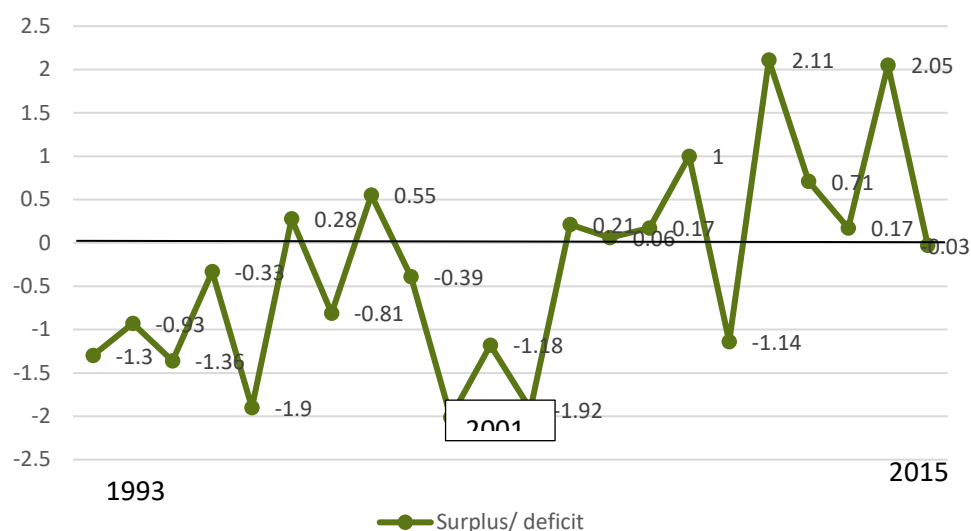
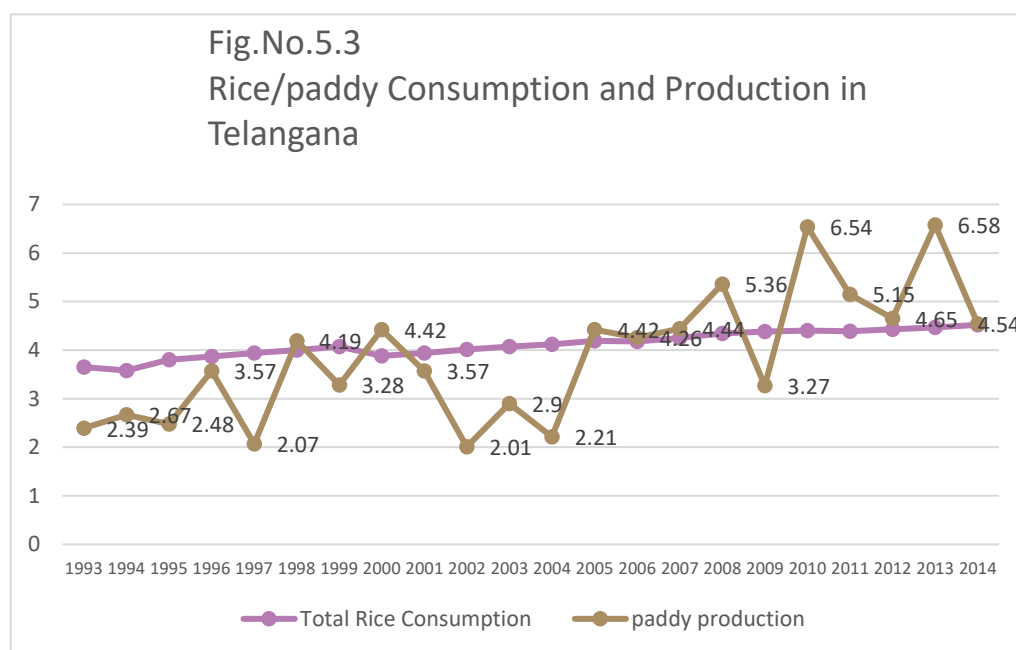


Table 5.3: Monthly per capita consumption in Telangana

Year	Monthly Per Capita Rice Consumption (Kg.)		Monthly Per Capita Consumption Expenditure (Rs.)	
	Rural	Urban	Rural	Urban
1993-94	11.50	10.10	288.7	408.6
1994-95	10.89	10.06	293.91	516.93
1995-96	11.63	9.93	324.84	552.59
1999-00	11.71	9.91	453.61	773.52
2000-01	10.86	9.64	490.15	928.43
2001-02	11.17	9.24	537.8	858.74
2004-05	11.06	9.55	585.55	1018.55
2005-06	11.38	9.13	704.17	1303.95
2006-07	11.14	9.14	727.14	1360.68
2007-08	11.16	9.31	816.17	1549.55
2008-09	11.17	9.28	889.63	1689.01
2009-10*	11.19	9.26	969.69	1841.02
2010-11*	11.21	9.25	1056.96	2006.71
2011-12*	11.216	9.22	1152.09	2187.32
2012-13*	11.243	9.20	1255.78	2384.17
2013-14*	11.259	9.18	1368.80	2598.75
2014-15*	11.276	9.16	1491.99	2832.64
2015-16*	11.293	9.14	1626.27	3087.58
2016-17*	11.309	9.12	1772.63	3365.46

Note: Estimated using 2007-08 NSS round

Per capita rural rice consumption in Telangana state is constant from 1993 to 2017. But urban per capita slightly declines for rural 11.50 kg to 11.309kg and urban 10.10kg to 9.12 kg this could be because urban people eat other items like wheat, meat, eggs etc. Engle principle also suggests when income increases expenditure on cereal decline. Most rural people preserved rice for self-consumption and less dependent on the market and also provide the ration shop against urban peoples depend on the market and ration shop. Rural people per head expenditure less than urban people per head spending in 30 days from 1993-94 to 2016-17 because urban people mostly depend on the market, but rural people preserved rice for self-consumption.



Thus, paddy production in Telangana has been growing since 1993. The production has grown from 2.39 million tons in 1990-91 to a peak of 6.58 million tons in 2013-14, which is a 300 percent rise in thirty years. Telangana was part of united Andhra Pradesh till 2014. Hence, a domestic situation in terms of deficit or surplus does not make much sense. But as estimated by RamanaMurthy et al (2012), the united-state had begun to become self-sufficient by 2000, and there on because of rabi production increase, the surplus production issue began arising. The Telangana case is that from 2005, it became a rice surplus state, which can be seen from the above graph. From 2005-06 onwards, there is a consistent surplus

production can be seen, with an exception of 2009-10. Such a surplus is clearly linked to the monsoon performance. Whenever, there is a normal year or surplus rainfall year, there is going to be 25 percent excess production over the domestic need. This situation, if continued, it will put severe burden on the state government to procure. This along with the addition contribution from the central pool can make surplus situation more. Therefore, there is a need to discourage rice production. Probably, diverting the rabi crop into some other substitute crop will be advisable, since the rabi crop is not preferred in the state. However, it may not be easy to convert it into millets, since soil moisture may not allow diversification to dry land crops.

5.2conclusion:

We have seen that rice production and its growth is prompted by factors such as excessive cultural preference to eat rice, the market support by the state like procurement and minimum support price, the stable long and short varieties of HYV seeds, fertilizer subsidy and new irrigation technologies. The production has quadrupled in the last 35 years, even while the area under paddy has slightly declined, the yield increase has more than compensated. We observed that per capita rice consumption in rural areas has remained stable, while it declined in urban areas. This is in line with the national trend. We have estimated the consumption demand for rice, using NSS data on consumption expenditure, prices, and population of Telangana. We have examined the production vis-à-vis consumption of rice in Telangana and we found that Telangana has consistently become a rice surplus region since 2005. Telangana has an excess production over the local demand in the state. This will lead to downward pressure on the market prices and political pressure on the state to procure all the paddy production. This would create enormous burden on the state to procure. There is a need to diversify from rice, as further production would be detrimental to the interest of the farmers in the long run.

Chapter 6

Summary and Conclusions

Telangana's agricultural development is more than a century old by now. Commercialization of farming began during the Nizam rule. Both food and non-food crops have become commercialized along with Colonial masters. Telangana's moment of commercialization has occurred during 1900-10, when the demand for castor seed surged in the world, as it is used as lubricant in the newly discovered fuel, namely, the diesel. The world wars have increased the levies on the farmers and the adverse effects of Great Depression had serious consequences leading to depeasantisation, increased tenancy and forced labour. A shadow of doubt on the extent of development of agriculture of Telangana is often cast by historians and popular writers. But our survey of literature and reports shows that Nizam government had taken several measures to develop agriculture in Telangana, diversify its crops, established agricultural department and scientific research centers to develop new varieties of seeds. It has encouraged sugarcane cultivation, tobacco cultivation, paddy cultivation, cotton and ground nut cultivation, besides different types of horticultural crops. The taxation policies and lack of banking facilities had, of course led to deep indebtedness of small peasantry, which led to the great Armed Struggle of Telangana during 1946-49.

The adverse conditions of Great Depression, Second World War and their consequences have continued on Telangana for about two decades, reflected in stagnation. The Green Revolution implementation is delayed in the Telangana, as new canals have arrived only 1973-74. Thus, the relative position of Telangana, vis-à-vis Andhra region fell behind. Telangana relatively was deprived of canal irrigation, compared to Andhra region in the combined state, but rural electrification has provided an alternative source of irrigation, namely, that of bore well irrigation, even if costlier for the farmers. Telangana's farmers have strived hard to make place for a living with the opportunities that have come up and the new State of Telangana stands with

promise to make improvements in Telangana's agriculture. The way forward is to push more investment, modernization, technology and appropriate cropping pattern shift.

Conceptually, agriculture plays an important role for modern sector, as per the Lewis model of development. Even the Marxist theories argue that development of agriculture through development of capitalist relations can greatly increase the backward and forward linkages for the industrial development. Hence agricultural development in Telangana is absolutely necessary at the stage Telangana region stands at this point.

All development theories point out that there is a need to boost agricultural production, productivity and at the same time profitability. Second, as for agriculture concerned, there should be a healthy diversification. And instability of production can seriously undermine the livelihoods. The structure of the agrarian holdings, where there is an increasing small and marginal holding also poses the problem of vulnerable livelihoods. Thus, Telangana's agriculture is poised to provide crucial forward and backward linkages with industrial growth in the region.

Given these conditions, the present thesis examines the changing cropping pattern, crop combinations, nature of supply response and supply-demand position in the major crops like paddy in the past thirty years. The objectives of study are as follows: (1) to understand the changing of cropping pattern, irrigation, land utilization in Telangana state; (2) to understand cropping pattern, crop combinations, and crop diversification; (3) to estimate the Telangana state three importance crops supply responses; (4) to calculate the Telangana state food grains supply and demand, and (6) to assess the need for diversification from the food crop intensification.

The thesis assumes four simple hypotheses, such as: (1) the crop combination in Telangana is dynamic over period, which suggests changing institutional factors; (2) crop concentration is growing in the state and crop diversification have reduced; (4) the food crops in the state respond to institutional factors such as technology and marketing; (5) non-food crops respond to price factors; and (6) Telangana has become a food surplus state.

The study based on the completely secondary data collected from the government records, NSSO, statistical year books, director of economics and statistics Telangana and India, indiaastat.com. Secondary data belongs to irrigation, cropping pattern, major crops of Telangana area, production, yields, whole sales prices, farm harvesting prices Telangana state and from

1970-2014. Data availability the statistical techniques like averages, correlation, multiple regression, log multiple regression, multicollinearity triangle, standard deviation, coefficient of variation, coefficient of determination, compound growth rates, DOI's crop combination method, crop concentration ratios, crop diversification index, rice demand projection technique, t-test and software techniques like E Views and STATA have also been used in the present study.

We have surveyed literature on agriculture at country level as well as regional level. We make following four sets of observations. First: in India, the expansion of cultivated land had reached its peak by 1961. India has an arable land of 66 percent, which is one of the highest in the world. Being a tropical country, with ample sunlight, India can have two to three crops. The only constraint is irrigation. Therefore, India increased its irrigation potential to a very large extent and its percentage of net irrigated area is about 39 percent and gross irrigated area being 48 percent by canal sources. But the rest is irrigated by bore wells, which in turn depends on rainfall. The studies have shown that there are problems in big dams, where gross inefficiencies are there in water utilizations. Also, there are differences in productivity along irrigation channels. The siltation and DE capacity are another issues. However, expansion of big irrigation has enabled India to achieve food security. Probably, the next challenge is to conserve the water.

Second literature suggests cropping pattern changed in two phases in independent India. The initial phase the food crop area has expanded and later decreased in India. This is because, after reaching the peak production, further improvements in yield will need lesser land and hence the reduction in the second phase of land under food crops did not led to any fall in output. The non-food commercial crops increased in the later half. The coarse cereals have given way to finer cereals. This trend probably needs a reversal in the future.

Third, the demand side studies have shown that India needs about 280 million tons by 2020 and the production has exactly reached that point. In some states a perpetual surplus is leading to fall in profitability of the crop, which will call for further crop's diversification. Telangana is on a brink of marginal surplus. We need to ascertain the demand-supply situation once again.

Fourth, Indian farmers are rational and respond to price signals wherever they can. In case of food crops, self-sufficiency and stability factors will determine the supply response,

whereas for non-food crops the price factors are more important. There is need for greater economic intelligence to be supplied to the farmers for production not to overshoot the demand. Formation of cooperatives perhaps holds some answers to such questions.

Fifth, the studies on Telangana agriculture are all most non-existent. Hence there is a scope for a study to cover the basic aspects such as growth, cropping pattern, crop diversification, and supply-demand analysis for food crops. This thesis tried to contribute to this end.

Telangana's Agriculture: past and present

Telangana region has undergone a substantial change in the past 35 years of its agricultural development. A prominent feature of this growth story is a rise in gross sown area, in spite of rise in fallows and diversion of land use to non-farm purposes. Such an increase in gross sown area is contributed by rise in irrigated land, prominently by the well irrigation. The canal and tank irrigation have declined mostly, except there has been little revival in canal irrigation in the recent past. These changes in land use have also led to changes in cropping pattern. Most prominent change is the rise of rice, cotton and maize to dominance as the three-crop combination commanding 71 percent of area sown. Since, well irrigation is dominant source; the serious externality of this is the high area, crop and yield instability. The production rise has two important phases of growth, namely, 1980-94 and 2005-15. The phase in between is marked by a relative stagnation. Among these two phases, the first phase growth is contributed by both area as well as yield while the latter phase is marked by area shift alone. The wild fluctuations in output in these three major crops call for appropriate policy action to protect the farmers. Finally, the rice production which has grown significantly in the past one decade appears to have surpassed the domestic demand, making the Telangana state a rice-surplus state. There appears a serious need for a cropping pattern change from this three-crop combination to more diverse crops, particularly, crops like fruits and vegetables. Maize crop acreage response depends on lagged area, irrigated area, lagged price, well irrigated and these elasticities are 1% and 5% level of significant. Cotton crop area explained variables have lagged price, yield, well irrigated area and these coefficients of elasticity's are 1percent and 5percent level significant. Paddy acreage response independent variables have been fertilizer, rainfall; lagged area and these variables elasticities are statistically significant at one percent significant level.

The net sown area has marginally declined in growth rates, what has significantly increased is the area put to non-agricultural use. What a declined in forest area, cultivable waste. What is interesting is that while other fallows declined, current fallows have declined significantly; this could be due to expansion of bore well irrigation.

The total cropped area has increased from 42.75 percent in 1980-81 to 47.43 percent of total land in 2014-15. Such 4.6 percent of land is perhaps a massive growth in area cultivated, thanks to irrigation facilities. The areas sown more than once have tripled over these years. But the other fallows and current fallows together constitute about 17 percent, which would throw tremendous instability in area cultivated and production. Such expansion of area also seemed to have come at some expense of common lands, often exists under the name of barren and uncultivable waste. And forest land also is gone by 2 percent. These are the lands that government allowed weaker sections to occupy and cultivate.

The three major sources of irrigation in the state are well, tank and canal irrigation in Telangana, an issue which remained at the heart of formation of the new state. Out of the total 43.7 lakh hectares of net sown area, the total irrigated area formed about 14.43 lakh hectares in 2014-15, which is about 33.02 percent. Out of this, a lion's share of 84 percent of irrigated area is irrigated through wells, while 9.61 percent is irrigated by canals and 4.47 percent is covered by the tanks. Overwhelming share of well irrigation, which is mostly by the bore wells, reflects the burden of private investment, compared to the declining public investment reflected by decreasing share of canal and tank irrigation.

Production of cotton has grown at a compound rate of growth of 13.5 during 1980-2015. Maize has growth at a rate of 5.59 percent and paddy at 2.83 percent during the same time. These are quite impressive on the face of it. Much of this growth has come during two periods, namely, 1980-95 and 2005-15. The decade of 1995-05 is somewhat lost decade, as for Telangana agriculture is concerned.

The cropping pattern at the aggregate in Telangana shows a drastic change in terms of crop combinations and cropping pattern over the last fifty years. In 1973-74, food grains which were sown in 77.9 percent area have declined to 49.16 percent in 2014-15. This is a positive

development in one sense, because, despite the area reduced, the overall production of food grains massively increased. Jowar as the principle food crop is replaced with paddy. Paddy increased from 19 percent to 30 percent in the last 40 years. Pulses have declined in the recent period, otherwise was steady. Cotton has increased from 2 percent to 30 percent. Maize increased from 5 percent to 13 percent. All oil seeds have declined. All small millets have declined. The three-crop dominance is perhaps not necessarily good for farming prospects.

The yield improvement is the second important source for production. In Telangana, the cotton crop has recorded an impressive growth rate of 5.61 percent during 1980-2015, followed by maize at 2.77 percent. Paddy has shown a modest growth of yield by 1.74 percent. Much of the yield improvements again have happened during 1980-95. The second wave improvement in yield in cotton is supposed to have come from Bt Cotton.

The compound rates of growth of area shows that cotton has increased at breath taking rates 7.44 during, while maize areas grew at a remarkable 3.03 percent and paddy at a modest rate of 1.07 per cent during 1980-2015. All these are at the expense of declining area under food grains. Such high growth of cotton would face a market risk. Unless we look into export possibilities with adequate institutional mechanisms, cotton growth can also face gluts.

The crop combination of Telangana, which is a measure of a combination that takes majority of the area sown, estimated showed that its number began with four in 1973-74, increased to five in 1996-97, declined to four in 2006-07 and further to three in 2014-15. The progressive decline of diversity of crops towards the end is the issue to be discussed. Particularly when the state essentially growing three crop combination region suggests certain policy imperatives. This suggests that farmers have lost wider opportunity and therefore at the end of high risk in each crop.

As for crop concentration, the important trends are that by 1973-74, Jowar is the dominant food crop. Paddy was cultivated slightly in Nizamabad, Jowar in Khammam, Mahabubnagar and Hyderabad. Cotton is concentrated in Adilabad, fruits were in Hyderabad. This is was the period where irrigation was sparsely spread. By 1996-97, the bore wells have arrived; paddy cultivation began expanding and concentrating in Nalgonda, Nizamabad, Karimnagar and Warangal. Sugarcane is in Medak. But Jowar has to still to be found in

Rangareddy, Medak, Warangal and Khammam. Mirchi is in Khammam. Cotton has in dry belts of Adilabad, Warangal, and Khammam. Groundnut concentrates in Mahabubnagar. By 2006-07, paddy concentration grips Nalgonda, Karimnagar and Nizamabad. By 2006-07, paddy began increasing in Nalgonda, Karimnagar, and Nizamabad. Cotton continues to concentrate in Adilabad, Warangal, and Khammam. Turmeric concentrates in Nizamabad and Karimnagar. By 2014-15, crop concentration ratios have not changed much. We still find that paddy in the three districts of Nizamabad, Karimnagar, and Nalgonda. Sugarcane is in Medak. Cotton has in Warangal, Khammam and Adilabad. Spices have in Khammam and Nizamabad.

Coming to crop diversification, in Telangana, Rangareddy district has the highest crop diversification index at 0.82. This is more because Rangareddy has vegetable production as well as others, as being close to Hyderabad city. This is followed by Medak and Mahabubnagar, which have diversified portfolio of crops. Medak has sugarcane, maize, paddy, pulses, cotton and vegetables. Mahabubnagar is diversified into paddy, cotton, maize, groundnut, jowar, fruits and vegetables. Similarly, Nizamabad is diversified between paddy, maize, and pulses, besides turmeric. Adilabad has the lowest diversification at 0.59, where cotton is cultivated in 50 percent of the land, followed by Nalgonda (0.62), where the two crops namely cotton and paddy consumes 82 percent of the area. The three principal crops paddy, maize and cotton are distributed in such a way that paddy is concentrated in Nalgonda, Nizamabad, Karimnagar, and Khammam. Cotton is concentrated in Mahabubnagar, Nalgonda, Warangal, and Adilabad. Maize is concentrated in Medak, Nizamabad, Karimnagar, Mahabubnagar and Rangareddy. By 1973-74, paddy confined to Nalgonda, Nizamabad and thinly spread into other districts. But by 2014-15, paddy expanded massively in Karimnagar and Khammam, besides in the traditional districts. Further, cotton which was totally absent in 1973-74, appears as dominant crop by 2014-15. Many traditional crops such as jowar, bajra, sugar cane, oilseeds have declined relatively. On the whole, the saga of crop diversification is that it began increasing from 1973-74 from 0.81 to 0.85 in 1996-97 and declined to 0.84 in 2006-07 and sharply declined to 0.78 in 2014-15.

Demand-Supply Comparison for Rice in Telangana

Having seen an impressive growth paddy production in Telangana, particularly in the last one decade, we made an estimation of consumption demand for rice, using per capita consumption figure for rice from NSS data and blowing it for the population. This exercise produces some very interesting results. The

production of rice in Telangana has been below its consumption during 1991-2004. From 2005, rice production distinctly and almost consistently surpasses the consumption levels of the region, except for exceptionally bad year of 2009-10. From 2005-06 onwards, it is way above the consumption. This means Telangana has emerged as rice surplus state and less dependence from the central pool. This also means, the market prices may tend to fall unless active procurement is undertaken by the state agencies. Therefore, it is not wise to promote paddy production further in the state, which would only create problem excess production and price stagnation in the future. This further supports our argument that a greater diversification of crop production is to be encouraged.

The estimations of the thesis have validated all the four hypotheses assumed in the introductory chapter. The estimates have shown that cropping pattern has changed towards a narrow three crop combination. We have shown that food crops respond to institutional factors and non-food crops to price factors. Finally, we have shown that Telangana has become a food surplus state. These estimates therefore support our larger argument for greater diversification of cropping pattern for Telangana. The study, admit ably, has its limitations, like it has not examined relative profitability, field level issues, credit and other institutions. Hopefully, these aspects are taken up in our further research and by other scholars.

For policy perspective two changes are obvious from our analysis. First, the water conservation methods using drip irrigation has to be adopted, since canal irrigation expansion alone is not adequate. There is scope to diversify to millets, with possibly same profitability and government support. Second, there appears a serious need for a cropping pattern change from these three-crop combinations to more diverse crops, particularly, crops like fruits and vegetables. Commercial crops like maize and cottons, acreage response is determined by prices and expectations. Whereas, for food crops, irrigation, rainfall, fertilizer and power where be much more important. However, there is a need to discourage paddy, since finding markets would be difficult. Diversification into millet, fruits and vegetables would be a better choice, than encouraging farmers to grow only rice. The analysis of this paper, however, should be taken in the larger picture of institutional changes and policy to encourage a stable growth of agriculture.

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STRUCTURE AND GROWTH OF TELANGANA AGRICULTURE (1981-2015): AN ECONOMIC ANALYSIS OF THE PRINCIPAL CROPS

DASTAGEER AAULA * R.V.RAMANA MURTHY **

1. Introduction

The state of Telangana is the newest state formed in 2014, from the bifurcation of Andhra Pradesh. The new state is formed on lot of expectations on development of the state, in particular, the agricultural sector. Agricultural sector that roughly forms a quarter of the state domestic income of the state is still very important for the state's economy, as it supports about half of the total workers of the state. Any meaningful structural transformation in the state can happen only through a substantial growth of agriculture and transformation of this sector in itself. What are the factors that are positive and negative that would hold their influence on Telangana's agriculture? We would classify three broad classes of factors that influence agricultural production as: First, institutional or structural, second geographical and natural resources and the third, policy factors. The agrarian structure, tenurial arrangements, entrepreneurial culture and marketing would constitute institutional factors. Geographical weather, soil, and water resources constitute natural resources. Finally factors such as extent of state support in prices, credit, subsidies, irrigation, power, procurement and research & extension are policy issues. While covering all these are beyond the scope of any one research article, this paper attempts to cover some of the important aspects mentioned above, which would help in build a perspective for a productive policy analysis.

There is a need to ascertain the nature and structure of its agriculture, for the larger policy of agricultural development. In this context, this is a modest attempt to outline some of those historical trends in the growth of Telangana's agriculture in the past 35 years, in Telangana, during 1980-2015. For a large period of this time period, it actually remained a part of united state of Andhra Pradesh, till 2014-15. The paper documents the changes in land use pattern, irrigation, cropping pattern, growth of production of major crops, and demand-supply position of rice. Such delineation of trends would help build a fresh narrative of Telangana's agriculture and identify the issues and problems, wholly tentatively.

2. Backdrop of Telangana Agriculture

Since, Telangana has been part of united state of A.P, specific studies on Telangana are

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relatively few. We have culled certain crucial points to build a narrative of nature of Telangana agriculture, to serve as departure points to his paper. Historically, Telangana is seen to have been behind the regions under British rule, during the pre-independence period in commercialization and growth. Pavier (1991) showed that commercialization has entered Telangana as early as 1900s, land tax policy on the colonial lines and expansion of castor production indeed introduced commercial production on a significant scale. Abolition of land tax in post-Independent period relieved farming sector of the agrarian distress; agrarian production was lulled into petty production and subsistence farming. By the time of formation of Hyderabad state, only 15 percent of area was irrigated through canals, 50 percent by tanks and 35 percent by open wells [Ayyengar (1956)]. Land transfer to the upper intermediate castes in late 1950s, occupation of commons in 1970s by weaker sections and sale of land by upper segments in 1980s began changing the agrarian structure, despite failure of implementation of land ceilings [Reddy, D. N (2008)]. The operational holdings structure broadly in consonance with national trend, with marginal, small and semi-medium farmers constituting 80 percent of holdings and owning about 60 percent of arable land, conveying that majority of the farmers' capacity to invest and accumulate is low. A slew of measures by the state since 1970s, such as introduction of HYVs in early 1970s, diesel pump sets, spread of rural electrification, arrival of agricultural mechanization, improvement in canal irrigation, arrival of bore wells, expansion of bank credit, crop diversification, last but not the least, anti-landlord dominance peasant struggles, have all contributed to an accelerated growth in agriculture in Telangana since early 1990s [Subrahmaniam, S (2005)]. Such a growth, built on disproportionate share of private investment in irrigation, is also accompanied by severe crop instability, farmers' distress, indebtedness and a high incidence of farmers' suicides [Revathi and Galab (2008)]. The viability of farming in all major crops has eroded profitability and farming has ceased to be principal source of income for majority of farm households [Ramanamurthy (2012)]. Such growth is described as 'immiserising growth' by some scholars [Vamsi Vakulabharanam (2004)]. We would attempt to build our narrative around these coordinates of Telangana's history of agricultural growth. While this paper only modestly flags some of the issues, there is a need for further work to fashion appropriate policy options for a sustainable growth of the same.

The present paper would present its analysis on land use pattern, cropping pattern, crop diversification, sources of irrigation, trends in production and supply response of major crops. These we consider important to draw policy direction. We also undertake a demand-supply analysis for rice, which is the major food crop, to ascertain the relative position vis-à-vis its domestic consumption.

Data and Methodology

This study is based on secondary data published in Statistical Abstract, Govt of Andhra Pradesh, pertaining to Telangana 10 districts, NSSO rounds on Household Consumption, Statistical Year Books published by Director of Economics and Statistics, A.P & Telangana, Indiaaastat.com, Agricultural Costs and Prices, Ministry of Agriculture. Data is collected on variables like land use, irrigation, cropping pattern, area, production, yield in major crops of Telangana; Whole Sales Prices, Farm Harvesting Prices Telangana state and districts from 1970 to 2014. It has used simple statistical techniques like averages, compound growth rates, correlation, multiple regression, log multiple regression, multicollinearity triangle, standard deviation, coefficient of variation, coefficient of determination, compound growth rates, DOI crop combination method, crop concentration ratios, crop diversification index, rice demand projection technique, mostly estimated using statistical packages like E-Views and STATA.

3. Land Use Pattern and Instability

Telangana's total geographical area is about 112 lakh hectares in 2014-15, after losing about 2 lakh hectares from alienation of 6 mandalas during the formation of the state. Out of this, about 25.4 lakh hectares is forest land (22.6 percent), which is slightly higher than the national average [table 1]. Net sown area is about 43.7 lakh hectares in 2014-15 (39 percent). In the previous 35 years, it roughly remained same, even though it lost marginally in between. It lost some 5 lakh hectares during 1980-2006 and recovered 3.7 lakh hectares in the last one decade during 2006-15. The current fallows and other fallows form about 17.7 percent, (constituting 12.5 & 7.18 percent respectively) shows that there is a potential to increase the net sown area in the future by some appropriate policy. The current fallows show a tendency to fluctuate between 12-16 percent, for having a greater share of well irrigation. Interestingly, the increase in other fallows is outweighed by a fall in forest land and barren land, thus making overall net sown area almost constant. Most important fact is that the area sown more than once has increased from 3.8 lakh hectares to 9.7 lakh hectares. As percentage of net sown area, this has increased from 8.4 percent to 21.4 percent during 1981-2015. The net addition to gross sown area is approximately 6 lakh hectares. On the flip side, we also observe that about 2.3 lakh hectares of commons are lost, the pasture and grazing land came down from 5.2 lakh hectares to 2.9 lakh hectares during 1980-15. Similarly, about 1.2 lakh hectares of cultivable waste has come down. About 2.1 lakh hectares is agricultural land converted to non-agricultural use. Thus, with an appropriation of forest land, cultivable waste land and pastures & grazing land, appear to have contributed to a stable net sown area and a rise in gross sown area, besides area sown more than once, in spite of a rise in current and other fallows and land put to non-agricultural use. The coefficient of variation of gross cropped area is about 9.14

percent; that of net sown area is 7.5 percent and that of area sown more than once is about 33.4 percent. Thus with a greater reliance on well irrigation as we will show later, area sown more than once will tend to show wide swings along with fluctuations in rainfall, producing nearing 10 percent variation in gross sown area, to have similar variation on the agricultural output.

We can also see the unstable pattern of growth in terms of compound rates of growth. The net sown area during 1980-15, has declined at -0.1 percent. When divide the 35 years into three sub-periods, broadly as pre-reform period (1980-1991, first phase of reform (1992-04), and second-phase of reform (2004-15), we observe that the net cropped area was lost sharply during the first phase, but recovered in the second two periods. Similarly, the gross sown area has declined at -0.35 percent, but recovered at 1.8 percent rate during the last phase, making overall growth positive. The area sown more than once has grown faster during 1980-91 and 2004-15 at 2.2 & 2.05 percent respectively. The gross sown area has increased for overall period at 2.89 percent.

Table 1.Land utilisation in Telangana (1980-2015)

years Sector	1980-81 Area (Hector)	Share	1990-91 Area (Hector)	Share	1998-99 Area (Hector)	Share	2006-07 Area (Hector)	Share	2014-15 Area (Hector)	Share
GEOGRAPHICAL AREA	11477000	100	11477000	100	11477000	100	11484100	100	11207810	100
Forest	2780000	24.22	2810000	24.48	2745000	23.92	2743476	23.89	2540101	22.66
Barren and uncultivable land	659000	5.742	532000	4.64	621000	5.41	603453	5.25	607430	5.42
Land put to non-agriculture uses	679000	5.92	702000	6.12	772000	6.73	794860	6.92	884596	7.89
Culturable waste	214000	1.86	161000	1.4	203000	1.77	183747	1.6	182511	1.63
Permanent pastures grazing lands	518000	4.51	457000	3.98	348000	3.03	327260	2.85	298597	2.66
misc. tree crops and groves	76000	0.66	77000	0.67	72000	0.63	113789	1	112180	1
Other fallow lands	567000	4.94	545000	4.75	843000	7.35	803504	7	805150	7.18
Current fallows	1459000	12.71	1804000	15.72	1568000	13.66	1910593	16.64	1400669	12.5
Net sown area	4525000	39.43	4366000	38.04	4305000	37.51	4003418	34.86	4376576	39.05
Area sown more than once	381000	8.4	670000	15.34	870000	7.58	938035	20.2	938793	21.4
Total cropped area	4906000	42.75	5036000	43.88	5173000	45.07	4941449	43.03	5315333	47.43

Source: Statistical Year Books, Dir of Economic and Statistics, Gov AP.

While, rise of gross sown area appears brighter side of the story, the flip side has two aspects. One, there could be lot more scope for increasing cultivated land. And second, loss of commons would make allied activities to agriculture like dairy and livestock to have an adverse impact

Area under Cropping

An interesting aspect of Telangana agriculture is that while gross area under cropping remained stagnant or marginally declined in the recent times, the gross sown area has increased at 0.32 percent during 1980-2015. Particularly, during 2005-15, it has increased at 1.8 percent

per annum, which is remarkable, all because of rabi area under rice. Even net cropped area has increased at 1.73 percent during this time, mostly because of well irrigation using submersible pump sets. We shall examine it further in the next section. The instability which we were referring can be seen in table no.3, where the coefficient of variation of gross cropped area is about 9.14 percent. This matches with the current fallows, which have tremendous correlation to fluctuate with the rainfall to produce this kind of instability.

Table2 :**Compound growth rate of Net and Gross cropped area**

	1980-81 To 2014-15	1980-81 To 1991-92	1992-93 To 2004-05	2005-06 To 2014-15
Gross area	-0.02 **	0.0001*	0	-0.23**
Net cropped area	-0.10*	-0.66 *	0.06*	1.73***
Gross cropped area	0.32**	-0.35 *	0.16*	1.80**
Area sown more than once area	2.89***	2.20 *	0.85*	2.05*

Source: estimated using double log regression of time trend; ***, **, & * significance at 1%, 5% and 10% levels respectively.

Table 3**Instability in Area under Crops**

	SD	CV
Gross area	62735	0.54
Net cropped area	322147	7.58
Gross cropped area	455438	9.14
Area sown more than once area	249000	33.8

Source: Estimated

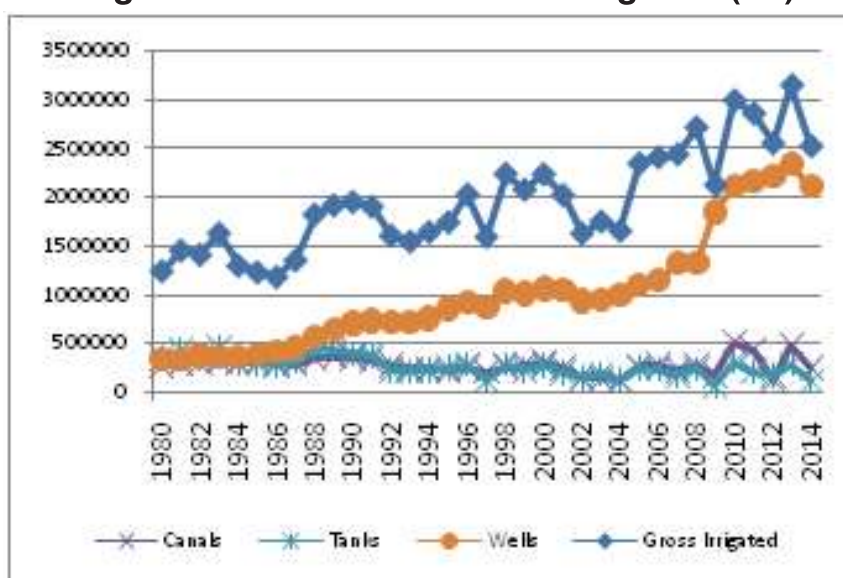
4. Irrigation: Excessive Borewell Expansion

The three major sources of irrigation in the state are well, tank and canal irrigation in Telangana, an issue which remained at the heart of formation of the new state. Out of the total 43.7 lakh hectares of net sown area, the total irrigated area formed about 25.28 lakh hectares in 2014-15, which is about 57.9 percent. Out of this, a lion's share of 84 percent of irrigated area is irrigated through wells, while 9.61 percent is irrigated by canals and 4.47 percent are covered by the tanks [see fig 1]. Overwhelming share of well irrigation, which is mostly by the bore wells, reflects the burden of private investment, compared to the declining public investment reflected by decreasing share of canal and tank irrigation.

The net irrigation in the state has increased at compound rate of 1.85 percent during the last 35 years [table 4]. It has growth faster in the pre-reform period during 1980-92, it rose at 2.33 percent. Immediately after the reforms, net irrigation declined at rate of 0.88 percent

during 1995-04, but recovered during the second phase during 2005-15, it increased by 1.74 percent per annum. However, the well irrigation that increased at 5.81 percent, while canal and tank irrigation declined in the last 35 years at -0.72 & -2.64 percent respectively. The well irrigation increased at 7.32 and 9.58 percent rates during 1980-91 and 2005-15. The growth rates of well irrigation are phenomenal, which are the reasons behind the growth as well as distress. Because, groundwater is very closely related to rainfall, well irrigation shows greatest instability compared to surface irrigation. As observed earlier, the rainfall influences the area sown, though changes in current fallows, groundwater backed by overwhelming well irrigation are likely effect production instability.

Figure 1. Different Sources of Irrigation (Ha)



Source: Dir of Economics and Statistics, AP

The instability is estimated by using coefficient of variation and standard deviation. From table no.5, we can see that C.V is 9.14 in gross cropped area, with 33.8 percent in area sown more than once. This is because of huge rise in rabi area, which squarely depends on the rainfall. This would produce a bumper crop during a normal year and huge drop in a poor monsoon year. Therefore, unless either canal irrigation is expanded or micro-irrigation is expanded, Telangana agriculture is going to suffer from severe crop instability.

Table 4 : Compound Growth Rates of Different Sources of Irrigation

Different sources	1980-15	1980-95	1995-05	2005-15
Canal	-0.72	-0.68	-6.5*	1.41
Tank	-2.64***	-2.9*	-4.80	-2.5
Well	5.81***	7.327***	1.31	9.58***
Other sources	1.15***	4.53***	-4.38**	2.11*
Net irrigated area	1.85***	2.33***	-0.88	1.74*
Gross irrigated area	2.22***	2.2**	-0.97	1.98*

Source: Estimated . *** , ** & * convey 1%, 5% and 10 % levels of significance

Table 5. Instability in Irrigation

Irrigation source	Standard deviation	Coefficient of variation
Gross irrigated area	515191	26.34
Net irrigated area	319832	22.15
Canal irrigated area	85230	31.04
Tank irrigated area	96959	37.07
Well irrigated area	586025	58.77
Other source	10869	20.76

Source: Estimated

5. Cropping Pattern: Towards Three Crop Dominance

Analysis of cropping pattern is very crucial over changing dynamics of agriculture of a region. Telangana, which is located in the Deccan plateau endowed with red alluvial and black soil, which are conducive for a wide range of food and non-food crops. Traditionally, Telangana as elsewhere, had about 78 percent of cultivated area under food crops dominated by and rest under non-food crops at the time of Independence, whose nature has not change much until 1980. By 2014-15, the share of land under food crops has come down to 49.16 percent and area under non-food crops has increased to 50.8 percent. This is not affected the production in anyway, thanks to the rise in productivity, the production of food has continued increase despite the fall in area, at the same time enabling a diversification towards non-food crops. One can say that the shift to paddy, however one might criticize, has indeed enabled this shift [table 6].

Table 6:

Cropping pattern in Telangana (1973-74 to 2014-15)(Per cent)

Years	Paddy	Jowar	Maize	Small Millets	Pulses	Food Grains	Sugarcane	Sunflower	Cotton	Groundnut	Sesame	Castor	Fruits	Vegetables
1973-74	19.2	32.2	5.0	2.2	13.7	77.9	2.1	0.1	2.0	5.6	2.3	6.2	0.2	0.3
1996-97	28	13.3	6.2	0.1	13.4	62.5	3.0	2.0	12.9	8.0	1.0	5.0	2.0	1.0
2006-07	30.1	5.7	12.0	0.01	13.90	62.4	3.1	2.2	14.8	3.6	1.0	3.7	2.9	1.5
2014-15	26.63	1.49	13.01	0.03	7.68	49.2	2.3	1.4	31.3	2.9	0.4	0.95	3.0	1.9

Source: Statistical Year Books, Dir of Economics and Statistics, AP [figures in bold for dominant crop]

We examined fourteen crops to see the changes in cropping pattern. Being rain fed region largely, Telangana had a wide array of crops, particularly among food crops such as jowar, bajra, maize, ragi, small millets, groundnut, and pulses. The major non-food crops were castor spices and condiments, sugarcane, cotton, tobacco, groundnut, sesames, sunflower, coconut, fruits, vegetables, and fodder crops. Jowar, the major food grain, occupied 32.2% of area 1973-74, followed by paddy 19.2 percent and Pulses by 13.7 percent. Caster and groundnut

occupied 6.2 and 5.6 percent respectively. The arrival of HYVs in paddy and the market support, and increased procurement in 1982 and rural electrification began changing the cropping pattern. These have changed the consumption as well as production patterns in the region. By 1996-97, the area under food crops, namely under jowar began rapidly, giving away paddy, cotton in a big way, maize in a small way. Thus four-crop combination expanded into five-crop combination, only to become smaller again the coming times. The area under millets and oil seeds began shifting to these crops, while pulses still managed to retain its share of 13 percent of area for one more decade since then. Finally, during period 2004-15, even pulses began falling and leading to a complete three-crop combination of paddy, cotton and maize to dominate 72 percent of the cropped area, with cotton commanding 31.4 percent, paddy 26.63 percent and maize 13 percent. The area under fruits and vegetables, two important crops, managed increased to 3& 2 percent by 2014-15, which is woefully low; there is a desperate need for an area shift into fruits and vegetables.

The crop diversification index has improved during 1973-74 and 2006-07, but declined to an all-time low by 2014-15. This could be a cause of concern, how farmers are sowing mostly three crops. In 1973-74, a four crop combination of jowar, paddy, pulses and castor is replaced by 5-crop combination by entry of cotton, and finally reduced 3-crop combination of rice, cotton and maize by 2014-15[table7].

Fortunately, crop concentration is spread across districts of Telangana. Crop concentration ratios are estimated for different districts in Telangana regions. According to the estimates, paddy is concentrated in Nizamabad, Karimnagar, Nalgonda and Khammam. Cotton is in Warangal, Adilabad, Nalgonda and Khammam; Maize in Mahaboobnagar, Nizamabad, Rangareddy, and Medak; pulses in Rangareddy, Medak, Adilabad, and Mahaboobnagar; fruits in Nalgonda and Rangareddy; and vegetables in Rangareddy. The marketing and agricultural services provision should follow the spread of crop concentration ratios across districts [appendix table 7b].

Table 7.
Telangana state crop combination 1973-74 to 2014-15

Years	Crop combination crops	Number of crops	Crop Diversification Index
1973-74	Jowar, Paddy, Pluses, and Castor	Four crops combination	0.82
1996-97	Paddy,Pulses,Jowar, Cotton,and Groundnut	Five crops combination	0.85
2006-07	Paddy, Cotton, Pulses, and Maize	Four crops combination	0.84
2014-15	Cotton, Paddy, and Maize	Three crops combination	0.78

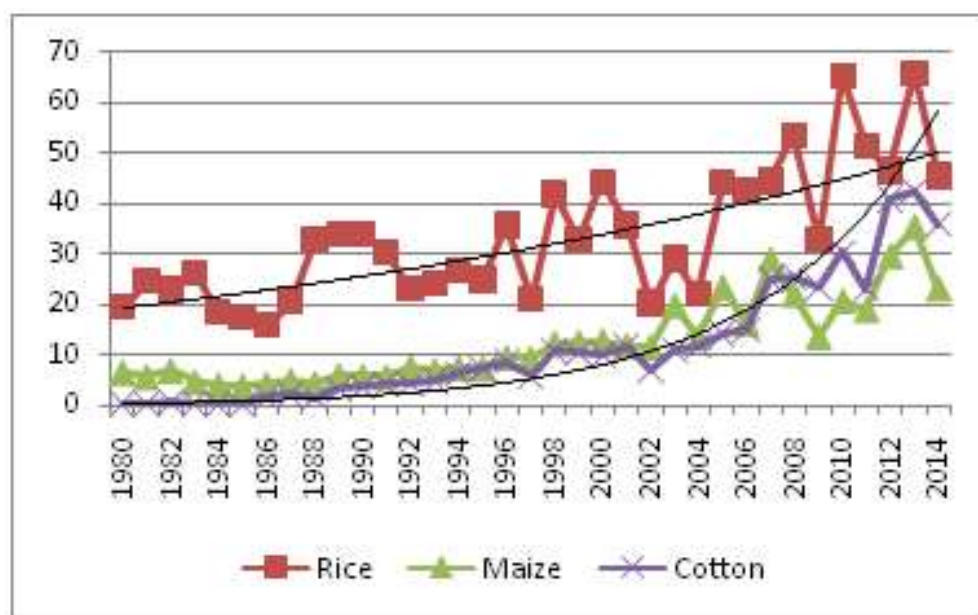
Source: Estimated

6. Growth of Production of Major Crops

As we have seen in the cropping pattern, the rice production has gradually replaced all coarse grains and millets in Telangana, became the foremost food crop in the region by 1995-

96 itself. What is interesting is in the past 35 years, the rainfall fell below normal for 14 years, leading to heavy fluctuations in area, yield and production. Such fluctuations are largest cotton, followed by maize and rice [fig 2]. The overall rice production has increased from 19.52 lakh tons in 1980-81 to 30.26 lakh tons in 1991-92 and to a peak of 65.81 lakh tons in 2013-14. The increase in rice production in the last 35 years has particularly gone up in the last phase of 2005-15, largely contributed by growth of area under Rabi. A relatively consistent monsoon during this phase has drawn huge swaths of land under paddy. Maize production increased from 6.7 lakh tons in 1980-81 to a peak of 35.12 lakh tons 2013-14, was the second biggest crop till 2008-09, is relegated to third. Cotton that became the second biggest crop had an accelerated growth during 2007-15. Tentatively we speculate that the moderately poor growth during 1995-05 and accelerated growth during 2005-15, both produced agrarian crises of different sorts. First phase was characterized by failure of bore wells, failures of crops and indebtedness, while later phase is by rise of cost of production, fall in relative prices, rise in indebtedness, except some price corrections carried out in specific years.

Figure 2. Production of Rice, Cotton and Maize (lakh tons)



Source: Dir of Economics and Statistics, AP

Table 8. Compound growth rate of Production of Major Crops

crop	1980-15	1980-94	1995-04	2005-15
<i>Area</i>				
rice	1.07***	0.22	-2.72	1.51
maize	3.03***	-1.02***	7.5***	1.64
groundnut	-2.68***	2.4**	-8.12***	-1.35
cotton	7.44***	9.46***	0.74	11.9***
Food grains	-0.8***	-2.65***	-0.68	-0.58

<i>Production</i>				
rice	2.83***	2.38	-1.71	2.52
maize	5.89***	1.79	7.23***	3.30
groundnut	0.007	3.6**	-6.5**	2.37
cotton	13.52***	22.9***	4.36	11.6***
Food grains	2.67***	0.912	0.92	2.10
<i>Yield</i>				
rice	1.74***	2.1***	1.04	0.99*
maize	2.78*	2.8**	-0.26	1.63
groundnut	2.77*	1.2	1.81	3.7***
cotton	5.61***	12.2***	3.6*	-0.35
Food grains	3.5***	3.6***	1.62	2.7*

Compound Growth rates estimated using double log regression over trend.

***, ** & * convey 1%, 5% and 10% levels of significance.

When examined the compound growth rates during different phases, the estimated growth rates once again convey that a faster phase of all the three major crops, namely, rice, cotton and maize are 1980-94 and 2005-15 [table 8]. The total food grain production growth rate has grown at 2.67 percent in the past 35 years during 1980-15 which is fairly high rate of growth of agriculture which is larger than the national average. This is achieved despite of decline of pulses and coarse grains/millets, but totally compensated by the growth of rice which grew at 2.83 percent. Growth during this phase is supported by not only area shift but yield growth as well in this phase. At the aggregate level, this is achieved by a growth rate of yield that grew at 3.5 percent, even though it lost area at rate of 0.88 percent. The decade between 1995-04 has been generally bad all crops for having 5 poor monsoon years, with exception to maize and groundnut, which was sustained by an area shift. Otherwise, the area and yield both dropped for rice and cotton. In the last decade during 2005-15, cotton production rose at an unprecedented annual rate of 11.6 percent during 2005-15, totally contributed by a rise in area 11.9 percent, despite yield rate dropped by -0.35 percent. The yield growth for most crops, except groundnut, has been stagnant; the growth rate is sustained by area increase alone. A consistent monsoon trail has a tendency to boost the well irrigation, thus can tremendously contribute to both Kharif and Rabi seasons, thus boosting paddy as well as cotton.

Table 9 : Mean and Dispersion of Area, Production and Yield of Major Crops

Crops	Mean	SD	CV
<i>Area</i>			
Rice	12.87	2.87	22.32
Maize	4.14	1.5	35.87
Groundnut	3.00	0.99	33.21
Cotton	6.6	4.75	71.97
Food grains	31.95	0.43	13.53

Production			
Rice	33.38	12.92	38.72
Maize	12.51	8.13	65.00
Groundnut	3.00	0.74	24.71
Cotton	11.57	11.66	100.73
Food grains	5.38	18.92	35.16
Yield			
Rice	2,518	476.05	18.91
Maize	2,74	89.3.7	32.53
Groundnut	1,083	374.7	34.61
Cotton	235	112.8	47.97
Food grains	1717	632.5	36.81

Source: Estimated

Such rainfall induced irrigation and area is likely to induce production instability. Cotton and maize, which are essentially dry land crops, show higher instability compared to rice. Cotton particularly shows a coefficient of variation of 100.73 percent, followed by maize 65 percent. Rice varies by 38.72 percent. The major source of variation for cotton and maize comes from area, by 71.9 and 35.87 percent respectively. Such large fluctuations are likely to cause large price fluctuations, making farmers lose heavily during the harvest failures as well as bumper harvests. It is important to analyze the sources of area fluctuation and stabilize it in the medium run for achieving a stable production [table 9].

7. Acreage response

Having seen the changing cropping pattern in Telangana region towards emergence of three principal crops namely, paddy, cotton and maize, we have estimated acreage response for these three crops. Acreage response hypothesizes that area under a crop is function of lagged price, irrigation/rainfall, fertilizer use, and lagged area. The Nerlovian specification can be written as :

(maize area) = $\alpha_0 + \alpha_1$ (lagged maize area) + α_2 (maize irrigated area) + α_3 (lagged maize price) + u_0

(cotton area) = $\alpha_0 + \alpha_1$ (cotton lagged price) + α_2 (cotton yield) + α_3 (well irrigated) + u_0

(rice area) = $\alpha_0 + \alpha_1$ (fertilizer) + α_2 (rainfall) + α_3 (rice lagged area) + α_4 (lagged paddy price) + u_0

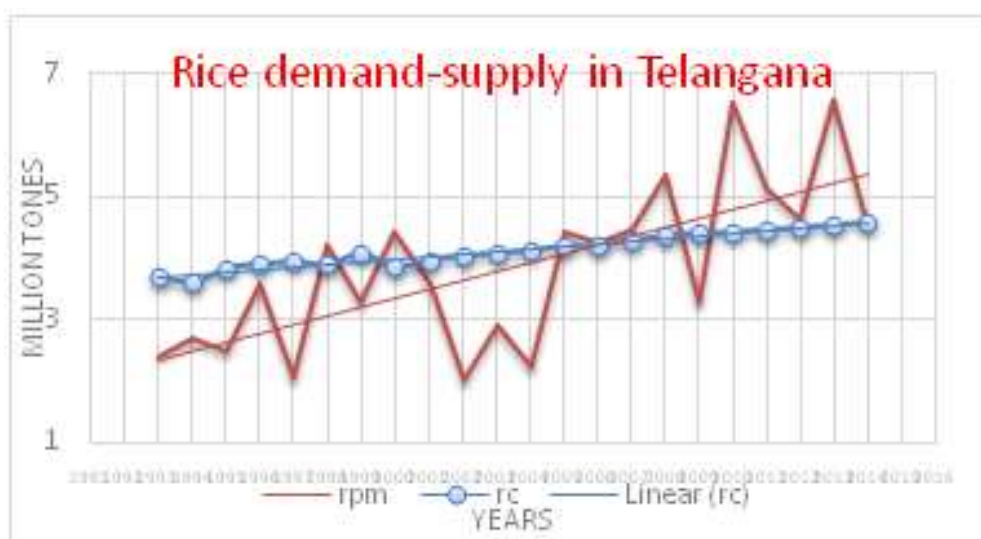
The estimated results are given in the table no.10. The acreage response is estimated in the Nerlovian augmented expectations model, where current acreage is a function of lagged acreage, lagged price and an institutional variable such as irrigation or rainfall. All the coefficients of independent variables are expected to have a positive sign. It is to be acknowledged that acreage decision is usually quite complex, involving crop specific aspects regarding stability, manageability, labour requirements, specific investments, etc. We have rather kept our exercise

at a simplistic level, note the need for a deeper probing. Our estimation of supply response found that in case of maize lagged area, irrigated area and lagged price are the statistically significant factors that influenced. As we observed earlier, maize demand has increased due to poultry industry. The elasticities are 0.53, 0.42, and 0.23 respectively. In case of cotton, the lagged price, yield and well irrigation expansion are the significant factors to influence the acreage. The elasticities are 0.41, 0.11 and 0.7 respectively. These two crops, being non-food crops, are typically responding to price factor principally. The well irrigation appears to have contributed to cotton expansion. For paddy crop the principal food crop influenced by lagged area in Telangana, rainfall and fertilizer use, but not price. It could appear peculiar for rainfall to be significant, but given the fact that Telangana has significant rabi production, and dependent on borewells, the groundwater level influenced by the rainfall almost determines the acreage. Even though it is largely believed that the procurement and minimum support price keeps the price stable, the market price is not found statistically significant in influencing acreage of paddy. Therefore, we conclude that the price factor is quite crucial for maize and cotton farmers in Telangana; paddy is now self-sustaining in its growth given the supply-side architecture built over period. These results are indicative of importance of some of the factors that govern the production.

Table 10 :
Acreage response of the Principal Crops in Telangana (1980-2015)

Particulars	coefficient	t- value	Rbar Square
<i>Maize</i>			
constant	5.23***	4.15	0.87
Lagged area	0.42***	4.82	
Irrigated area	0.53***	5.77	
Lagged price	0.23**	2.25	
<i>Cotton</i>			
Constant			0.78
Lagged price	0.41***	7.25	
yield	0.11**	2.42	
Well irrigation	0.70***	28.47	
<i>Paddy</i>			
constant	2.52*	1.78	0.84
Lagged area	0.335***	3.78	
rainfall	0.72***	9.17	
Fertilizer	0.405***	7.28	
Lagged Price	0.102	1.25	

Source: estimated.[***1%, ** 5%, *10% significance level]

Figure 3. Rice demand-supply of Rice in Telangana

Source: Estimated

8. Demand-Supply Comparison for Rice in Telangana

Having seen an impressive growth paddy production in Telangana, particularly in the last one decade, is a legitimate question to appraise its necessity. An elementary comparison is always with demand for rice in the paddy for its simple implication. We made an estimation of consumption demand for rice, using per capita consumption figure for rice from NSS data and blowing it for the population. This exercise produces some very interesting results. The production of rice in Telangana has been below its consumption during 1991-2004. From 2005-06, rice production distinctly and almost consistently surpasses the consumption levels of the region, except for exceptionally bad year of 2009-10 [see fig 3]. From 2010-11 onwards, it is way above the consumption. This means Telangana has emerged as rice surplus state and less dependence from the central pool. This also means, the market prices may tend to fall unless active procurement is undertaken by the state agencies. Therefore, it is not wise to promote paddy production in the state, which would only create problem of prices in the future. This further supports our argument that a greater diversification of crop production is to be encouraged.

Results and Discussion

Telangana is a new state with a challenge of revitalizing its agrarian sector. It is a sector which is ridden with a crisis of viability, manifesting in terms of farmers suicides. The roots of such crisis lies in the structure of its agriculture and the nature of the growth model. The strategy that is followed for 35 years will show apparent success in terms of achieving growth. A prominent feature of this growth story is a rise in gross sown area, in spite of rise in fallows and diversion of land use to non-farm purposes. Such an increase in gross sown area is contributed by rise in irrigated land, unfortunately led by the tubewell irrigation. The canal and

tank irrigation have declined mostly, except there has been little revival in canal irrigation in the recent past. This has resulted in tremendous instability in area under crops and production. Since, well irrigation is dominant source; the serious externality of this is the high area, crop and yield instability. The production rise has two important phases of growth, namely, 1980-94 and 2005-15. The phase in between is marked by a relative stagnation. Among these two phases, the first phase growth is contributed by both area as well as yield while the latter phase is marked by area shift alone. The wild fluctuations in output in these three major crops call for appropriate policy action to protect the farmers. The changes in land use and cropping pattern also have led to vulnerability of farming. There are only three prominent crops such as rice, cotton and maize which role to dominance, commanding 72 percent of area sown. Crop diversity has declined. This decreased menu of crops increases the vulnerability of farmers. In each of the normal monsoon year, the supply will overshoot the demand and results in glut. We have demonstrated this in case of paddy. We have shown that the rice production which has grown significantly in the past one decade, surpassed the domestic demand in most of the years, making the Telangana state a rice-surplus state. This has led to fall in the market prices and profitability of paddy.

For policy perspective two changes are obvious from our analysis. First, the water conservation methods using drip irrigation has to be adopted, since canal irrigation expansion alone is not adequate. Second, there appears a serious need for a cropping pattern change from these three crop combination to more diverse crops, particularly, crops like fruits and vegetables. Commercial crops like maize and cottons, acreage response are determined by prices and expectations, whereas, for food crops, irrigation, rainfall, fertilizer and power would be much more important. However, there is a need to discourage paddy, since finding markets would be difficult. Diversification of farming into millet, fruits and vegetables would be a better choice, than encouraging farmers to grow only rice. The analysis of this paper, however, should be taken in the larger picture of institutional changes and policy to encourage a stable growth of agriculture.*

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Changing Perspectives in Development Economics: A Critical Appraisal

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ABSTRACT

Development Economics as a discipline has emerged to deal with the economic development in less developed countries. The post-colonial nations after the World War II made an attempt to build capitalist development with strategies of rapid industrialization. Several models of development were developed identifying certain key processes that can help acceleration of industrialization, with the help of an interventionist state. The experience of achieving development based on these models had mixed results. However, with decline of Keynesian economic and rise of neoliberalism in the developed countries led to an ideological attack on the development economics and its core assumptions. Yet, they could not dislodge some of the fundamental concerns of poor countries such as poverty alleviation from the discourse. This paper makes a critical review of these developments, which helps one to understand the changing perspectives in the literature.

Key words: Development Economics, Neoliberalism, Keynesian, economics, Neo-Marxist Critique

Introduction

Economics is largely understood as a branch of economics that focuses exclusively on economic development of 'backward'/'traditional'/'poor' countries with and without role of state in accelerating the process. It largely arose in the context of reconstruction of Europe which was ravaged by the World War II, but quickly adopted for poor countries. It was hailed as the pioneering and frontier discipline for about three decades by the mainstream thinking before a scathing and damning attack that was mounted since late seventies. The death of Development Economics was perhaps even announced

by mid-nineties, where it is declared that there cannot be more than one economics for all economies. How do we understand this drastic about turn in the global understanding? This paper makes an attempt to map the trajectory of development theory and its purported twilight. This in my opinion needs a critical appreciation of key contestations in understanding of capitalist economies. The present paper makes an appraisal of conditions in which development economics was conceived, different critiques and reasons for the decline of discipline.

State and Laissez Faire Economic

It is, perhaps, customary to begin with ideas of Adam Smith, who is often considered as the father of modern economics. In *Wealth of Nations*, Adam Smith extolled the virtues of *homo sapiens* of having the natural ability to *truck, barter and trade*, which no other animal possesses. The division of labour, invisible hand, capital formation, private property rights and law enforcement should spin natural course of growth and development. Comparative advantage and free trade are added as further stepping stones to growth by David Ricardo. Both of them were writing in times of Colonialist Imperialism of the emerging capitalist West, led by Great Britain, which finds little mention about the plunder and systematic drain of surplus that was feeding the division of labour and capital formation of Britain and France. Nor was the underdevelopment or lack of development in the Colonies a concern for Smith and Ricardo. One finds mention in the writings of Marx, about the colonial plunder in his journalistic pieces to New York Tribune. Marx apparently considered colonialism to plant the seeds of capitalist transformation from introducing private property and forced commercialization in his thesis on *uneven and combined development*. In the writings of all these three Classical thinkers, there is little mention of state as an active agent of capital formation and transformation.

A much more honest account of building capitalist economy came from German Historical School, a foremost writer of its views being Frederick List, who was advocating the interests of the latecomer to capitalism –the Prussian Empire since 1840s. He was clear that there is a historical process involved in the evolution of capitalist economy in its progress from pastoral to agrarian to industrial economy. When demands for workers rights and public utilities arise which have to come from taxes paid by the industry, he saw the need to protect the interests of the industry. Needless to mention that from French

Revolution to World War II, all wars in Europe fought for the interest of the bourgeois class and its markets. He rejected the Ricardian argument of free trade explicitly. To quote him:

“[A]ny nation which by means of protective duties and restrictions on navigation has raised her manufacturing power and her navigation to such a degree of development that no other nation can sustain free competition with her, can do nothing wiser than to throw away these ladders of her greatness, to preach to other nations the benefits of free trade, and to declare in penitent tones that she has hitherto wandered in the paths of error, and has now for the first time succeeded in discovering the truth” [List (1833)]¹

In the recent book *Kicking Away the Ladder*, its author Ha-Joon Chang (2008)² brings back the intellectual history of *infant industry* argument espoused by List. Gustav Schmoller, another exponent of German Historical School extensively wrote about the need for state intervention in harmonizing the interests of different classes of the capitalist society. His views have greatly influenced Japanese Meiji Restoration, which compelled to put down feudal classes and promote capitalist class interests. German Historical School actively engaged in serious sparring with the *Austrian School*, espoused by Bom Bowerk, Von Mises, Carl Menger initially and later by F.von Hayek. Austrian School actively argued for free trade without any state intervention, as a true inheritor of Smithian ideas. This clash between them during 1880-1910 was known as *Methodenstreit* (which means clash of methods), as a conflict between historical inductive method of the former versus the deductive and axiomatic methods of Austrians and later neoclassicals. The underlying tension was about the role of the state. When does the role of state becomes so contentious? It happens when capital in some countries reaches the stage of finance capital. Finance capital compels globalization and calls for removal of all kinds of protectionist measures. As long as industrial capital is in fledging stage, it calls for greater state intervention to protect its interests, but once it graduates into monopoly capital and gets subordinated to global finance capital, then state loses its power as arbiter of class interests within the nation-state.

¹ *The National System of Political Economy*, by Friedrich List, 1841, translated by Sampson S. Lloyd M.P., 1885 edition, Fourth Book, "The Politics", Chapter 33.

² Chang, Ha-Joon. *Kicking Away the Ladder: How the Economic and Intellectual Histories of Capitalism Have Been Re-Written to Justify Neo-Liberal Capitalism*, CUP, 2008.

Keynesian Revolution and role of State

The World Depression of 1929 has brought back the issue of state intervention into the discourse and policy. John Maynard Keynes identified the 'effective demand' failure as cause macroeconomic disequilibrium that had caused extremely serious levels of unemployment and contraction of the economy. Keynes supported the massive public works programs of Lloyd George's government in UK and Roosevelt's government in US in 1930, against the Treasury View which is a fiancé or monetary view. Hitler too undertook massive public works after his arrival into power in 1932 and built the famous *Autobahns* which will be later to be used for plying tanks for World War II. Anne Krueger and Milton Friedman, the *bête noire* of Keynesism, concluded that the Federal Bank's delay in replacing the money that was destroyed during 1929 stock market crash was the cause of Depression, not the demand failure. This line of argument was subsequently made popular by the Rational Expectation School, New Classical School, Real Business Cycle school, remained the canons of attack on state intervention until the Financial Crisis of 2009 [Snowden and Vane 2005].

Evolution of Development Economics

The actual context of many of the Development Theories such as Big Push and Balanced Growth have actually arose was in the context of European reconstruction in the post World War II era, where Rodan was working with UN mission was suggesting that all industries needed to be started at one go rather in piece meal fashion, since they are interdependent. When Harry Truman had announced that United State America would help the poor nations and would not let them suffer poverty, by offering Foreign Aid, the Truman Doctrine gave post-colonial countries some elbowroom to plan their national development, and promoting their industry, as bait not to join the Soviet sphere of influence.

We are familiar with at least four variants of development theories. Lewisian model (1954), espoused by the Jamaican LSC-trained economist, Arthur Lewis, explores into the possibility of a continuous growth through private investment in modern industry, as the real wage would remain constant until all the surplus labour in the traditional sector is absorbed by the former. Rosenstein-Rodan envisaged a big push in terms of raising massive dose of overall investment distributed a wide range of industries. The problem of

development eventually gets reduced to problem of growth, in turn as problem of raising the necessary saving. This gets more explicitly clear in Ragnar Nurkse's proposition that raising the savings rate to meet the necessary minimal rate of investment that push the economy out low level trap. While Nurkse favored a balanced investment across sectors and industry, Albert Hirschman prefers the alternative course of unbalanced approach, taking advantage of forward sectors in the economy. The common aim of all these models is to shorten the time span taken in building a capitalist economy by the Western capitalist economies, and show the possibility of catching up with them. They do not make any explicit mention of state intervention favorably or unfavorably, suggesting ownership of enterprise by public or private does not matter. It is the capital accumulation that is the sole determinant of capitalist growth. It becomes a corollary that in the absence of private capital, it becomes imperative for the state to build capital formation by raising the savings. The Keynesian legacy is implicit in the sense that state intervention is preferable given the unpredictability of 'animal spirits' to cause effective demand failures; is necessary by default to solve the problem of structural underemployment given its enormous power to mobilize resources (Mihir Rakhit 2011).

A significant variant in Development theory that merits a special mention is that of Gunnar Myrdal. Myrdal is a lone voice raised the concerns of this developmental process unleashed by investment-led growth process and also necessary institutional mechanisms for a responsible growth process. I would mention two aspects of Myrdal's contribution, first the issue of regional inequality. Myrdal perhaps was the first to recognize the undemocratic nature of growth process, where capital rich advanced areas will grow at increasing rate resulting from cumulative causation of growth process through the so-called spread effects one hand, backward regions becoming wastelands of developments through what he called 'backwash effects'. The second aspect is that he had emphasized the role of social and political factors in shaping the institutional ecology of development. Myrdal, albeit uncomfortably, expressed his strong view to introduce a social reform to espouse a modern culture of consciousness of public propriety, elimination of feudal values, corruption in public offices, spread of education etc in his *Asian Drama: An Inquiry into Poverty of Nations* (1968). This was perhaps the earliest ideas of human capital argument.

Development theories also favored planning by the state as the central means to achieve the gigantic process of mobilization of savings and channeling them into public and private sectors. Indian planning epitomized this strategy of building accelerated growth and development. Mahalanobis model provided handle to initiate the big push for the acceleration of growth rate, based on heavy industry strategy which is an allegory to two-department schema of Marx and Kalecki. I would not go into the judgment about how far development theory is successful in engendering growth and development. Everyone may agree on the understanding over the obstacles that surfaced as the planners began implementing the ideas of development. Sukhomoy Chakraborty has given a brilliant summary on the kinds of constraints that Indian planners faced in the first three decades of Indian Planning period. The foreign exchange constraint, the financial resource constraint, agricultural constraint, and information constraint for planning are explained well in his work. However, the development theory has certainly rejected the mainstream prescription of free trade and comparative advantage theories. Advocated the industrialization as the do-or-die strategy to achieve development, so not to end up as primary goods exporting nation. A lesson that they learned well from Singer-Prebisch school of Latin American Structuralism. How far they succeeded in become industrial economies could be a matter of debate and judgment certainly depends on parameters one sets to judge. All theories have of their moments of glory and twilight. One is only to understand why a school of thought fades away and what does it mean.

What did Development Theory represent? Will of the people? Will of the state? Or will of the emerging bourgeoisie of the newly independent states? Perhaps some or indeed lot of confusion for an ordinary student arises from the very term 'development' itself. It couches a universal sense of the term, while in concrete conceals lot more. It works hard to conceal the project of building 'capitalist development', and in the era of liberal electoral democracy, it is invoked as universal term. It betrays the same hypocrisy of 'common wealth' that Great Britain talked about during the entire era of colonialism, 'National Prosperity' that Prussian Empire referred to and now we refer to 'National Income' while it essentially means to boost the profits of the capitalists, and the incomes of the rest of the classes would result from the 'trickle down', and 'spill over'. Was it objective and realist enough in building the capitalist accumulation, even if we identify it that way?

Marxian and Neo-Marxian Critiques

The limits of development theory were critiqued by the Marxists long before it received criticism from the mainstream. Marxists understand that capitalist development is historically inevitable phase of development for every society. One only has to be clear about the process of class formation and constraints to capital accumulation, which becomes building blocks for conceiving the class struggle. Two most planks of criticism of the development theory (DT) were the first, it did not appreciate the need to remove the obstacles that remnants of feudal forces that have remained due to incomplete bourgeois revolution. The industrial capital had to compromise with feudal forces, pass on rental factor to the latter, state could not tax the latter who hid behind protection for small farmers. The second criticism was that DT did not appreciate the external factor, i.e., role of imperialism. These two factors have considerably reduced the growth potential of the economies. However, besides these, there is another major condition that post-colonial capitalist development faces. The Western capitalist development happened under imperialist conditions, pre-liberal democracy regimes and colonies in the New World of Americas and Australia, the capitalist development of post-colonial economies have happen under nation-states, liberal democracy, intensely global competitive conditions and lack of migration avenues of burgeoning populations [Rajni 1997].

Feminist Critique

By seventies, there is another wholly new dimension of criticism that has developed against in economic theory in general, which is becomes applicable to development theory as well. It is the feminist critique. Ester Boserup in 1974 has made a strident observation that in Asiatic and African agriculture, it is the woman of the household that overwhelmingly participates, bears the double burden of housework and work outside. This idea was further taken ahead by Maria Mies, to show how economies underreport the contribution of women by not recognizing the house work, which she calls as 'reproductive' work vis-à-vis 'productive' work that is formally recognized. Reproductive work is the subsistence activity of the household which draws from her naturally given ability to give child birth, and compulsive caretaker of family under patriarchy. Further, she is pushed into labour market to become the physically inferior, low skilled, less productive, hence lowly paid worker, which is employed intensively by the industry to maximize its capital accumulation. The specific conditions as women they face given the division

of domestic and productive work, are yet to be recognized by employers, state and male-dominated workers unions. There is a whole international division of labour that develops, not only in agriculture, but also semi-skilled and low-skilled manufacturing sectors, super-exploiting the female labour. It's a different matter that World Bank has hijacked this concept of 'Women in Development', made women as agent of transformation through self-help groups, where she becomes honest and trust worthy borrower, to carry the yoke of family burden as well as the nation's burden. The gender critique has opened a different dimension of development, which the later day development theories had to focus on [Srivatsan 2009].

The Neoliberal Critique

The strong and lasting body blow to development economics came from neoclassical and neoliberal economic theory. They have criticized that while market failure could be a reality, on which development theory built its etatist theory, the state failure is bigger reality to execute the lofty goals of development. Second, they criticized that public sector suffers principal-agent problem, that leads to non-accountability, red-tapism, and corruption. The rent seeking activities that happen under rationing and licensing would only lead to inefficient monopolies. Vested interest groups emerge to capture the state, to make the economies inefficient, stagnating, high inflation economies with high degrees of poverty. Planning suffers from information asymmetry and hence private planning can cope better than social planning. It further argued that development economics is a naïve theory, built on 19th century understanding of global conditions than the contemporary ones. Neoliberal attack on development economics did not remain in rhetoric, but has translated in patronage and funding for the school to fade in the American and European universities.

Reclaiming Development Economics

While development theories were coming under flak from the neoliberal economics over the role of the state, Amartya Sen (1983) has open a new dimension that was no one thought. It is a unique dimension of an individual diversity in a society. While neoclassical economics talks about the individual, it treats everyone the same in its representative individual. But individuals are different by gender, age, ability, class, religion, and psychological orientation. Therefore different individuals need different entitlements, capabilities and freedom. He strongly advocates a strong public action to address serious

deprivations in food, education and employment to provide for capabilities and entitlements. Thus he reinstates certain welfare measures as indispensable to any state, whether left wing or right wing. While being an ardent supporter of neoliberal reforms, Sen manages to articulate a strong welfarist position, besides laying emphasis on liberal society that respects debate and dialogue to solve social conflicts rather than authoritarian approaches. One can understand the influence of his ideas even on World Bank which has decided to finance micro-credit program, girl child education, and vaccination while funding neoliberal programs like power sector reforms and privatization.

Conclusion

The trajectory of development economics needs to be read along with global conditions of capitalist development. Development economics provided the theory of capitalist transformation in the early post-War period, reflecting aspirations of building national capitalism, focusing on home markets and industrialization, through raising savings and investment rates. However, the practice of development economics taught several lessons in terms of constraints and limitations of conditions of post-colonial capitalism. While it had inherited the *etatist* traditions existed within the economic theory, the decisive role of state is seldom accepted by the finance capital and monopoly capital. When Soviet Union fell and capital wanted to globalize, developing countries were compelled to abandon the strategy of national development, the change in policy was preceded by an intellectual attack on the theory. One should not lose sight of the fact that the pious intention of development economics was also none else than building a capitalist economy. One can lament that people lost power to negotiate with their own government over policies which are now dictated by global conditions. Since, conditions of autonomy are lost due dependence on global financial markets, development theories stands as an ancient windmills of the bygone era.

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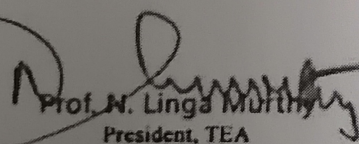


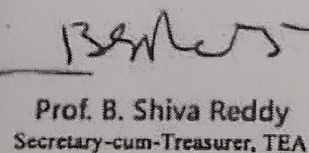
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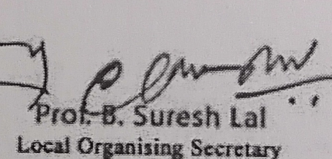
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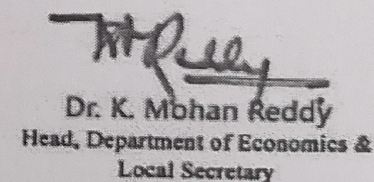
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File name: Dastageer_Draft_7_Final_version.docx (370.68K)

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