JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

# FUTURE OF AGRICULTURE SYSTEM AND TRANSFORMATION IN KARNATAKA

***Dr.Manjunath B. Tallur, Assistant Professor of Economics, Priyadarshini First Grade College, Rattihalli.**

****Smt. Roopa.S.Churi, Research Scholar, Dept. of Economics, Karnatak University, Dharwad.**

**ABSTRACT:**

Agriculture in India is livelihood for a majority of the population and can never be underestimated. Although its contribution in the gross domestic product (GDP) has reduced to less than 20 per cent and contribution of other sectors increased at a faster rate, agricultural production has grown. This has made us self-sufficient and taken us from being a begging bowl for food after independence to a net exporter of agriculture and allied products. Karnataka's Farmers have been facing several issues ranging from improper technology to agricultural loan debts. Karnataka is a vast state with varied topography, while there are agriculturally prosperous regions; some regions are severely affected by the frequent droughts. This study is an attempt to sketch out the future trends and opportunities for the transformation of agriculture in Karnataka. This study is purely based on secondary data sources and is descriptive in nature.

**Key Words:** Agriculture, Farming, Karnataka, Output.

## INTRODUCTION:

Karnataka's economy is largely dependent on the revenue generated from the IT sector, as major cities including capital Bangalore have become a major hub for IT industry. But on the other hand, agricultural sector's growth has been on a downward trajectory, as droughts are becoming a common event in various regions across Karnataka, while Northern Karnataka region is the worst affected region of the state. Although a state budget allocation of Rs. 3823 crore for the year 2017-18, the 2/3rd of the agricultural production in the state is still dependent on rainfall. Any delay in the rainfall or zero-rainfall, will affect the majority of farming communities in Karnataka due to lack of water management system and state's inadequacy to implement the policies to improve the condition of the agricultural sector.

Although we all currently rely on industrial agriculture to produce the majority of the food we eat, this type of agriculture is facing problems that may threaten its future. Two of the most major problems in agriculture are the loss of agricultural land and the decrease in the varieties of crops and livestock produced. One of the major problems facing agriculture is the loss of agricultural land, because as more land is lost, it will become more difficult to produce the amount of food needed to feed the growing human population.

Worldwide, around three million hectares of agricultural land are lost each year because the soil degrades and becomes unusable due to erosion, which is when soil components move from one location to another by wind or water. An additional four million hectares are lost each year when agricultural land is converted and used for highways, housing, factories, and other urban needs. The trends in the loss of agricultural lands do not look promising for the future of agriculture in the world. Another major problem in agriculture is the overall decrease in the varieties of crops and livestock produced.

## REVIEW OF LITERATURE:

Batla (2008) studied the regional dimensions of inter-crop diversification in India and observed that inter-crop area shifted in favour of high yielding crops like wheat, paddy, oilseeds, cotton and sugarcane, up to eighties and towards paddy, sugarcane, fruits- vegetables, fibres, plantations, condiments and spices during the nineties and early 2000. The area under wheat and paddy had expanded solely at the cost of low yield growth crops like coarse cereals and pulses due to price support and HYV programme.

Rajni et al. (2009) found that Variations in agricultural productivity in different states across the country are mainly due to large differences in the level of adoption of selected agricultural technologies and the underlying determinants of adoption of these technologies. Agricultural technologies selected in this study include high-yielding varieties of seeds, chemical fertilizers, pesticides, use of machinery, etc.

Pisani and Giorgio (2011) presented a paper on “Evaluation of social capital promotion in rural developmental programmes: a methodological approach” in which they opine that many of the past literature shows the importance of consistent immaterial contribution of LEAD approach (LA) in the promotion of social capital in rural areas. Therefore the insert of LA in the framework of Rural Development Programmes (RDPs) should be considered a powerful opportunity to promote rural development initiatives by means of a bottom methodology, much more focused on social relationships among local actors.

## OBJECTIVE OF THE STUDY:

To present an overview of agriculture in Karnataka, its current status, challenges, future trends and opportunities.

## STATUS OF AGRICULTURE IN INDIA:

Total foodgrain production in the country is estimated to be a record 291.95 million tonnes, according to the second advance estimates for 2019-20. This is news to be happy about but as per the estimates of Indian

Council for Agricultural Research (ICAR), demand for foodgrain would increase to 345 million tonnes by 2030. Increasing population, increasing average income and globalisation effects in India will increase demand for quantity, quality and nutritious food, and variety of food. Therefore, pressure on decreasing available cultivable land to produce more quantity, variety and quality of food will keep on increasing.

India is blessed with large arable land with 15 agro-climatic zones as defined by ICAR, having almost all types of weather conditions, soil types and capable of growing a variety of crops. India is the top producer of milk, spices, pulses, tea, cashew and jute, and the second-largest producer of rice, wheat, oilseeds, fruits and vegetables, sugarcane and cotton.

In spite of all these facts, the average productivity of many crops in India is quite low. The country's population in the next decade is expected to become the largest in the world and providing food for them will be a very prime issue. Farmers are still not able to earn respectable earnings. Even after over seven decades of planning since the independence, majority of the farmers are still facing problems of poor production and/or poor returns.

Along with this, the information technology revolution in India, new technologies in agriculture, private investments especially on research and development, government efforts to rejuvenate the cooperative movement to address the problems of small holdings and small produce etc are changing face of agriculture in India. Many startups in agriculture by highly educated young ones show that they are able to understand the high potential of putting money and efforts in this sector. Cumulative effects of technology over the next decade will change the face of agriculture. All the constraints in agriculture make the productivity and returns complex but still a high untapped potential is there in India's agriculture sector.

Advantageous weather and soil conditions, high demand for food, untapped opportunities, various fiscal incentives given by the government for inputs, production infrastructure, availability of cheap credit facilities and for marketing and export promotion are attracting many individuals, big companies, start-ups and entrepreneurial ventures to do a lot of investments on innovations, inventions, research and development and on other aspects of business.

**MAJOR CONSTRAINTS IN INDIAN AGRICULTURE:**

- According to 2010-11 Agriculture Census, the total number of operational holdings was 138.35 million with average size of 1.15 hectares (ha). Of the total holdings, 85 per cent are in marginal and small farm categories of less than 2 ha (GOI, 2014).
- Farming for subsistence which makes scale of economy in question with majority of small holdings.
- Low-access of credit and prominent role of unorganised creditors affecting decisions of farmers in purchasing of inputs and selling of outputs
- Less use of technology, mechanisation and poor productivity for which first two points are of major concern

- Very less value addition as compared to developed countries and negligible primary-level processing at farmers level.
- Poor infrastructure for farming making more dependence on weather, marketing and supply chain suitable for high value crops.
- Future of agriculture is a very important question for the planners and all other stakeholders. Government and other organisations are trying to address the key challenges of agriculture in India, including small holdings of farmers, primary and secondary processing, supply chain, infrastructure supporting the efficient use of resources and marketing, reducing intermediaries in the market. There is a need for work on cost-effective technologies with environmental protection and on conserving our natural resources.

**STATUS OF AGRICULTURE IN KARNATAKA:**

Experts have listed the important outcomes of our inappropriate and haphazard development policies due to greed, corruption, poor governance, and corporate influence on governance, and ignoring agriculture in Karnataka. This situation is similar in many states of India. In fact, as shown below, an unprecedented agrarian crisis is developing in the country due to continuous neglect of agriculture and least or no support to farmers by successive governments; Karnataka is not an exception to this trend.

The mean farm size is 0.5 hectare and that too scattered in 5 to 10 small plots. The small holding size will not produce enough food to support the family. Such small holders constitute the vast majority of farmers in many states including Karnataka. Because they are scattered individuals, they have little or no bargaining power or political influence in securing loans from scheduled banks (fewer than 4% of small holders have agricultural credit cards) and very few smallholder farmers carry crop insurance against natural calamities, etc. In addition, smallholders are especially vulnerable to climate change-aggravated weather events, like declining rainfall, untimely rains (especially at harvest times), severe droughts and floods, hailstorms and pest infestations, any of which can wipe out their crops. In addition, there decreasing water flows in the main Cauvery River due to deforestation and destruction of vegetation in the watersheds of the river Cauvery.

Smallholder farmers also continue to suffer from market uncertainties as most agricultural policies (and institutional support) tend to favour large farmers and agricultural or food corporations, e.g., industrial agriculture receives 80% of the farm subsidies and 90% of any research funds.

There is very little development outside Bengaluru and Mysuru, and the people in rural areas of Karnataka suffer from many forms of deprivation. Owing to lack of opportunities in rural areas, youngsters tend to move out of villages to cities in search of jobs and end up in slums. There is increased occurrences of petty thefts and other crimes due to growing poverty.

All of the above constitute an unprecedented agrarian crisis and over the last two decades it has resulted in most (87%) rural households suffering from extreme poverty and serious deprivations. Many rural smallholders and landless laborers suffer from poverty, malnutrition, dispossession of land assets by the greedy developers (especially near big cities), and death.

**PROBLEMS IN THE KARNATAKA AGRICULTURE SECTOR:**

Some of the major problems and their possible solutions have been discussed as follows. Indian agriculture is plagued by several problems; some of them are natural and some others are manmade.

**1. Small and fragmented land-holdings:**

The seemingly abundance of net sown area of 141.2 million hectares and total cropped area of 189.7 million hectares (1999-2000) pales into insignificance when we see that it is divided into economically unviable small and scattered holdings. The average size of holdings was 2.28 hectares in 1970-71 which was reduced to 1.82 hectares in 1980-81 and 1.50 hectares in 1995-96. Hence, there is a wide gap between small farmers, medium farmers (peasant group) and big farmers (landlords). The main reason for this sad state of affairs is our inheritance laws. The land belonging to the father is equally distributed among his sons. Different tracts have different levels of fertility and are to be distributed accordingly. Sub-division and fragmentation of the holdings is one of the main causes of our low agricultural productivity and backward state of our agriculture. A lot of time and labour is wasted in moving seeds, manure, implements and cattle from one piece of land to another. Irrigation becomes difficult on such small and fragmented fields. Further, a lot of fertile agricultural land is wasted in providing boundaries. Under such circumstances, the farmer cannot concentrate on improvement.

The only answer to this ticklish problem is the consolidation of holdings which means the reallocation of holdings which are fragmented, the creation of farms which comprise only one or a few parcels in place of multitude of patches formerly in the possession of each peasant. The other solution to this problem is cooperative farming in which the farmers pool their resources and share the profit.

**2. Seeds:**

Seed is a critical and basic input for attaining higher crop yields and sustained growth in agricultural production. Distribution of assured quality seed is as critical as the production of such seeds. Unfortunately, good quality seeds are out of reach of the majority of farmers, especially small and marginal farmers mainly because of exorbitant prices of better seeds. In order to solve this problem, the Government of India established the National Seeds Corporation (NSC) in 1963 and the State Farmers Corporation of India (SFCI) in 1969. Thirteen State Seed Corporations (SSCs) were also established to augment the supply of improved seeds to the farmers. High Yielding Variety Programme (HYVP) was launched in 1966-67 as a major thrust plan to increase the production of food grains in the country. The Indian seed industry had exhibited impressive growth in the past and is expected to provide further potential for growth in agricultural production: The policy statements are designed towards making available to the Indian farmer, adequate quantities of seed of superior quality at the appropriate time and place and at an affordable price so as to meet the country's food and nutritional security goals. Indian seeds programme largely adheres to limited generation system for seed multiplication. The system recognises three kinds of generation, namely breeder, foundation and certified seeds. Breeder seed is the basic seed and first stage in seed production. Foundation seed is the second stage in seed production chain and is the

progeny of breeder seed. Certified seed is the ultimate stage in seed production chain and is the progeny of foundation seed. Production of breeder and foundation seeds and certified seeds distribution have gone up at an annual average rate of 3.4 per cent, 7.5 per cent and 9.5 per cent respectively, between 2001-02 and 2005-06).

**3. Manures, Fertilizers and Biocides:**

Indian soils have been used for growing crops over thousands of years without caring much for replenishing. This has led to depletion and exhaustion of soils resulting in their low productivity. The average yields of almost all the crops are among the lowest in the world. This is a serious problem which can be solved by using more manures and fertilizers. Manures and fertilizers play the same role in relation to soils as good food in relation to body. Just as a well-nourished body is capable of doing any good job, a well nourished soil is capable of giving good yields. It has been estimated that about 70 per cent of growth in agricultural production can be attributed to increased fertilizer application. Thus increase in the consumption of fertilizers is a barometer of agricultural prosperity. However, there are practical difficulties in providing sufficient manures and fertilizers in all parts of a country of India's dimensions inhabited by poor peasants. Cow dung provides the best manure to the soils. But its use as such is limited because much of cow dung is used as kitchen fuel in the shape of dung cakes.

The fertilizer problem is, therefore, both acute and complex. It has been felt that organic manures are essential for keeping the soil in good health. The country has a potential of 650 million tonnes of rural and 160 lakh tonnes of urban compost which is not fully utilized at present. The utilization of this potential will solve the twin problem of disposal of waste and providing manure to the soil. As a result of initiative by the government and due to change in the attitude of some progressive farmers, the consumption of fertilizers increased tremendously. In order to maintain the quality of the fertilizers, 52 fertilizer quality control laboratories have been set up in different parts of the country. In addition, there is one Central Fertilizer Quality Control and Training Institute at Faridabad with its three regional centres at Mumbai, Kolkata and Chennai. Pests, germs and weeds cause heavy loss to crops which amounted to about one third of the total field produce at the time of Independence. Biocides (pesticides, herbicides and weedicides) are used to save the crops and to avoid losses. The increased use of these inputs has saved a lot of crops, especially the food crops from unnecessary wastage. But indiscriminate use of biocides has resulted in wide spread environmental pollution which takes its own toll.

**4. Irrigation:**

Although India is the second largest irrigated country of the world after China, only one-third of the cropped area is under irrigation. Irrigation is the most important agricultural input in a tropical monsoon country like India where rainfall is uncertain, unreliable and erratic India cannot achieve sustained progress in agriculture unless and until more than half of the cropped area is brought under assured irrigation.

**5. Lack of mechanisation:**

In spite of the large scale mechanisation of agriculture in some parts of the country, most of the agricultural operations in larger parts are carried on by human hand using simple and conventional tools and implements like wooden plough, sickle, etc. Little or no use of machines is made in ploughing, sowing, irrigating, thinning and pruning, weeding, harvesting threshing and transporting the crops. This is specially the case with small and marginal farmers. It results in huge wastage of human labour and in low yields per capita labour force. There is urgent need to mechanise the agricultural operations so that wastage of labour force is avoided and farming is made convenient and efficient. Agricultural implements and machinery are a crucial input for efficient and timely agricultural operations, facilitating multiple cropping and thereby increasing production. Some progress has been made for mechanising agriculture in India after Independence. Strategies and programmes have been directed towards replacement of traditional and inefficient implements by improved ones, enabling the farmer to own tractors, power tillers, harvesters and other machines. A large industrial base for manufacturing of the agricultural machines has also been developed. Strenuous efforts are being made to encourage the farmers to adopt technically advanced agricultural equipments in order to carry farm operations timely and precisely and to economise the agricultural production process.

**6. Soil erosion:** Large tracts of fertile land suffer from soil erosion by wind and water. This area must be properly treated and restored to its original fertility.

**7. Agricultural Marketing:** Agricultural marketing still continues to be in a bad shape in rural India. In the absence of sound marketing facilities, the farmers have to depend upon local traders and middlemen for the disposal of their farm produce which is sold at throw-away price. In most cases, these farmers are forced, under socio-economic conditions, to carry on distress sale of their produce. The Rural Credit Survey Report rightly remarked that the producers in general sell their produce at an unfavourable place and at an unfavourable time and usually they get unfavourable terms. In the absence of an organised marketing structure, private traders and middlemen dominate the marketing and trading of agricultural produce. Many market surveys have revealed that middlemen take away about 48 per cent of the price of rice, 52 per cent of the price of grounduts and 60 per cent of the price of potatoes offered by consumers. Therefore, the government has come out with regulated markets. These markets generally introduce a system of competitive buying, help in eradicating malpractices, ensure the use of standardised weights and measures and evolve suitable machinery for settlement of disputes.

**8. Inadequate storage facilities:** Storage facilities in the rural areas are either totally absent or grossly inadequate. Under such conditions the farmers are compelled to sell their produce immediately after the harvest at the prevailing market prices which are bound to be low. Such distress sale deprives the farmers of their legitimate income. The Parse Committee estimated the post-harvest losses at 9.3 per cent of which nearly 6.6 per cent occurred due to poor storage conditions alone. Scientific storage is, therefore, very essential to avoid losses and to benefit the farmers and the consumers alike. At present there are number of agencies engaged in

warehousing and storage activities. The Food Corporation of India (F.C.I.), the Central Warehousing Corporation (C.W.C.) and State Warehousing Corporation are among the principal agencies engaged in this task. These agencies help in building up buffer stock, which can be used in the hour of need.

**9. Inadequate transport:** One of the main handicaps with Indian agriculture is the lack of cheap and efficient means of transportation. Even at present there are lakhs of villages which are not well connected with main roads or with market centres. Most roads in the rural areas are Kutcha (bullock- cart roads) and become useless in the rainy season. Under these circumstances the farmers cannot carry their produce to the main market and are forced to sell it in the local market at low price. Linking each village by metalled road is a gigantic task and it needs huge sums of money to complete this task.

**10. Scarcity of capital:** Agriculture is an important industry and like all other industries it also requires capital. The role of capital input is becoming more and more important with the advancement of farm technology. Since the agriculturists' capital is locked up in his lands and stocks, he is obliged to borrow money for stimulating the tempo of agricultural production. The main suppliers of money to the farmer are the money-lenders, traders and commission agents who charge high rate of interest and purchase the agricultural produce at very low price. The money lender is losing ground but is still the single largest contributor of agricultural credit. Rural credit scenario has undergone a significant change and institutional agencies such as Central Cooperative Banks, State Cooperative Banks, Commercial Banks, Cooperative Credit Agencies and some Government Agencies are extending loans to farmers on easy terms. There has been a steady increase in the flow of institutional credit to agriculture over the years.

## FUTURE PLANS AND PROGRAMMES FOR TRANSFORMATION OF AGRICULTURE IN KARNATAKA:

Government of Karnataka has been striving for the promotion and development of agriculture in India. One of its institutions called Karnataka Agriculture Product Processing & Export Corporation Limited ( KAPPEC ) has undertaken several plans and policy programmes for the transformation of agriculture in Karnataka which are listed as follows:

- Plans to enhance the trading both in domestic as well as overseas markets for the benefit of farmers to help them to realise a fair return for their produce of KAPPEC.
- Plans to create post-harvest infrastructure facilities like pack house, pre-cooling unit, cold storage, processing unit, quality control labs & refrigerated transport etc., in potential areas in a phased manner. Already one such project with a financial implication of about Rs.300 lakhs has been implemented at Bijapur.
- Plans to enter into joint venture participation with private sector for the development and increase of agriculture and horticulture exports from the state.

- To make available quality Bangalore rose onion seeds at reasonable prices to farmers in order to raise production, productivity and quality of this variety of onion. KAPPEC has already procure certified quality Bangalore rose onion seeds from the national horticultural research development foundation, Nashik and has distributed to farmers.
- To conduct seminars, symposiums, training programmes for the benefit of farmers in order to create awareness among them about the package of practices to be followed in the area of pre and post harvest management.
- To participate in the international & domestic fairs and exhibitions to increase the demand for agriculture and horticulture commodities grown in Karnataka Government vide order
- Government of Karnataka has released Rs.10 crores to KAPPEC for creating post harvest infrastructure facilities like pack house, pre-cooling unit, cold storage, processing unit, quality control labs & refrigerated transport etc., in potential areas in a phased manner..

**NEW VISION FOR TRANSFORMATION OF AGRICULTURE:**

It has been empirically demonstrated that agriculture growth is significantly beneficial for reducing poverty and increasing per capita income. Beside inclusive growth, agriculture matters for health and nutrition, sustainability, climate change and quality of life in the country. All these factors underscore the need for a new vision for agriculture as we move forward in the 21st century.

Some aspects of the new vision for agriculture are discussed below by grouping these under following heads:

1. Growth to efficiency

2. Employment Generation

3. Food Security to Nutrition and Health

4. Shortage Management to Surplus Management

5. Input Intensive to Knowledge Intensive Agriculture

6. Climate Change and Sustainability

7. Production and Producers

8. Policy Interventions, Regulations and Reforms

**KEY FUTURE TRENDS AND OPPORTUNITIES FOR AGRICULTURE IN KARNATAKA:**

1. Changing demand due to increase in incomes, globalisation and health consciousness is affecting and going to affect more the production in future. Demand for fruits and vegetables, dairy products, fish and meat is going to increase in future.

2. Researches, technology improvements, protected cultivation of high value greens and other vegetables will be more. There will be more demand of processed and affordable quality products.

3. More competition will be there among private companies giving innovative products, better seeds, fertilisers, plant protection chemicals, customised farm machinery and feed for animals etc in cost effective ways at competitive prices giving more returns on investment by farmers. Use of biotechnology and breeding will be very important in developing eco-friendly and disease resistant, climate resilient, more nutritious and tastier crop varieties.

4. Some technologies will be frequently and widely used in future and some will become common in a short time while some will take time to mature. For producing the same products in other way so as to use resources judiciously and using new resources also like hydroponics, use of plastics and bio-plastics in production. There will be more of vertical and urban farming and there will also be efforts in long term to find new areas for production like barren deserts and seawater.

5. Precision farming with soil testing-based decisions, automation using artificial intelligence will be focused for precise application inputs in agriculture. Sensors and drones will be used for precision, quality, environment in cost effective manner. Small and marginal farmers will also be using these technologies with the help of private players, government or farmer producer organisations (FPO). Use of GPS technology, drones, robots etc controlled by smart phones etc can make life of farmers easy and exciting with good results. These advanced devices will make agriculture be more profitable, easy and environmentally friendly.

6. Use nano-technology for enhancement of food quality and safety, efficient use of inputs will be in near future. Nano-materials in agriculture will reduce the wastage in use of chemicals, minimise nutrient losses in fertilisation and will be used to increase yield through pest and nutrient management. IFFCO has already done successful tests in nano-fertilisers.

7. India has improved remarkably in its digital connectivity and market access has become very easy. Farmers will be behaving more smartly with mobiles in hands and would be able to be more aware and connected with different stake holders. Government will be making wide use of digital technology for generating awareness among farmers, information sharing, government schemes using digital technology for direct transfers of money.

8. There will certainly be more work by government, village communities, agri startups and private players in conserving sharply depleting water resource. Use of digital technology can make revolution in this direction. There will be use of satellites, IoT, drones for better collection of data regarding soil health, crop area and yield which will make cost for insurers less with better estimations and system will be more exact and effective.

9. There will be more of niche marketers in operations, area, and crop specific small equipments which will make operations even at small farms easier and efficient. Food wastage will be less and better use of waste materials in agriculture will be more. Number of warehouses in private sector will be more and linkages between government and private warehouses will be increasing. This will help in balancing supply with demand and stabilisation of prices of agri-outputs in the market.

10. Retailing in agriculture will largely be digitalised. A study estimates that over 90 per cent of kirana stores across the country will be digitalised by 2025 with modern traceable logistics and transparent supply chain. Many players have already taking kirana stores to the door steps of consumers like Amazon and Jio Mart.

**CONCLUSION:**

There is an urgency to think about this problem and come up with solutions to help improve agriculture on a sustainable basis and to develop the rural areas by providing urban amenities in rural areas. There is now abundance of modern farming technology and equipments that can enhance agricultural production. The governments have also realised the importance of agriculture and the significance of self-reliance in food production. Question arises whether farmers will be able to make use of modern technologies in a country where education, holding size, infrastructure, low level of technology adoption and many other constraints are there. Anyhow, we can certainly hope that the future of agriculture in Karnataka and India is certainly not bleak and agriculture will witness a transformation that is sustainable and long lasting.

**REFERENCES:**

Batla Seema, 2008, Regional dimensions of inter crop diversification in India: Implications for production and productivity growth. Agriculture situation in India, 64(12): 601-620.

Rajni, Jain., Alka, Arora., Raju, S.S., 2009, A novel adoption index of selected agricultural technologies:Linkages with infrastructure and productivity. Agricultural Economic Research Review, 22(1): 109-120.

Pisani, Elena., Franceschetti, Giorgio. 2011, Evaluation of social capital promotion in rural developmental programmes: a methodological approach.

Saraswati, P. A, Basavaraja, H., Kunnal, L. B., Mahajanashetti, S. B. and Bhat, A. R. S. 2012. Growth in area, production and productivity of major crops in Karnataka. Karnataka. J. Agric.Sci., 25: 431-36.

Singha, A. and Chakravorty, A. 2013. Crop diversification in India: a study of maize cultivation in Karnataka. Scientific. J. Rev. 2: 1-10.