Indira Gandhi Krishi Vishwavidyalaya
Krishak Nagar, Raipur - 492 012 Chhattisgarh
IGKV Vision 2030

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The greatest challenge to agriculture in the years to come is to not only provide adequate food to increasing population but also to provide other agriculture crops maximising income to the farmers of rural population. We will have to successfully deal with scarce water resources, degrading lands and difficult access to energy. Agriculture sector is witnessing radial changes and challenges at national and global level. The demand for agricultural commodities is increasing with changing food preference of new generation. Agriculture sector is struggling with decelerating profitability and its share in GDP. The emerging challenges and opportunities call for a paradigm shift in the innovation driven education, research and extension system.

I am delighted to note that the Indira Gandhi Krishi Vishwavidyalaya has shown the foresight and prepared roadmap for Agriculture University in the form of “Vision 2030”. I am sure that this approach and proposed strategies would bring a substantial change, and improve efficiency, effectiveness and relevance of Indira Ganghi Krishi Vishwavidyalaya.
Agriculture occupies a fundamentally important position in the economy of Chhattisgarh. The state has taken a big leap in agricultural development by achieving growth rate of 11.5% in previous year due to conducive policies and down to earth plans and programs. However, it is time for this sector to take another great leap forward in years to come. This will be possible with a clear recognition of the many existing inter-linkages and a clear roadmap to enhance productivity, profitability, sustainability and competitiveness of the agriculture sector in state, with special reference to rainfed farming.

A new farmer centric, industry driven knowledge based strategy may bring about desired results. It is the need of the hour to identify doable programs and implement them in a time bound manner. The approach will have to change from one where the farmer is viewed as a “tiller”, to one where we look at the farmer as an agri-preneur who is eager to look at new forms of engagement with other stakeholders, to enhance productivity and profitability from agriculture. It will also be required to provide inputs of knowledge and scientific research, access to markets, credit support and insurance coverage and management techniques for effective utilization of various resources for running farming as successful business operation.

In order to achieve these goals it will be required to develop new generation of farmers, scientists and extension workers along with appropriate programs in the state. I am happy to note that Indira Gandhi Krishi Vishwavidyalaya is aware of the situation and has prepared a road map of university for next two decades. I compliment university authorities for its timely preparation and wish all the best for their future endeavors towards development of agriculture in state.

(Dr. Raman Singh)
The agriculture sector now a days witnessing changes and challenges at state as well as national level. The demand for agricultural commodities is precipitously rising; food preferences of the new generation are also shifting; and agriculture sector is struggling with decelerating profitability which is dragging its performance. The emerging challenges and opportunities call for a paradigm shift in the innovation-driven agricultural education and research system to address all the stakeholders in the entire food supply chain.

I am delighted that the Indira Gandhi Krishi Vishwavidyalaya has shown the foresightedness and prepared strategy and framework in the form of Vision 2030 to address the issue in coming future. The present document IGKV Vision 2030 provides the strategic framework for innovation-led inclusive and sustainable agricultural growth. I complement the efforts made by the Indira Gandi Krishi Vishwavidyalaya to come up with a comprehensive roadmap with potential to transform agriculture towards prosperity.

I am confident that the forward looking approach and proposed strategies of the university would bring a substantial change in the agricultural research system, and improve its efficiency and effectiveness to accelerate the growth of agriculture in the state.

(Dr. Charandas Mahant)
Minister of State Agri. & Food Processing
Govt. of India, New Delhi
Chhattisgarh is one of the important rice growing states in eastern part of country. The rainfed rice grown in 75% of cultivated area is lifeline of state. The productivity is still quite low with 15.97 as compared to national average of 23.72 q/ha. The state is predominantly mono-cropped. Nearly 70% of our cultivated area is highly vulnerable to drought, and agriculture is dominated by marginal and small tribal farmers. The state is very large and diverse agroclimatic situations pose a great challenge for agriculture development. In spite of these, agriculture sector of Chhattisgarh, including animal husbandry and fisheries, has performed well towards the enhancement of production and productivity of various agricultural commodities with a growth rate of 6.3%. Rice production has reached to a record 62.0 lac ton during 2011-12. Needless to say, this could be achieved because of the relentless efforts of our farmers, agricultural scientists, officials of state government and other organizations.

Differential approaches and policy instruments, are required to address these problems. The region is on the threshold of a multifaceted growth in agriculture, and the government of Chhattisgarh has given very high emphasis on this sector. During the 12th plan period Chhattisgarh plans to allocate 23% of the plan outlay in agriculture sector and has prepared state agricultural policy. The state has also prepared separate budget for agriculture. I am very happy to learn that IGKV is well aware of the situation and has prepared this “Vision 2030” document in order to effectively play its role in furthering the agricultural development in state.

I compliment the university officials for this endeavor, and I am confident that it will help university in addressing the needs of farming community of Chhattisgarh in future.

(Chandrashekhar Sahu)
Minister of Agriculture, Fisheries & Labour
Government of Chhattisgarh, Raipur
The Indira Gandhi Krishi Vishwavidyalaya is responsible for spearheading agricultural research, education and extension activities for productivity, profitability, livelihood enhancement and diversification of agriculture in the state of Chhattisgarh. The comprehensive initiatives taken by the university have led to notable accomplishments and growth in agriculture sector of state.

The university has prepared Vision 2020 in 2000; however with changing agricultural scenario it has became necessary to formulate new strategies. The IGKV 'Vision 2030' documents key challenges and opportunities that are likely in the next two decades, strategies and framework to address these issues by harnessing power of science, and provides a roadmap to articulate role of IGKV in shaping the future of agricultural research for growth, development and livelihood security in Chhattisgarh.

I would like to express my sincere gratitude to Hon'ble Shri Shekhar Dutt (SM), Governor, Chhattisgarh for his invaluable guidance in preparing university road map. I am grateful to Hon'ble Chief Minister Govt. of Chhattisgarh Dr. Raman Singh, Dr. Charandas Mahant, Minister for Food Processing Industries Govt. of India and Hon'ble Minister of Agriculture, Fisheries and Labour, Government of Chhattisgarh Shri Chandrashekhar Sahu for their keen interest in the University affairs and support.

I am sure that IGKV Vision 2030 would provide a direction for achieving higher, sustainable and inclusive agricultural development and growth in this tribal state.

(S.K. Patil)
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Agricultural scenario of world, nation vis-à-vis state

The greatest challenge to agriculture of the world in the years to come is to provide adequate food to combat with hunger and malnutrition to the burgeoning population which is projected to become 7.5 billion in 2020, 8.1 in 2030 and over 9.0 in 2050 from the present population of 6.2 billion. We will have to feed more people with scarce water resources, degrading lands and difficult access to energy. The FAO has reported 803 million tons of global cereal requirement in 2025 against the present production of less than 600 million tons, and therefore, the global cereal demand is to increase 1% per year up to 2025. The production will have to be increased by 60-70% by 2050.

Demand for food grains in country would increase from 192 million tons in 2000 to 308 million tons in 2025. In 2011-12 the country could produce 252 million tons and can boast of a buffer stock of 70-80 million tons to meet any exigency. Hence, in the next 10 years, production of food grains needs is to be increased at the rate of 4.0 million tons annually with 3% annual growth in agriculture. The scenario would be more terrible, when we visualize the per capita availability of arable land, which would decline to 0.15 ha by 2050 from 0.23 ha in 2000 and 0.38 in 1970. India has 2.4% of the total land and 11.3% of total arable land of the world, and has to support 17.5% of world's population. A major part of world population dependent on agriculture lives in India which constitutes to about 22%. Obviously, land: man ratio of India is only 0.13 ha which is quite lower than world (0.20 ha).

India is a country of more than 1.21 billion people and 1.0 billion animals, and 73 per cent of its population still lives in rural areas. It is projected that country will achieve zero population growth by 2060 with an estimated population of 1.7 billion people. India is world's youngest nation. Out of 121 crore total population, there are 60 crore youth in the country at present. There are 16 crore population of below 6 years age. By 2020 the average age of Indian population will be 29 years. If this energy is properly utilized Indian youth can rule the world. It can go otherwise also if the challenges are not addressed properly. It is also projected that by 2050 the Indian economy will bypass US
economy. However, the major challenge is how to retain rural youth in agriculture in future. It is also important to think who will farm in future and how.

India is a land of small scale farmers, about half of all farms are less than 1 ha in size, and another 20% are less than 2 ha. Agriculture contribution in the gross domestic product is declining, and touched 12.3% in 2010-11 from about 30% in 1990-91. The comparison of GDP and food grain production with decadal growth of population indicates that there is long way to go for country as well as state to keep pace with its burgeoning population. On the economic front the GDP has grown annually by more than 10.2% during 2001-10 and annual growth rate of food grain production registered 1.15% (218.2 million tons in 2009-10 from 196.8 million tons in 2000-01). It is still a shade lower than the population growth rate during 2001-2011. During the last two decades, the average annual growth of agriculture sector was less than half (around 3%) of the overall average growth of the economy (6-7%) (NAAS, 2009). Industrial and service sectors have outpaced performance of agriculture sector during the last two decades. However, the proportion of workforce engaged in agriculture did not commensurate with the decline of its share in the gross domestic product. At present also, agriculture sector provides employment to about 52% of the workforce that used to be about 61% in 1990-91. These starkly different trends reveal that incomes in non agriculture sectors are growing faster than agriculture sector, and a sizable workforce from agriculture is needed to be shifted to non-agriculture sector for income and livelihood opportunities. However, a better way is to reorient the research and development focus in a way to develop and promote those technologies that raise agricultural income and ensure employment opportunities in the agri-supply chain to a vast majority of the workforce and ensures sustainability of production systems.

The demand for food and processed commodities is increasing due to growing population and rising per capita income. The demand for high value commodities such as horticulture, dairy, livestock and fish is increasing faster
than food grains. For most of the high value food commodities, demand is expected to increase by more than 100% from 2000 to 2030. These commodities are all perishable ones and require different infrastructure for handling, value addition, processing and marketing (ICAR, 2011). Indian agriculture is required to grow at 3 per cent per annum to meet its internal demands.

Land degradation coupled with land scarcity, is one major constraint. Present estimates reveal that nearly 120.72 million ha of land in the country is degraded due to soil erosion and about 8.4 million ha has soil salinity and water logging problems (ICAR, 2011). Data compiled by the National Remote Sensing Agency (NRSA) indicated that 15 per cent of India’s total geographical area was comprised of degraded cultivatable wasteland (NRSA, 2000). In Chhattisgarh 47.84 Lac ha area (36% of TGA) comes under degraded and wastelands (Maji et al, 2010). Fertilizer application rose more than five-fold between 1970 and 2002 to 17360 thousand tons. Imbalanced proportioning of chemical nutrients is a major problem associated with fertilizer application in India and Chhattisgarh. This has resulted in deterioration of soil health, acidity and salinity and increased deficiency of micro and secondary nutrients. Technological interventions for proper utilization and rehabilitation of land is the need of the hour.

Water is another major constraint for Indian agriculture. Water consumption in agriculture rose sharply with increase in net irrigated area from 31.1 to 86.4 million hectares between 1970-71 and 2010-11. In state the irrigated area is very less and has increased from 10.4 lac to 14.87 Lac ha during 2000-01 to 2009-2010. The irrigated area in state is highly concentrated in few blocks. Obviously, groundwater, one of the India’s major sources for irrigation, is being rapidly depleted. The number of dark blocks, where groundwater extraction is more than 85 percent of the availability has increased dramatically in last decade. The problem of groundwater depletion has been reported from rainfed states like Andhra Pradesh, Karnataka, Rajasthan, Madhya Pradesh, Chhattisgarh and Gujarat.
The Green Revolution technology has generally by-passed rainfed dryland areas and resource-poor farmers. The country is looking towards eastern part of India, including Chhattisgarh for its future food security as this region is largely untapped and potential of increasing productivity is existing. The evergreen revolution in rainfed areas will become reality only with dryland agri-horticulture-forestry, integration of animal husbandry with crop management practices that permits crop intensification through adoption of suitable soil and water conservation practices, and adaptation of organic and green farming technologies. Sustainable production and consumption systems that make efficient use of resources like water, land, and energy must become the basis of tomorrow's economy in such areas.

Chhattisgarh is one of the important rice growing states in eastern part of country with 37 lakh hectare cultivated land. Rice is grown on 75% area mostly in rainfed farming. Pulses and coarse cereals are other important food crops grown in the state with production of 5.37 lakh tons of pulses and 2.3 lakh tonnes of coarse cereals. Agriculture in Chhattisgarh is the pivotal sector for ensuring livelihood security to almost 60% population. Increasing production of essential food grains continuously from this rainfed region is a great challenge for this state where farmers are very poor and belongs to tribal community, and 80% of cultivated area is highly vulnerable to drought. The situation is further complicated by climate change and degradation of natural resources, and dominance of marginal and small farmers. Thus, growth in state cannot be truly inclusive if it does not benefit the farmers in terms of remuneration to especially small and marginal farmers.

The population of state has increased from 2.08 in 2001 to 2.55 Crors in 2011 with a growth rate of 2.06% and is 2% of the national population. The population may reach 3.5 Crore with this rate by 2030. There are only 10 states in India with growth rate of more than 2.0%. The percentage decadal growth rate has also increased from 18.2 to 22.6 in Chhattisgarh. On the other hand, it has declined for country from 21.54 (1991-2001) to 17.64 (2001-2011) and is the sharpest decline in decadal growth since independence. In all the states it is
negative whereas in Chhattisgarh it registered positive change of 4.32%. This will require additional food grain by 2030 and hence the agricultural production will have to increase continuously to feed this population.

The state has achieved good growth rate of 6.3% in agriculture in recent past, however, maintaining this rate will be a challenge. The GDP of state is 6007990 Lac Rs in 2009-10, which is 1.3% of national GDP. The agriculture share for state is 12.9% and it is 1.2% of the national agricultural GDP. The state support 2.0% of Indian population on 3% of country's arable land and 4.6% of geographical area. Nearly one-third of the state population lives below poverty line, and about 80% of our cultivated area is highly vulnerable to drought. The agriculture is dominated by marginal and small farmers, and its contribution in GDP is declining due to relatively high performance of industrial and service sectors. The share of agriculture in GDP did not match with the proportion of workforce engaged in agriculture, which is 52%. Reorientation of the research and development focus is required to develop and promote those technologies that raise agricultural income, ensures employment opportunities, and sustainability of production and consumption systems.

Rice is the lifeline of state and total rice production of 62 lac mt has been achieved in 2011-12. The productivity is still quite low with 15.97 as compared to national average of 23.72 q/ha. The state is predominantly mono-cropped with rice as major crop during the rainy season. Millets like ragi, kodo, kutki occupy a major area. Lathyrus, is a major rabi crop grown as relay crop (utera) after rice. Horticulture, though there is a great potential, is very much neglected in this region. The live-stock population is very high but the milk production is very low due to breed and poor nutrition. Ensuring large scale availability of improved breeds of animals is of prime importance. The rainfed, rice based mono cropping system needs serious attention for food and nutritional security, sustainable development, poverty alleviation and employment generation in this state.

The landscape in Chhattisgarh is undulating with five distinct farming situations on topo-sequence. This toposequence together with high rainfall
(1200-1400 mm) is responsible for severe erosion and land degradation. Therefore, integrated farming systems and soil and water conservation, crop diversification, intensification, and maintenance and utilization of biological wealth for developing high yielding, biotic and abiotic stress tolerant varieties are priority areas for acceleration of agricultural growth and livelihood improvement in the present as well future context.

There is dominance of marginal and small farmers in the state where 80% farm families holds only 20% cultivated area. The marginal farmers are in highest proportion (52%). The farmers have poor socio-economic conditions and 32.5% of population lives below poverty line as compared to 21.8% in the country. This is one of the highest percentages in the country along with Orissa, Jharkhand and Bihar. Sustaining high yields and income to this category through application of science and technology, allied enterprises, post harvest and value addition together with social engineering is immediately required.

The state is very large and diverse agro-climatic situations pose a great challenge for agriculture. The climatic situations in southern part of Bastar is similar to coastal conditions. It is a plateau with an altitude of 600 to 1000 MSL. In some areas the plateau is as low as 40 MSL. The northern part is hilly area with temperate climatic conditions. The central part is hot and humid with an altitude of 300-350 MSL.

During the last couple of years, the agriculture sector of Chhattisgarh, including animal husbandry and fisheries, has performed well towards the enhancement of production and productivity of various agricultural commodities. Rice production has reached to a record 62.0 lac ton during 2011-12. Needless to say, this could be achieved because of the relentless efforts of our farmers, agricultural scientists, officials of state government and other organizations, who have all been a part of this transformation process. Chhattisgarh is an assured rainfall zone and here the major issues include increasing the double cropped area in rainfed farming by introducing short duration, moisture stress and high temperature tolerant high yielding varieties of rabi crops such as gram, lentil, linseed, lathyrus, peas, mustard, sunflower,
horse gram, niger and sesame after kharif rice.

Differential approaches and policy instruments, will be required to address these problems. The region is on the threshold of a multifaceted growth in agriculture. The government of Chhattisgarh has given very high emphasis on this sector. During the 12\textsuperscript{th} plan period Chhattisgarh plans to allocate 23\% of the plan outlay in agriculture sector and has prepared state agricultural policy. The state has also prepared separate budget for agriculture with focus on assistance to seed growers for quality seed production, incentives for crops diversifications which include pulses and oilseeds, demonstration of rainfed farming technologies to increase cropping intensity, establishment of farm machinery banks and soil testing labs on PPP mode, special schemes for micro irrigation, support for off-farm livelihood via animal husbandry sector, and sponsoring breed important program.

Sustainable growth can only be achieved with significant technological interventions for increasing cropping intensity and yield and profitability enhancement in this region. The shift from input-intensive to sustainable, particularly organic farming is a difficult task as it involves a number of policy measures dealing with a variety of issues ranging from the transfer of information and technology to the development of markets. The agricultural technologies needs a shift from production oriented to profit oriented sustainable farming. In this direction, development and adoption of resource conserving technologies needs greater attention. The promising strategies which needs promotion for sustainable agricultural development includes, Integrated farming systems and soil and water conservation, crop diversification, intensification, and maintenance and utilization of biological wealth for developing high yielding, biotic and a-biotic stress tolerant varieties natural resource management emphasizing soil and water management, precision land leveling, zero tillage, non puddle rice culture, nutrient management through soil test, leaf colour chart for real time nitrogen management, and site specific integrated nutrient management and customized nutrient solutions, strategies for crop improvement and strategies
for improved crop management, use of value added products, development of rural based enterprises and e-learning tools for dissemination of knowledge and technologies.

Thus, the major challenge for state agriculture, is to increase productivity, production, and profitability while minimizing environmental impact for sustainability and provide economic opportunities. This includes conserving and protecting the quality of the resources that determine the performance of agriculture like land, water, air and biodiversity, ensuring the dissemination of latest knowledge and information, and developing the next generation of farmers and scientists. Indira Gandhi Krishi Vishwavidyalaya has prepared strategies and framework to addresses these issues in time bound manner. This 'Vision 2030' documents key challenges and opportunities that are likely in the next two decades, strategies and framework to addresses these issues and provides a roadmap to articulate role of IGU in shaping the future of agricultural research for growth, development and livelihood security in Chhattisgarh.
About IGKV

Indira Gandhi Krishi Vishwavidyalaya located at Raipur, which is the capital of Chhattisgarh, is only agricultural university in state with responsibility of agricultural education, research and extension of technologies. It has a prestigious and long history of services to the tribal farming community of this region. The research was started in 1903 by establishment of Agricultural Research Station “Labhandi “. In 1961, college of agriculture was established, and on January 20th in 1987, IGKV was established with following objectives;

Objectives
1. Making provision for the education in agriculture and other allied sciences.
2. Carrying out research in agriculture and other allied sciences.
3. Undertaking field extension programs, and;
4. Improving the level of living of rural people.

The jurisdiction of IGKV is entire state which has three distinct agro-climatic zones and has diverse conditions. The Bastar zone is among one of the eight biodiversity hot spots in country. The university is recognized as one of the most important biodiversity repository in the world, particularly for rice and lathyrus. The teaching is imparted in agriculture and agricultural engineering faculties through its 9 constituent and 15 affiliated colleges. There are nine research stations carrying out research in different areas, and 20 Krishi Vigyan Kendras involved in dissemination of technologies to the farming community of state.
Fig-1: Teaching, Research and Extension Network of IGKV

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- College of Horticulture [1]
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- Krishi Vigyan Kendra [20]
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Fig. 2: Organizational Set up

- **Academic Council**
  - **Vice-Chancellor**
  - **Dean, Faculty of Agriculture**
  - **Dean, Faculty of Agril. Engg**
  - **Deans all constituent colleges**
  - **Dean Student’s Welfare**
  - **All Directors**
  - **Dean of Faculty (Res, Ext)**
  - **Director (Res, Ext)**
  - **Director of Research**
  - **Registrar**
  - **Comptroller**
  - **SPP**
  - **2 HoDs Agriculture**
  - **1 HOD Agril. Engg.**
  - **Two Deans constituent college**

- **Board of Management**

- **Extension Council**
  - **All Directors**
  - **Dean, Faculty of Agriculture**
  - **Dean, Faculty of Agril. Engg**
  - **Deans all constituent colleges**
  - **Dean Student’s Welfare**
  - **All HODs**
  - **One Teacher from each Faculty to be elected**
  - **Three teacher from sister Agricultural University**

- **Directorate of Research**
  - **Chhattisgarh Plain**
    - **Res. Station, Raipur**
    - **CARS, Bilaspur**
    - **RARS, Raigarh**
    - **Res. St., Bhatapara**
    - **Res. St., Boronda**
    - **Res. St., Kawardha**
  - **Northern Hills Zone**
    - **ZARS, Ambikapur**
    - **KVK, Bilaspur**
    - **KVK, Ambikapur**
    - **KVK, Jagdalpur**
    - **KVK, Mahasamund**
    - **KVK, Bhatapara**
    - **KVK, Janjgir**
    - **KVK, Narayanpur**
    - **KVK, Rajnandgaon**
    - **KVK, Bhatapara**
    - **KVK, Balrampur**
    - **KVK, Mahasamund**
    - **KVK, Rajhodagond**
    - **KVK, Kanker**
    - **KVK, Jagdalpur**
    - **KVK, Dantewada**
    - **KVK, Rajgarh**
    - **KVK, Khammam**
    - **KVK, Bhatapara**
    - **KVK, Gariyabandh**
    - **KVK, Korba**
    - **KVK, Balrampur**
    - **KVK, Jashpur**
    - **KVK, Narayanpur**
    - **KVK, Bilaspur**
    - **KVK, Jagdalpur**

- **Directorate of Extension**
  - **KVK, Bilaspur**
  - **KVK, Ambikapur**
  - **KVK, Jagdalpur**
  - **KVK, Mahasamund**
  - **KVK, Bhatapara**
  - **KVK, Janjgir**
  - **KVK, Raigarh**
  - **KVK, Dhamtari**
  - **KVK, Korba**
  - **KVK, Balrampur**
  - **KVK, Jashpur**
  - **KVK, Narayanpur**
  - **KVK, Bilaspur**
  - **KVK, Jagdalpur**
  - **KVK, Khammam**
  - **KVK, Bhatapara**
  - **KVK, Gariyabandh**
IGKV Vision 2030

Vision

Sustainable integrated development of agriculture for rural livelihood enhancement, generation of economic growth and opportunities in state of Chhattisgarh.

Mission

Improving the competitiveness of agriculture sector, by building capacity, enhancing productivity and profitability, maintaining sustainability of production and consumption systems through efficient use of natural resources and energy, and catalyzing innovation across the agriculture in order to ensure food and nutritional security, and inclusive growth.

Vision themes

1. Quality and capacity of Agricultural Education

The growth of rural sector depends on successful implementation of developmental programs as well as their adoption by farming community. Obviously, it will require trained man-power for successful implementation. The state is facing problems due to lack of field extension staff. Currently, 24 colleges with 1250 intake capacity are in operation focused on agriculture, horticulture, and agricultural engineering. It is a matter of concern that due to limited intake capacity only 5000 graduates were produced in last 25 years in the state. It is envisaged in the state agricultural policy that it is essential to have one agri-professional over 1000 farm families, if we want to provide proper backstopping to farmers. Considering 32 lac farm families state would require about 32000 farm professionals. Further, every year the country requires 50000 graduates as against the total capacity of about 24000 at present.

India's economy and the aspirations of its middles classes are creating a huge new demand for skills and quality Higher Education. Gross enrolment rate in agriculture is 11% in the country and government of India is targeting it to increase up to 15%. On the other hand, the overall GER in state is only 8.5% as compared to national GER of 12.5%. The national GER is also very low as
compared to global GER, which is 24%. In view of this it is required to increase number of colleges as well as number of seats in established ones. Recent years have seen an explosive growth in private institutes of higher education, which now sign up about 30% of all enrolments in higher education. Possibilities, with stringent quality control norms needs to be further explored in agricultural education.

Even after reaching to 15% GER, The 85% school educated youth will remain in search of opportunities. The skill and entrepreneurship development for school educated youth is essentially required to increase income and employment opportunities particularly in rural areas. This will become driver of agriculture development in state in future. It will require huge support to the university in next two decades with large investment in infrastructure, manpower and facilities. It will be worth reminding that the Bastar region alone of state is larger than Kerla, Haryana and Punjab put together. However, the man-power and financial resources of the University are very less as compared to these states.

India is a young nation with 13.1% (16 cror) of its population in 0-6 year group, and with 14.0% population in this category, the state of Chhattisgarh is still younger. Out of 121 crore total population, there are 60 cror youth in the country at present. By 2020 the average age of Indian population will be 29 years. On the other hand, there is reducing interest of youngsters in agriculture, and attracting and retaining youth in this sector is very important for future food security. There is need of creating educational avenues for this youth population. Their interest needs rejuvenation to take up agriculture as profession, business and way of earning decent livelihood. Youngsters can be brought in by making it profitable and prestigious business. It is possible only through modern technologies of precision farming, poly house and green house cultivation, hydroponics, modern dairy and fishery enterprises. The education needs to be raised to such a standard where our colleges prepare students which are ready for taking up challenges. There is need to formulate new policy to attract and retain the bright brain for agricultural education and research.
The 73% of the population in the state is rural and we need to bring more youngsters from rural background in agricultural education having good understanding of rural problems. It is required to find out ways / mechanisms for attracting youngsters from rural background in agricultural education.

Encompassing and integrating multiple methodologies of learning, involving hard and soft skills and experiences is required to improve the capabilities of student. The curriculum needs continuous reforms according to the present day needs to develop leadership qualities, creative thinkers, self-learners, problem solver, employable and industry ready graduates. Higher education system in university is required to progress in the direction which facilitates learning up to the current frontiers of knowledge, research that pushes the frontiers of knowledge, exposure to the cutting age technology, innovations to address the problems and opportunities in the society, and builds competence of entrepreneurship in students to generate wealth in society. It is also required to develop ethical and moral values so that students develop social concerns.

Redesigning and re-orientation of agriculture education system which meets the expectations of the stakeholder's and requirement of the end users is continuously required. It should be tuned to meet the changing requirements of the state and the country like changing needs of the food and food habits, requirement and development of technologies, globalization, IPR regime, participation of private and public sectors for the development of demand driven value chains and agri-business concept, food processing, value addition, food safety, and food quality. There is need of establishment of academia-industry partnership. The industry-education linkage will benefit the farmer as well as further develop agricultural education in the State. This will help in production of industry ready graduates. Stakeholders (industry, business house, farmers) participation in education needs to be ensured.

In order to meet out new challenges in farm sector it is required to start new courses on rural management, agribusiness management, supply chain management, nanotechnology, GIS and Remote sensing, marketing, and
bioinformatics to equip state with required force of professionals. In order to provide the graduates the latest knowledge it is required to develop university as state of art learning center based on ICT.

2. Harnessing the benefit of frontier science and technology

Sustainable growth and self sufficiency in food can only be achieved with significant technological interventions for increasing cropping intensity, productivity and profitability with environmental sustainability as there is little possibility of area increase. Increasing production of essential food grains continuously from this rainfed region is a great challenge where farmers are very poor and belongs to tribal community, and 80% of cultivated area is highly vulnerable to drought. The situation is further complicated by climate change, degradation of natural resources and dominance of marginal and small farmers, where 80% farm families holds only 20% cultivated area. Application of cutting edge science and technology can only provide the answer under such situation.

The major constraints for sustainable production in state are biotic, a-biotic, and edaphic (apart from socio-economic). The biotic factors are mainly weed flora, insect pests and diseases. The a-biotic factors consists of variability in agro-climatic conditions, erratic occurrence of unpredictable monsoon, resulting in excess or deficit water situations. The edaphic factors of importance are land degradation due to high rainfall and undulating topography, physic-chemical problems of soil health like acidity, imbalance of nutrients and deficiency of micronutrients.

In order to overcome these constraints and yield barriers to ensure food security in future, development of biotic and a-biotic stress tolerant short duration crop varieties, climate smart management practices, more efficient input use system which is less dependent of agro-chemicals is required through application of frontier science and technologies. Research in conventional plant breeding and genetics is required to be supported by developments in the field of biotechnology, bioinformatics, nano-biotechnology, and transgenic
approach. Similarly, cadastral mapping of natural resources which includes soil and land, water, vegetation, forest for sustainable planning and mitigation of climate change is also very essential. Application of space age technologies like remote sensing, geographical information system, and simulation modeling in natural resource management needs serious attention. Investments in developing state of art infrastructure and laboratories and scientific capacity building will be required in coming future.

In order to ensure continuous progress and growth in agriculture in the state, it is required to plan and work for attaining excellence in areas of strategic advantage. Rice, lathyrus, linseed and millet, and crop biodiversity is among special areas for the state. Similarly biodiversity in vegetable crops, tubers, fruits and non cultivated fruits and medicinal-aromatic plants found in forest ecosystem needs exploration, conservation and development in to suitable varieties for different biotic and abiotic stresses. In order to achieve these goals improving facilities and quality of research and developing university as one of the best rice research center needs serious attention. Developing center of excellences for research on pulses, oilseeds, vegetable crops, millets, and farm mechanization for rainfed farming, secondary agriculture and rural agro-processing, organic farming, land and water management and modern facilities for biodiversity exploration, conservation, characterization and utilization will be the areas in which application of new science and further strengthening is required.

Location specific crop management technologies, water harvesting, integrated farming system models, increasing crop and animal diversity in rainfed farming, precision farming, adoptable integrated pest, disease and nutrient management practices so as to help farmers in reduction of cost of cultivation and gradual adoption of organic farming practices are the futuristic technologies in which research and development is essential. The P and K are imported and prices of their fertilizers will continuously increase in future as well. The coming decade will be very high time for finding out technologies, innovative ways for reduced dependency on their chemical forms. Application
of nano technology may provide a breakthrough in this direction. The state has diverse land and climatic situations. In order to develop location specific technologies there is need of establishment of more regional research stations particularly in areas which greatly differs like, Narayanpur, Bijapur, Konta, Jashpur, Mainpat, Surajpur, and Garyaband.

3. Sustainable production and consumption system for evergreen revolution and green economy

Agriculture and food systems will have to change towards sustainability in order to meet the challenges of sustainable growth as it is the largest human activity and has critical impact on environment. The environmental impacts of current agricultural and food systems are high. A transformation in agriculture towards sustainability is key to reduce the hunger, malnutrition, poverty and increasing agricultural production while preserving the environment. It will require save and grow technologies of conservation agriculture, production and use of in-situ and alternative sources of organic production inputs, as well as reduction in post harvest losses and wastages. The post harvest losses are reported to be in the range of 8-10% in state for food grains. This means that we are throwing 6 to 7 lac tons every year between production and consumption. Improving agricultural and food systems is essential for a world with healthier people and healthier ecosystems. Healthy and productive lives cannot be achieved unless “all people at all times have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life” (FAO, 1996). Healthy ecosystems must be resilient and productive, and provide the goods and services needed to meet current societal needs and desires without jeopardizing the options for future generations. The goods and services includes food production, climate regulation, nutrient cycling, cultural values, providing drinking and irrigation water, functioning of water systems, preserving and regenerating soils, fixing carbon, filtering pollution, biodiversity conservation, and much more (FAO, 2007). They are the
underlying basis for agriculture and play a determining role in the productivity and resilience of production systems. In the production system there is need of improving the diverse range of agricultural and food systems to reduce negative environmental impacts on soil, water and nutrient depletion, greenhouse gas emissions, and pollution. It is required to protect and harness ecosystem services such as biodiversity conservation, climate change mitigation and watershed protection.

a. Enhancing productivity, profitability, and sustainability of production systems through organic and green farming

Unscientific adoption and use of green revolution technologies has resulted in deterioration of soil health, declining input use efficiency and growing imbalances in soil and environment. The modern agriculture systems now proved to be exhaustive, exploitative and abusive towards nature, man and civilization. The cost of inputs in agriculture is increasing day-by-day, and land holdings are decreasing making agriculture unviable for majority of farmers. Most of the farmers are caught in the debt trap and do not have risk taking ability. This necessitated development and adoption of environment friendly technologies which can bring back the very pride of our farmer, his self-respect, his self-confidence, and his faith in the agriculture heritage of his own ancestors. This has given rise to farming without chemicals in natural ecosystem and is termed as organic farming, green farming and sustainable farming. It is environmentally sustainable and productivity at its core, in addition ensures healthy soil, healthy food and healthy people.

In the organic farming system approach, a piece of land is used optimally and to its fullest potential to produce a range of nutritious and healthy food as well as other required commodities in a manner which can healthily feed a small family, and maintain soil health and productivity by agricultural practices based on principles of nature. Pests (both insects and diseases) are also controlled and managed by the selection of crop mixes and using biological control measures. As per the definition of FAO, organic farming is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological
activity. It emphasizes, the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system. In philosophical terms organic farming means "farming in spirits of organic relationship. It is better defined as “Jaiwik Krishi”, meaning agriculture through organism.

The Green Revolution has brought economic prosperity in some parts of country, however, it also had serious damage to soil, water, environment and human health. Further, it has bypassed the small and marginal farmers even in such areas. There is need of promoting a productive agriculture that conserves and enhances natural resources by increase in soil organic matter, water flow regulation, pollination and natural predation of pests. At the same time it is also needed to carefully apply appropriate external inputs at the right time and in the right amount to improved crop varieties that are resilient to climate change and use nutrients, water and external inputs more efficiently. Increasing resource use efficiency, cutting the use of fossil fuels and reducing direct environmental degradation are key components which will help in saving money for farmers and preventing the negative effects of overusing particular inputs. Thus, promotion of sustainable green technologies in the state of Chhattisgarh is required so that the agriculture of this region can be saved from the ill effects of modern agriculture, and at the same time agriculture can be made more remunerative by sustainable enhancement of system productivity and increased economic opportunities in rural areas with special reference to small and marginal farmers, and transforming Chhattisgarh into an organic farming state. It is right time for the state to systematically integrated green revolution technologies with natural farming principals, allied enterprises and adoption of sustainable agriculture.

The pesticide centric agriculture has taken centre stage in country's planning. The green revolution states like Punjab, Haryana and cotton growing tracts have become highest insecticide users. The state of Chhattisgarh is very
fortunate as the current application rate is very less. In areas like Bastar region of state, the application rate of chemical fertilizers is still only 8-10 kg/ha and that of pesticides is negligible making this area very suitable for organic farming. If green technologies are focused and promoted to carryout organic farming in state, sustainable agriculture with safe and nutritious food and environment can be ensured, and Chhattisgarh can become poison free destination. Further, about 74% farmers in state are small and marginal. Organic farming is most relevant to them because they are resource poor and do not afford costly inputs for enhancing yield. Their only resource viz. land, need to be prevented from degradations.

Because organic and green farming is locally specific and knowledge-intensive, transition from existing systems will call for much greater investment at farmer, regional and national levels aimed at expanding research and extension for this change. It will also require greater emphasis on public–private partnerships to stimulate research and development, technology development and uptake, and knowledge management.

b. Enhancing sustainability of consumption systems

Consumption systems comprise the diverse set of institutions, technologies and practices that govern the way food is marketed, processed, transported, accessed and consumed. Consumption systems influence not only what is being consumed and how it is produced and acquired, but also who is able to eat, and how nutritious their food is. On the consumption side, we need to reduce over-consumption, shift to nutritious diets with a lower environmental footprint and reduce food losses and waste throughout the food system. One of the great flaws in current food systems is that, despite significant progress in development and food production, hundreds of millions of people are hungry because they lack the means to produce or purchase the food they need for a healthy and productive life. Food systems must be managed in a way that delivers universal food security. Fair access to resources, employment and income is key to overcoming hunger. Social protection programs and linking of such programs with agricultural production and consumption systems will
require serious thinking. However, even if we do increase agricultural output by the required pace we will still have people hungry in 2050 because, they would still lack the means to produce or purchase the food they need. For them, food security is not an issue of insufficient production; it is an issue of inadequate access. The only way to ensure their food security is by creating decent jobs, paying better wages, giving them access to productive assets and distributing income in a more equitable way. The agricultural economists and social scientists have to play an immense role in this direction in preparing state specific policies and plans.

4. Technology for Small farm holders

The marginal and small farmers constitute largest part of the farming community in the state. The marginal farmers are largest in proportion. There are 32.5 lac farm holding with an average size of 1.6ha. Out of these 17.5 lacs (53.7%) are marginal and the average holding size is 0.44ha. Similarly, small farmers are 7.2 lacs (22%) with average holding size of 1.42 ha. These two categories constitute the largest section of farming community in the state (76%). The medium farmers are 7.5 lacs and the holding size is 3.7ha, and the large farmers are 0.39 lacs with holding size of 16.5 ha. This means that 76% families are sustaining their lives on only 34% of cultivated land, on the other hand 24% farmers are controlling 66% land. Further, the holding size is continuously decreasing making it very difficult to survive a family on farming alone. Fragmentation of holding is another very serious issue for these farmers. In past, there was an acceptance of low yields of small holders. However, in future small holder's improvement is very critical to address poverty and regional and national food hunger. It is also important in order to stop diversion of small farms in to non-farm activities. A small farm has potential for intensive agriculture, but a small farmer suffers from the cost, risk and return structure of farming. There is an urgent need of providing the power of technology and economy of scale to small producers at production, post-harvest, and marketing ends of farming. The changes are required towards small holders
green revolution with robust commercial agriculture. A shift is required from farming for livelihood to farming as business. The socio-economic constraints that need to be addressed are farmer's resource limitation, risk avoidance attitude due to lack of credit facility and timely availability of quality inputs. This will however, requires large investment and promotion of contract / cooperative farming. This will have economic benefits by lifting greatest number of people out of poverty. It will provide opportunity to implement improved irrigation and fertilizer management practices at scale. Increased productivity of small holders will reduce pressure on forest and thus will bring in environmental sustainability.

Innovations will be required for development and adoption of suitable models at this scale. The models must incorporate conservation agriculture and organic farming, self sustained, least external input dependent, integrated farming systems for profitability enhancement, and reduction in cost of cultivation through adoption of integrated nutrient and pest management principles. Recycling nutrients as efficiently as possible and increasing input use efficiency is a necessity for smallholder producers. Appropriate models for increasing resource use efficiencies through water harvesting models, precision farming tools and approaches, and small farmers mechanization needs to be worked out. In order to generate economic opportunities and provide additional income post harvest processing and value addition, and development of suitable models with allied enterprises (horticulture, floriculture, sericulture, poultry farming, mushroom cultivation, bee and lac cultivation and dairy, piggery, goatery) will be of immense importance. Appropriate technologies will be needed to address these issues for small holders.

Social engineering will be required to a great extent in order to consolidate holdings for community/ contract farming, farmer's companies, self-help groups, development of infrastructure, and sharing of resources so that marketable surplus of selected commodities can be produces. This will also help in addressing issues related to input arrangements and marketing. In case
of contract farming the farmers right over land need to be protected so that it benefits farmers as well as investors and purchasers. There is need of providing complementary support to smallholders and income generation opportunities in order to improve risk bearing ability, cash for work and cash transfer programs that contribute to strengthening of local production and consumption circuits. Domestic innovations, domestic value added products, maximizing benefit of ICT, policies that generate wealth at bottom of pyramid will be required.

5. **Management of energy and bio-waste for energy-smart agriculture**

The food sector accounts for around 30 percent of the world's total energy consumption. High-income countries use a greater proportion of energy for processing and transport. In low-income countries, cooking consumes the highest share. Improving access to energy and ensuring the sustainability of energy resources are two of the most important aspects of achieving sustainable development in food systems. The agriculture must become energy smart. Produce more with less energy.

Agriculture consumes large quantities of energies directly through animate power sources of men and draft animals, diesel engines, electric motors, tractors, power tillers, other self propelled equipment, fuelwood and other biomass. It also uses energies indirectly in the farm of seeds, manures, fertilizers, pesticides and other chemicals, implements and machines, etc. Agriculture and agro-processing are energy intensive. Traditional sources of energy, power and inputs do not meet requirements of modern intensive agriculture that achieves production and productivity levels, which assures food and nutrition security of the country. Use of commercial energies, directly and indirectly, are inevitable. Indigenous R&D on energy studies have established that specific energy consumption per unit of productivity of Indian agriculture is higher than in the developed nations and is on the rising trend. It raises unit cost of production and reduces competitiveness in global market. Energy, power and inputs need to be optimally provided and efficiently utilized
for efficient and profitable intensive agriculture and alternate cheaper and renewable sources needs to be progressively adopted. In future there is need to target farm power availability of 2 kWh/ha and increase as mechanization advances.

Animal energy is and will remain a very important source. Animate energy use needs to be enhanced through ergonomically sound matching equipment, more efficient equipments and rational work- rest cycles. Integrated efforts are needed refining cropping and crop rotations, adopting of precision farming equipment and practices, plugging wastage in direct and indirect energy use, conserving commercial energies, supplementing and substituting with renewable energy sources. Adoption of equipment and practices that conserve energy such as zero-till drill, raised-bed planter, seed-cum-fertilizer drills and planters, rotovator for seedbed preparation, mechanical rice transplanter, drips and sprinklers and their variants for irrigation needs promotion.

Utilization of renewable sources of energy like stand alone power units run on producer gas, biogas, plantations and other biomass need to be developed in state. Briquetting of crops residues yield fuelwood substitutes with superior burning characteristics. Briquetted fuels from crop residues needs to be popularized. Energy plantations on non-arable lands can provide fuel wood/ charcoals and feedstock to producer gas gasifiers. Gassifiers run on wood billets, crop and processing residues need to be popularized for shaft power as well as process heat reducing dependence on fossil fuel and electricity. Solar cookers, solar water heaters, solar dryers and photvollatic gadgets both domestic type as well as community/ commercial type need to promoted and progressively refined for greater efficiency and economy. Family and community size biogas plants run on cattle dung and alternate feed stocks needs serious attention. Burning of crop residue is becoming common with the increased use of combine harvester. There is need of development and adoption of bio-methanation for energy and manure, composting, and vermi-composting methods.
The global demand for modern bioenergy, and especially liquid biofuels, is rapidly growing, driven mainly by climate change mitigation policies and increasing oil prices. This creates both opportunities and risks for us. On one hand, modern bioenergy development can boost both agricultural and rural development by raising agricultural productivity, creating new employment and income-generating opportunities, and improving access to modern energy services in rural areas. On the other hand, if not properly managed, modern bioenergy development can trigger a number of negative environmental and socioeconomic impacts, for instance, by putting pressure on key resources such as land and water. The environmental and socio-economic sustainability of modern bioenergy has been highly debated over the past few years. One of the most controversial issues that has dominated this debate is the relationship between bioenergy and food security. The Bioenergy and Food Security should go hand in hand if we want to develop bioenergy for future. The state has several tree borne oil seeds of annual availability is about 8.25 lac tones. The present collection of TBO seeds is nearly 40,000 tonnes from 27 different oil seeds. Out of these six TBO species has potential to explore the possibilities of bio-diesel & Value added Products.

6. Climate smart agriculture through management of natural resources.

The region is facing the challenge of sustaining its rapid economic growth while dealing with the threat of climate change. Regional climate change is now being felt by common person in the Chhattisgarh as well. Rainfall quantum is decreasing and the distribution is changing in many districts in Chhattisgarh. The monsoon onset is delayed by 8-10 days and the winter is also delayed. This demands adjustments in sowing time and other crop operations. It is required to adapt to climate change and secondly, to further enhance the ecological sustainability by adoption of climate smart agriculture. Climate change may alter the quality of natural resources and adversely affect the livelihood of its people. The state economy is closely tied to its natural resource base and climate-sensitive sectors such as agriculture, water and forestry may
face a major threat because of the projected changes in climate.

Agriculture is largest single human activity affecting environment and will remain so in future as well. Human-environmental interaction has had negative consequences for the environment. Achieving a world with healthy people and healthy ecosystems requires changes in the way that people interact with the environment. The crop and livestock sectors use 70 percent of all water withdrawals and, together with forestry, occupy 60 percent of the earth's land surface. Agriculture accounts for approximately 30 percent of total greenhouse gas emissions, and is projected to be a significant source of future emissions growth (IPCC, 2007). Agricultural production can have negative impacts on water, soil and air resources as well as wildlife and ecosystem biodiversity and human health. Forty percent of the world's degraded lands are located in areas with high poverty rates, with the greatest threat being loss of soil quality, followed by biodiversity loss and water resource depletion and quality degradation (FAO, 2011d). Therefore climate change mitigation, watershed protection and biodiversity conservation—particularly agricultural biodiversity—is very important. Agricultural production systems must “do more with less” and hence climate smart technologies based on the principals of conservation and integrated agriculture becomes very important. It is needed to increase radically the use of knowledge-intensive management strategies in all production systems.

a. Dryland farming

The state of Chhattisgarh is largely rainfed and 40-45% area is upland which is suitable for dryland fruit cultivation. Further, only 10% area is under assured irrigation and even if full irrigation potential is exploited it cannot be increased beyond 40%. Thus, major area will remain under dryland farming. The evergreen revolution in this state is possible only with adoption of dryland agriculture-horticulture and agroforestry model particularly in uplands with suitable soil and water conservation measures and allied enterprises. There is need to promote plantation of dryland fruits like, anola, ber, guava, custard apple, jamun, cashew, litchi, mango. It is required to adopt proper planting
technique, soil and water conservation measures, quality planting material and proper canopy management so as to permit dryland intercrops. The availability of quality planting material is one of the most critical limitations in this regard. Established of mother blocks at all research, college and KVK farm needs high priority with infrastructure development so that breeder/foundation category planting material can be made available. Further, research is required on developing suitable agro-techniques for fruits and forestry crops.

b. Natural resource management

The quality of soil, land, and water is worsening and is a key constraint in augmenting agricultural production. The topography is undulating in state which coupled with high rainfall gives rise to very high soil erosion, land degradation, loss of huge quantities of nutrients and development of soil acidity. This deteriorating quality and health of soil is something to be checked. Problems are further aggravated by imbalanced application of nutrients and excessive mining of micronutrients, leading to deficiency of macro- and micronutrients in the soils. These problems can be rectified by better management options, application of amendments, and adoption of suitable ground water recharge practices. The research and development challenge is to stop further degradation and rehabilitation of degraded lands and water resources.

Reinforcing the natural resilience of landscapes is fundamental. Deforestation, degradation of catchments/watersheds, land degradation, reduces nature’s defence capacity. Disasters, in turn, contribute to ecosystem degradation and loss, including increased soil erosion, declining land quality, acidity and salinization of soils and biodiversity loss.

More number of smaller projects to bring additional area under assured irrigation through the principles of watershed management needs serious attention. Budgeting of water, consumption, and allocation to different sectors and planning within agriculture sector for allocation to field crops, horticulture and fisheries needs immediate attention to increase water productivity. Precision farming development for conservation of production inputs and
irrigating or fertilizing only the root zone needs priority in the state. Planning needs to be done for large scale adoption of precision farming tools like drip or sprinkler in place of flood irrigation systems common with tube wells/canal irrigation. Special programs to help small and marginal farmers in adoption of precision farming technologies in order to increase their cropping intensity is required.

Preservation of soil fertility and nutrition management is very important component. More focus is needed to reduce indiscriminate use of synthetic chemical fertilizers which can seriously disturb the natural soil ecosystem. The balanced use based on soil testing and integration with bio-nutrients in the form of bio-fertilizers and composts needs promotion. Rejuvenation of soil health through addition of soil organic matter in bulk quantities and micronutrients needs serious attention.

There is need to develop specific land use plans as per the capacity of land for different farming situations to ensure that no land is left unused. There is a need and scope of crop diversification in the state for the cultivation of medicinal and aromatic plants and floriculture. Land use planning is required at district, block and village levels. The marginal lands should be used for plantation and medicinal crops. Application of ICT in the form of GIS and remote sensing needs special attention in this direction.

c. Biodiversity

The Bastar region of state is among one of the eight biodiversity hotspots of country. The richness of biodiversity is important from the point of view of future food security, agricultural heritage and climate change adaptation. Diversification of varieties, breeds and production activities across agricultural landscapes is another way to increase resilience against climate change. Greater diversity in agricultural ecosystems may also lead to healthier and more sustainable diets, which is a particularly important consideration for producers whose consumption is largely drawn from their own production (FAO, 2012b). It is required to systematically collect, conserve, characterize and utilize the biodiversity for future challenges.
7. Post harvest and rural agro-processing industries

The other option, which is not yet explored for addressing the issue of growth, income enhancement and temporary migration, is secondary agriculture i.e., processing and value addition. Large quantities of rice, tomatoes, fruits and vegetables are available in the season. Further, there are large quantities of forest produces in the state which is marketed in raw form. Strategic plans needs to be prepared for entrepreneurship development and institutionalization of rural community to take up viable enterprises on these commodities. This will help in creating employment and income opportunities in the village itself. Inadequate storage facilities and poor post-harvest technology for products especially domestic value added, are the bottleneck. Forests cover a large portion of land in the state, and is also one of the primary sources of livelihood for most tribal. Application of science and technology for sustainable exploitations of non timber forest produce and increasing profitability in its trade with processing and value addition has tremendous potential in livelihood enhancement in this region.

Food losses and wastage is another area of great concern. It is estimated that about 23% food is lost during the process of travelling food from seed to plate. FAO estimates that global food losses and waste amount to 1.3 billion tonnes per year–roughly one-third of the world food production for human consumption–and correspond to more than 10 percent of the world's total caloric energy consumption (Source: FAO, 2011b). Food losses refer to the decrease in edible food mass available for human consumption throughout the different segments of the supply chain. Food losses resulting from decisions to discard food that still has value to others are referred to as food waste. It is lost mostly during the early and middle stages of the food supply chain; much less is wasted at the consumer level. The causes of food losses and waste are mainly connected to financial, managerial and technical limitations in harvesting techniques, storage and cooling facilities, infrastructure, packaging and marketing systems, and the fact that loss-reducing technologies are too costly relative to the price of food to make their use cost-effective. Programmes to increase consumer awareness of food waste and energy use in food products,
regulations mandating reductions in organic waste management, promoting low-cost farm storage facilities as well as upgrading transport and processing facilities is required.

8. **Agri-knowledge management and dynamic technology extension network.**

Today, the country is passing through a phase of knowledge and technology based agricultural revolution. An innovative dynamic extension network that facilitates and promotes widespread dissemination of agricultural practices, implements and technology to the farming community, is essential for agricultural growth and prosperity. Increasing population, growing urbanization, high and volatile food prices and malnutrition due to poverty has made the issue of food security, of prime importance. We have to feed more and more people from the same land and water resources. Further, agriculture is facing the problem of low productivity, diminishing returns and increased cost of production. The possibility of increasing area under cultivation and water resources is limited. Thus, major breakthroughs in agricultural productivity is highly dependent on innovative approaches towards agriculture, on new technologies, how knowledge can reach the farmer in a useful form and hence new knowledge management systems are required.

It is time to think of sustainable evergreen revolution so as to bring more stability and sustainability to irrigated agricultural production systems and to bring sustainable green revolution in rainfed areas which continue to face the challenges of low productivity and scarcity of water and small fragmented land holdings, which are unable to take advantage of economies of scale. If we want to make agriculture profitable in such situation it is required to take agriculture as business and shift away from tilling land for self consumption to a situation where the farmer, along with other stakeholders, works to produce high output of single commodity for market. This not only require advice about crop planning and production, but also increased access to market information, insect and weather forecasts, latest management information on real time
basis. In fact this is the most precious service in the years to come.

Results from agricultural research are sometimes too academic to guide farmers, intermediary organizations and extension agencies. As a result the farmers gain little, as the knowledge is not being transferred to them in an understandable and doable form. Therefore, programs that reinforces partnerships between intermediary organizations and university, to produce accessible content in local languages, and at the appropriate technical level needs to be started. The digital revolution and mobile technology will be very useful to organize and share information and knowledge for the benefit of farming community. This will help in faster dissemination of technologies and solving the problems of farmers quickly and effectively in time. A network is required down to block and panchayat level, in which krishi vigyan kendras which are located at district level will have to play anchoring role in develop next generation of farmers.

It is high time to evolve models of value generation. The value can be generated by appropriate marketing of raw resources, value added products, marketing of technologies (ideas), and market innovations. The state with huge youth population should go for it. In software sector the country has done and in same way there is need of preparing youth in agriculture. Productivity enhancement of rainfed crops in the state will help in increasing farm sector growth and rural income. In several of the crops, the productivity levels in state are below national average. Strategic plans needs to be prepared for attaining this average during 12th plan period and surpassing it in phased manner. Research and development on identification/ screening of the most appropriate practices/ technologies from amongst the available ones, for extending green revolution in this part of the country is very important.

Providing farmers the state of the art services of soil testing, quality seed, quality planting materials and breeds of the animals and quality inputs of allied enterprises is very essential. The personals of KVK has to continuously update themselves in meeting out these challenges. A well defined and regular capacity building plan needs to be prepared in emerging areas of extension in order to
update the skills and proficiency of subject matter experts. Every district or agro-eco-situation (AES) has different limitations, capabilities and requirements. Thus, AES based extension plan and thrust areas are required to be identified for each KVKs. The KVKs need to demonstrate new technologies and methods to the farmers, commercialize technology so that its social value can be felt and should promote public private partnership.

9. **Agri-business in the supply-chain operations and management**

Indian agriculture is passing through a revolutionary change. The phenomenal development in the service sector has lead to accelerated economic growth of India in the past decade. The future growth of agriculture and allied sectors will largely depend on new and globally competitive technologies. New technologies have brought great improvements in the lives of farmers in advanced economies. It is important that state takes advantage of the modern practices, technologies and develop strategies to benefit its farmers from the growing demand in both domestic and international markets. Thrust areas include improving production and productivity, increasing profitability by reducing production cost, wastage reduction, post harvest and value addition, high-tech agriculture, micro propagation, micro irrigation, integrated nutrient management, organic farming, integrated pest management, protected cultivation, etc. The agribusiness will facilitates flow of investment, technologies, skill sets and modern management practices, supply chain management and alignment with domestic and international requirements, and improvement of market access through market Intelligence. The agribusiness will facilitate state of the art technology, knowhow and avenues for marketing of the produce apart from investments by private sector in developing the much needed agri infrastructure & agro based industry. Growth in agribusiness will act as an engine for the rural economy, creating employment and incomes. But this outcome is not automatic: improved policies, investment and governance are crucial.
10. Skill and entrepreneurship development

Indian agriculture is at the crossroads; on the one hand, there are bright spots, as in the fields of milk, cotton and horticulture production. On the other, there are dark spots, as for example, stagnation in the productivity of major food crops, fall in factor productivity, inadequate storage facilities and poor post-harvest technology. On the human side, over 40 per cent of farmers would like to quit farming, if they have another option. It is also becoming difficult to attract and retain youth in farming.

Agricultural growth will act as an engine for the rural economy, creating employment and incomes and reducing hunger and poverty in this state. For chronically hungry people in both rural and urban areas, employment opportunities contribute to improved access to food. Trained man-power is prerequisite for growth in rural sector and successful implementation of developmental programs. Limited youth gets opportunity of higher agricultural education, however, it is a matter of great concern as to how to get back the school dropout rural youth in agriculture. In agrarian areas like Chhattisgarh, where 50% farmers are marginal, agricultural vocational courses are very much important besides higher education in agriculture. If properly trained, these youth force can become expert future farmer. Skilled youth can provide a wide range of demand-driven services such as farm health management, production and marketing of the biological control agents, seeds and planting materials, improved post-harvest technology, village knowledge center to provide the right information at the right time and spread knowledge. Therefore, skill development and capacity building of such drop outs and farmers is required. Special programs for skill and entrepreneurship development needs high priority for increased rural job opportunities. Various vocational courses are also required to ensure that the farmers are capable of repairing and maintaining their own implements, and are in a position to make an educated and need based choice regarding purchase of new equipment. Training landless labourers would equip them with professional skills leading to their empowerment as well as increase in the productivity of land they work on.
11. Forest agriculture

Forests contribute directly and indirectly to food security and nutrition, while providing ecosystem services in broader agricultural landscapes. The forestry sector provides formal employment and income to a large section of society in this state. Food from forests and trees provides valuable sources of protein, minerals and vitamins. Tribal communities living in or around forests are highly reliant on these resources for their food supply. Forests serve as safety nets that are crucial for the survival of tribals. The collection and sale of non-timber forest products is an important source of household income, especially for women. Forests influence the amount of water available and regulate water surface and groundwater flows while maintaining high water quality; they sequester carbon; they can be used as shelterbelts and windbreaks; and also contribute significantly towards reducing soil erosion and protecting against landslides and floods. However, agriculture and forests are not being seen as in one landscape.

Agriculture has played a key role in the development of human civilization and the vast majority of the human population laboured in agriculture until the industrial revolution. The type of agriculture that developed was typically subsistence agriculture in which farmers raised most of their crops for consumption on farm, and there was only a small portion left over for the payment of taxes, dues, or trade. Due to advancement in technologies and its subsequent adoption by farmers productivity and food grain surplus increased, and subsequently many farmers diverted to other more profitable ventures.

The subsistence agriculture is still being practiced in several parts of Chhattisgarh. The farmers still practicing it without tilling the soil. In these areas the non timber forest produces (NTFP) are one of the major sources of livelihood support and their livelihood can only be improved by addressing all land based activities However, NTFPs are not considered under conventional agriculture, since it comes from forest without cultivation and tillage, and thus, it is not being looked after properly by any organization. In order to bring in the
sustainability in agricultural production systems, and with advancement of knowledge, we are again talking about zero tillage or no tillage systems. This suggests that anything that is coming out of land without tillage can be, and should be considered under agriculture.

There are several commodities which are being collected from forest by the tribal farmers in the form of leaves, fruits, gums, resins, roots and tubers. It is being sold raw, or, with minimum processing. The department of forest is involved in this activity. However, science and technology can play a very important role in this area. Further, there can be introduction of new crops (without tillage/minimum tillage) in forest for improving those who are living in such disadvantaged areas. Such areas are predominantly rainfed and green revolution in such regions can be sustainably brought in only if such activities are also considered.

Therefore, there is a need of revisiting the scope of agriculture by considering “Forest Agriculture” as one of the stream. It is required to establish new institutions and mechanisms of working. Core expertise should be developed for R & D on NTFP in agricultural university. There are a whole range of issues like; collection, conservation, evaluation of forest species, their sustainable exploitation, primary processing and value addition, branding and marketing in which concentrated efforts are required. The second green revolution in rainfed farming areas will become reality only when science and technology is used in improving this form of livelihood. It requires more information and knowledge about technologies, practices, market and institutions as compared to activities in irrigated areas because of diversity in produces and activities. On the contrary getting diversified knowledge to rainfed farmers are very difficult because of their location in disadvantaged areas and limited access to knowledge centres due to their poor socio-economic condition attached with poor supportive network.

Therefore, there is need of providing strong support to agricultural university in order to effectively play this role and to start new faculties of marketing, post harvest processing, and policy analysis. It is required to
establish new departments where core expertise in the area of collection, transportation, storage, marketing intelligence will be made available.

12. Policy research and analysis

The entire production system has to be shifted towards sustainability and this fundamental shift from unsustainable to sustainable requires fundamental changes in the governance of food and agriculture. It will require involvement of huge investments for input availability, production, marketing and post harvest processing. On farm investments for improving production efficiency at different scale involving all category of land holders will also be required. The speed of change should also be our concern, so that the vulnerable population can adapt and be part of the changes instead of widening the gaps that exist today. The governance challenge is that we know what has to be done, but we still lack a system of governance that will make sure that what is known is implemented, monitored and evaluated.

Even if we increase production in required pace there will remain two major concerns by 2050. First, the projected production increase must be achieved in an environmentally sustainable way given the pressures building on ecosystems. Second, even if we achieve the projected increases in food production, lakhs of people may still suffer from chronic hunger in 2050, primarily as a result of their lack of access to sufficient food. Policy decisions to address income growth patterns, changes in dietary preferences, levels of food waste and how agricultural production is used for non-food purposes will be required.

Key areas for action on policy to build the necessary incentives and capacity to eradicate hunger and make the transition towards sustainable agricultural and food systems include: establishing and protecting rights to resources, especially for the most vulnerable; incorporating incentives for sustainable consumption and production into food systems; promoting fair and well-functioning agricultural and food markets; reducing risk and increasing the resilience of the most vulnerable; and investing public resources in
essential public goods, including innovation and infrastructure, to create an enabling environment.

Sound policies are needed to create the incentives and capacities for sustainable consumption and production and to enable consumers and producers to make sustainable choices. In order to address these issues and to prepare strong policy framework for agricultural developments of state there is need of establishment of a centre for policy research and analysis. This centre should work on preparation of policy instruments in consultation with planners and leading experts of country.
**Strategy and Framework**

The following strategy and framework (Annexure I) would be adopted to accomplish the vision and the goals of the Indira Gandhi Krishi Vishwavidyalaya.

1. Empowering youth with knowledge and skill and improve quality and efficiency of human resource.
2. Reorientation of the research and development focus to develop and promote those technologies that raise agricultural productivity, profitability, income, ensures employment opportunities, and sustainability of production and consumption systems with special focus on small farm holders.
3. Provide state-of-the-art scientific facilities in laboratories and infrastructure.
4. Commercialization of technologies through organized intellectual property rights and benefit-sharing system.
5. Facilitate accelerated dissemination of improved technologies, knowledge and information.
6. Promote effective, efficient and decentralized governance by introducing best management practices.
**Epilogue**

The Indira Gandhi Krishi Vishwavidyalaya is committed to bring knowledge and technology-led sustainable revolution in agriculture of Chhattsiagrh and thereby augmenting food and livelihood security of tribal dominated farming community. We envision that innovations in agriculture would transform agriculture sector into a vibrant and competitive sector. We firmly believes that agricultural research and development would augment farmers' income, generate employment opportunities, conserve natural resources, and increase value addition for higher and inclusive agricultural growth. To sustain the benefits of research and development, the university would sensitize and facilitate in creating a favourable institutional support, infrastructure and policy environment at different administrative levels. The university would be transformed to be more sensitive to the needs of the farming community, especially of the tribal and smallholders and of the poor living in the disadvantaged areas of the state. The university will develop strategies to respond to the needs of the stakeholders. More vigilance and institutional processes that develop a culture of responsibility, accountability and integrity will be brought in the institution for this purpose.
References


### Annexure 1: Strategic Framework

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<th>Outcome</th>
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| Qualified and skilled manpower in agriculture, agri-research and agri-business. | a. Improving quality of higher agricultural education and enhancing capacity of human resource in research.  
b. Increasing gross enrolment ratio in formal and non-formal agricultural education through more education opportunities.  
c. Providing quality assurance through assessment and accreditation.  
d. Enhancing integration of education with research, and developing and nurturing new generation of scientists  
e. Attracting rural youth in agriculture  
f. Strengthening and streamlining education system to meet future challenges through appropriate reforms in curricula, academic regulations, experiential learning and improving teaching and learning processes to develop entrepreneurial capabilities, and produce employable and industry ready graduates.  
g. Establishment of industry-education linkages.  
h. Capacity building of faculty through training at the national and international level.  
i. Skill and entrepreneurship development in rural school drop outs through vocational courses.  
j. Regular manpower planning and development in agriculture sector with focus on research and development system, agri-service providing system, and agri-business. | Empowering youth with knowledge and skill and improve quality and efficiency of human resource          |
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| Harnessing the benefit of frontier science and technology | a. Establish modern laboratories of biotechnology, bioinformatics, nano-biotechnology, transgenics, biodiversity parks, remote sensing, and geographical information facilities, and developing state of art infrastructure.  

b. Establishment of new research centres, centre of excellence for varied agro-climatic situations | a. Modern technologies developed to address emerging issues.  
b. Facilities developed for training of research students in frontline areas | |
| Reorientation of the research and development focus | a. Prioritize, formulate multi-disciplinary, multi-institution target-oriented eco-region-wise research and technology development programmes in entire production to consumption chain.  
b. Focus more on rainfed, marginal and small farmers with focus on emerging market opportunities.  
c. Develop models of sustainable agriculture through integrated farming systems and organic farming with shift from input-intensive to knowledge intensive agriculture.  
d. Develop crop varieties with tolerance to various biotic and abiotic factors (particularly the drought and high temperature).  
e. Developing technologies for precision farming, protected cultivation, and farm mechanization with special reference to rainfed farming.  
f. Developing technologies for forest agriculture | Developed technologies to address real world issues |
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| Maintaining and improving status and quality of natural resources for climate smart agriculture | a. Develop management options to improve soil and land quality.  
b. Technological options to enhance water-use efficiencies, water quality, and increase water availability.  
c. Management strategies to conserve and use wastelands and marginal lands.  
d. Development of land use plan at appropriate levels.  
e. Technologies for climate change adaption and mitigation for risk reduction in agriculture. | a. Improved water and input use efficiencies.  
b. Reclaimed degraded soil, land and water.  
c. Technologies and management practices developed for drought management. |
| Exploring biodiversity for development of biotic and abiotic stress tolerant new high yielding crop varieties | a. Collect, conserve, characterize and promote use and access to genetic diversity.  
b. Develop germplasm repository and necessary infrastructure and facilities.  
c. Extensive use of Marker Assisted Selection for increased genetic gains  
d. Using all available modern biotechnological tools including transgenic and genomics to harness the valuable genes for drought tolerance, nutritionally important traits, stem borer tolerance, herbicide tolerance, low nutrient tolerance | a. Developed efficient new crop varieties.  
b. Protected biodiversity for future |
b. Developing recycling systems.  
c. Management of energy and agricultural waste. | Reduced dependency on external inputs, increased profitability and clean environment |
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| Improve food security and livelihood and enhance opportunities for inclusive growth | a. Sustainable agriculture intensification for higher productivity, profitability through efficient use of land and water resources. 
 b. Development and promotion of integrated farming systems for incorporation of allied enterprises. 
 c. Reorientation of the research and development focus to develop and promote those technologies that raise agricultural income, ensures employment opportunities, and sustainability of production and consumption systems. 
 d. Developing models of forest agriculture in tribal and forest areas. | Reduced poverty and hunger. |
| Improve Post harvest processing, value addition and rural agro-processing industries | a. Development and introduction of demand driven high value products with their cost effective post harvest technologies 
 b. Develop approaches and machines to improve processing, storage and distribution. 
 c. Develop pilot research models in production to consumption system with special reference to non timber forest produce. | a. Improved livelihood opportunities, higher income and better quality of life. 
 b. Developed techniques and processed products. 
 c. Established public-private partnership and linkage of industry and farmers. |
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| Improve Agrisknowledge management and dynamic technology extension network | a. Develop and pilot effective delivery systems and evolve institutional models to link research and development system with farmers and other stakeholders in the value-chain for accelerated adoption of technologies.  
  b. Developing models and support system for application of information and communication technology and e-extension  
  c. Improve post-harvest management, value-addition and market intelligence for prices, niche market and products.  
  d. Shift to knowledge intensive agriculture from input intensive.  
  e. Developing next generation of farmers | a. Dynamic technology extension system developed.  
  b. Quick dissemination of technologies and remedies for the problems of farmers |
| Technology commercialization | a. Identification of Technologies and partners for commercialization.  
  b. Developing IPR and benefit sharing system.  
  c. Developing technology management system | a. Commercial linkages established  
  b. Speedy dissemination of technologies |
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| Policy research and analysis                  | a. Form policies for accounting ecosystem services; ecological economics; trade in carbon credits; virtual water trade.  
  b. Policies for commercialization of technologies and food processing.  
  c. Policy issues in conservation and utilization of germplasm.                                                                   | Sound policies available for designing research and development programs  |
| Improving governance of academic system       | a. Management information system (MIS), priority-setting, monitoring and evaluation (PME) by employing information and communication technology;  
  b. Develop a performance-based work-culture with incentives-and rewards system  
  c. Develop a futuristic human resource development programme in cutting-edge science and technology.                          | Improved efficiency and delivery                                         |