26

COMMITTEE ON AGRICULTURE
(2010-2011)

FIFTEENTH LOK SABHA

MINISTRY OF AGRICULTURE
(DEPARTMENT OF AGRICULTURAL RESEARCH AND EDUCATION)

DEVELOPMENT OF ABIOTIC STRESS RESISTANT CROP VARIETIES AND DISSEMINATION OF PRODUCTION ENHANCING TECHNOLOGIES – REVIEW OF R&D AND EXTENSION EFFORTS IN THE COUNTRY

TWENTY SIXTH REPORT

LOK SABHA SECRETARIAT
NEW DELHI

AUGUST, 2011/ BHADRAPADA, 1933 (Saka)

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Presented to Lok Sabha on	30.08.2011
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CONTENTS

ANNEXURES

APPENDICES

COMPOSITION OF THE COMMITTEE ON AGRICULTURE (2010-2011)

Shri Basudeb Acharia - Chairman

MEMBERS

LOK SABHA

2. Shri Narayansingh Amlabe
3. Shri K.C. Singh 'Baba'
4. Shri Thangso Baite
5. Shri Jayant Chaudhary
6. Smt. Shruti Choudhary
7. Smt. Ashwamedh Devi
8. Shri Biren Singh Engti
9. Smt. Paramjit Kaur Gulshan
10. Shri Anant Kumar Hegde
11. Shri Sk. Nurul Islam
12. Shri Naranbhai Kachhadia
13. Shri Surendra Singh Nagar
14. Shri Prabodh Panda
15. Shri Premdas
16. Shri Vitthalbhai Hansrajbhai Radadiya
17. Shri Nripendra Nath Roy
18. Shri Bhoopendra Singh
19. Shri Uday Singh
20. Shri Jagdish Thakor
21. Shri Hukmadeo Narayan Yadav

RAJYA SABHA

22. Shri Shashi Bhusan Behera
23. Shri Narendra Budania
24. Shri Satyavrat Chaturvedi
25. Shri A. Elavarasan
26. Shri Vinay Katiyar
27. Shri Mohd. Ali Khan
28. Shri Upendra Kushwaha
29. Shri Bharatsinh Prabhatsinh Parmar
30. Shri Rajpal Singh Saini
31. Shri S. Thangavelu

SECRETARIAT

1.	Shri Deepak Mahna	-	Joint Secretary
2.	Shri P.V.L.N. Murthy	-	Director
3.	Shri P. C. Koul	-	Additional Director

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Shri Basudeb Acharia - Chairman

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8.	**Shri Biren Singh Engti**
9.	**Smt. Paramjit Kaur Gulshan**
10.	**Shri Anant Kumar Hegde**
11.	**Shri Sk. Nurul Islam**
12.	**Shri Naranbhai Kachhadia**
13.	**Shri Surendra Singh Nagar**
14.	**Shri Prabodh Panda**
15.	**Shri Premdas**
16.	**Shri Vitthalbhai Hansrajbhai Radadiya**
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20.	**Shri Jagdish Thakor**
21.	**Shri Hukmdeo Narayan Yadav**

RAJYA SABHA

^22.	**Shri Narendra Budania**
23.	**Shri Satyavrat Chaturvedi**
24.	**Shri A. Elavarasan**
$25.	**Shri Sharad Anantrao Joshi**
26.	**Shri Vinay Katiyar**
27.	**Shri Mohd. Ali Khan**
28.	**Shri M. Rajasekara Murthy**
29.	**Shri Bharatsinh Prabhatsinh Parmar**
30.	**Prof. M.S. Swaminathan**
***31.**	**Shri Khekiho Zhimomi**

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* *Vice Shri Khekiho Zhimomi who ceased to be the Member of the Committee on his retirement from Rajya Sabha on 2 April, 2010 and Smt. B. Jayashree nominated on 2 July, 2010.*

^ *Vice Shri Narendra Budania who ceased to be the Member of the Committee on his retirement from Rajya Sabha on 4 July, 2010.*

$ *Vice Shri Sharad Anantrao Joshi who ceased to be the Member of the Committee on his retirement from Rajya Sabha on 4 July, 2010.*

INTRODUCTION

I, the Chairman, Committee on Agriculture, having been authorized by the Committee to submit the Report on their behalf, present this Twenty-Sixth Report on the subject 'Development of Abiotic Stress Resistant Crop Varieties and Dissemination of Production Enhancing Technologies – Review of R&D and Extension Efforts in the Country'.

2. The Committee (2009-10), taking into consideration the serious challenges in the form of climate change and consequent global warming and feeling that a lot needs to be done to face these challenges, had selected this subject for detailed examination and Report to Parliament. The Committee (2009-10) were briefed on the subject by the representatives of the Ministry of Agriculture (Department of Agricultural Research and Education) on 16 September, 2009 and took their Oral Evidence at the Sitting held on 21 January, 2010. The Committee on Agriculture (2010-11) decided to continue the examination of the Subject and took further Oral Evidence of the representatives of the Department on 25 November, 2010. The Committee wish to express their thanks to the officers of the Department of Agricultural Research and Education and Indian Council of Agricultural Research for appearing before them and furnishing the information desired by it in connection with the examination of the subject.

3. The Committee also wish to express their sincere thanks to their predecessor Committee for the significant contribution made by them in the examination of the subject. The Report was considered and adopted by the Committee at their Sitting held on 29 August, 2011.

4. For facility of reference the Observations/Recommendations of the Committee have been printed in bold letters at the end of each Chapter of the Report.

NEW DELHI;
29 August, 2011
7 Bhadrapada,1933 (Saka)

BASUDEB ACHARIA
Chairman,
Committee on Agriculture

ABBREVIATIONS

AICRP	All India Coordinated Research Projects
BE	Budget Estimate
CG INSTITUTES	Central Government Institutes
CICR	Central Institute of Cotton Research
CIMMYT	International Maize and Wheat Improvement Centre
DARE	Department of Agricultural Research and Education
DBT	Department of Biotechnology
DG	Director General
DNA	Deoxyribonucleic acid
GDP	Gross Domestic Product
GHGs	Greenhouse Gases
GIS	Geographical Information System
GM	Genetically Modified
IASRI	Indian Agricultural Statistical Research Institute
ICAR	Indian Council of Agricultural Research
ICARDA	International Centre for Agricultural Research in the Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IIPR	Indian Institute of Pulses Research
IIVR	Indian Institute of Vegetable Research
IMD	Indian Meteorological Department
IPCC	Inter Governmental Panel on Climatic Change
IRRI	International Rice Research Institute

KVKs	Krishi Vigyan Kendras
NARS	National Agricultural Research System
NGOs	Non Governmental Organizations
NIC	National Informatics Centre
NPK	Nitrogen Phosphorus Potassium
NPTC	Network Project on Tangencies in Crops
NRCPB	National Research Centre on Plant Biotechnology
NRCRM	National Research Centre on Rapeseed Mustard
PSUs	Public Sector Undertakings
QTL	Quantitative Trait Loci
R&D	Research and Development
RE	Revised Estimate
SAU	State Agriculture University
UAS	University of Agricultural Sciences
ZPDs	Zonal Project Directors

CHAPTER I

INTRODUCTORY

The Indian Council of Agricultural Research with its vast network of Institutes spread all over the Country is surging ahead to provide scientific and technological support for enhancing production and productivity for sustainable agriculture through innovative approaches. Through its research, education and extension programmes, the Council is committed to transforming Indian agriculture primarily for food self-sufficiency to enhancing profitability. Department of Agricultural Research and Education/ICAR have 45 Research Institutes, 4 Deemed Universities, 6 National Bureaus, 17 National Research Centres, 25 Directorates/Project Directorates, 61 All India Coordinated Research Projects and 17 Network Projects. Besides 45 States Agricultural Universities, one Central Agricultural University and 584 Krishi Vigyan Kendras (Agricultural Science Centers) (KVKs) supporting agriculture in the Country.

1.2 The Department have informed the Committee that agriculture is inherently sensitive to climatic conditions and is among the sectors most vulnerable to weather and climate risks. Globally, over 70 per cent of natural disasters are related to weather and climate. Variability in weather elements, especially rainfall has been, and continues to be, the principal source of fluctuation in food production. Droughts, floods, tropical cyclones, heavy precipitation events, hot extremes and heat waves are known to negatively impact agricultural production and farmers' livelihood. Almost 80 million hectares of our land is rainfed; the Country has had 26 droughts in last 130 years; with 1987 and 2002 being the major drought years in recent times. Droughts have always caused considerable loss in food production; for example, the recent drought of 2002 led to reduced coverage of more than 15 million hectares of the *kharif* crops and resulted in a loss of more than 10% in food production. On the other hand, floods are also frequent, especially in eastern India, which adversely affect the livelihood security of

million of farmers. Frost and cold waves also often cause yield losses in north-western India. During December, 2002-January, 2003, there was a cold wave all over northern Indian that caused considerable damage to crops, such as mustard, mango, guava, papaya, brinjal, tomato and potato. The nation has also witnessed frequent episodes of heat stress, which cause loss in crop production. In March, 2004, temperatures were higher in the India-Gangetic plains by 3-6^{0}C, which is equivalent to almost 1^{0}C per day over the whole crop season. As a result, wheat crop matured earlier by 10-20 days and its production dropped by more than 4 million tonnes in the Country. Losses were also very significant in other crops, such as mustard, peas, tomatoes, and other vegetables and fruit crops. Cyclones, common in eastern coast of India are again another major source of concern. Coastal ecosystem are subjected to periodic surge in salinity and cyclonic floods.

1.3 During the course of Oral Evidence of the representatives of the Department on 21 January, 2010, the representative of the Department clarified further in this regard:

> "I would also like to give a little background of the whole problem and come to specifics also…….. Abiotic stress as you mentioned rightly, is nothing new to this Country with the kind of variations we have from 8 degree North latitude to 34 degree latitude. This is the range we have from coastal to Himalyan ecosystem. With this out of about 327 million hectares in this Country, about 140 $\pm$ 2 million hectares is under cultivation. In that area we have different kinds of problems. As was rightly pointed out, drought prone area is about 12 million hectares and salt affected area is about 6.7 million hectares. There is an area about 90 million hectares which is acid affected, while such area under cultivation is about 12 million hectares. These are the situations under which we are cultivating".

1.4 There are several other abiotic stresses that crops experience. Intensive agriculture in some places has caused depletion of natural resources such as soil organic matter water and nutrients, leading to lowered water table and nutrient imbalances in the production system.

Alkalinity and salinity have increased in large parts of north western plains and soils in the north eastern hills are affected due to acidity. A large number of marginal and small farmers generally do not invest in application of micronutrients which also has led to increase in deficiencies of nutrients such as zinc, boron, sulphur and iron. This imbalanced nutrient use coupled with degrading environments or pollution has led to increasing toxicities of arsenic, selenium and other heavy metals.

1.5 According to the written information furnished by the Department to the Committee, the major abiotic stresses encountered by agriculture sector are drought, floods/water logging, soil and water salinity, soil acidity and nutrient deficiency. Indian soils are generally deficient in nitrogen, phosphorus, sulphur and micro-nutrients like zinc and boron. About 25 m ha of soils with pH less than 5.4 are critically degraded and have very less productivity. These stresses can reduce crops productivity by as much as 65% in India depending on the crop, region and severity of the stresses at the national level. Animal and fish productivity are also significantly affected by these stresses. About 80 m ha area out of total 140 m ha cultivable area is rainfed, which is frequently prone to a combination of several stresses coupled with drought stress. The state-wise/zone-wise information is at **Annexure - I.**

1.6 During further Oral Evidence on 25 November, 2010 the Secretary, DARE and DG, ICAR informed the Committee as under:

> "Today, we are into several kinds of abiotic stresses, but in many places severe cold witnessed in winter, Cold is also one thing and last year due to frost in many districts of Rajasthan particularly there was a extensive loss to crops. These are all different kinds of abiotic stresses which we were not used to experience earlier. As you stated that situation of drought and floods has come up simultaneously in various parts of the country. Now it has been seen that there is flood in Northern portion and drought in Southern portion of the same state. In some districts we came across, say, some

Talukas are under kind of water stress and some under floods. These are the kinds of wavering pattern. This is what we have been submitting. We talk of nitrogen, phosphate and potassium but do not talk zinc & sulphur. First time even for the last five years we have been attempting this. The cloud burst which is rare event but that has also added to the frequency. Of about 327 million hectares, 104 million hectares are under some on the other stresses".

1.7 Research and Development in Scientific disciplines is a capital intensive proposition. Moreso, in frontier science areas. The Committee, therefore, desired to know about the allocations over the years to the Department for carrying out their mandated responsibilities professionally and in a time bound manner. In response, Secretary, DARE and DG, ICAR stated during the Oral Evidence:

"Sir, on the first point with regard to allocation against Rs.5600 crore that we had as Plan allocation during the Tenth Plan, the Working Group recommended something like Rs.36000 crore. Then it was stated as Rs.31000 crore. As against that we got a tentative allocation of Rs.12500 crore, whereas, the actual allocation was Rs12023 crore".

1.8 Carrying further he added:

"We have also given areas where it might be difficult for us to achieve the full objectives because during the current year, we have set very specific programmes like enhancing input use efficiencies, our programmes in bio-technology, breed development, diagnostics and vaccines. These are some of areas, which we have listed for ourselves. We have been told that next year, we could get full amount. So we had given detailed justification. But as I understand now it would be that kind of figure. May be it might go to 20 per cent; it may not be beyond that so in that context also, we have submitted recently what are those areas, which we can address and what are those areas where it might me a problem for us to achieve all the targets. I would again seek you guidance and support in getting greater allocations to achieve the full objectives".

1.9 In the considered opinion of the Committee, apart from the Indian farmer, it is the National Agricultural Research System with ICAR as its guiding spirit which has ensured the food security and safety of the Country. With 45 Research Institutes, 4 Deemed Universities, 6 National Bureaux, 17 National Research Centers, 25 Directorates/Project Directorates, 61 All India Coordinated Research Projects and 17 Network Projects forming the Research and Development core and 45 State Agricultural Universities, one Central Agricultural University and 584 KVK forming the bulwark of the Extension Services, the DARE/ICAR network has contributed significantly towards self-reliance and development of agriculture and allied sectors in India. Having successfully met the challenge of ensuring food security during the last five odd decades, ICAR need to now gear up to face many different types of challenges. The increased economic and industrial activities have led to a paradigm shift in the climate and environment of the world. Apart from the diseases and pestilence, new threats are emerging to agriculture sector due to global warming and climate change etc. In such a scenario, agriculture which is inherently sensitive to climatic conditions had acquired additional vulnerability, which at the present juncture is highly unpredictable.

1.10 Variability in weather particularly when almost 80 million hectares of land in India is rainfed poses serious ramifications on the agri-sector. The Committee observe that inspite of the declining contribution of this sector to GDP drastically over the years, agriculture continues to provide livelihood to almost 60% of our workforce. The Committee note that though abiotic stresses are as old as agriculture itself, the changing dimension due to climate change are a worrisome aspect. The growing vagaries of weather apart, abiotic stresses are also a result of depletion of water table and nutrient imbalances in soil like zinc, boron, sulphur and iron, increased salinity and alkalinity, deficiencies of nitrogen, phosphorous and sulphur, imbalanced use of fertilizers, increasing toxicities of selenium and other heavy metals, etc. The Committee realizing the emerging threats, had in their Forty Seventh Report (Fourteenth Lok Sabha) on the 'Impact of Global Climate Change on Agriculture and Allied Sectors in India' suggested several remedial measures and strategies to cope up with the situation. What has, however, dis-appointed them was that the Government, despite being forwarned of the impending threats and their likely ramifications on the agriculture sector and livelihoods of million of people has chosen to remain impervious to the gravity of the situation. The Committee had in view of the capital intensive solutions to these vexed problems recommended in their said Report that National Agriculture Research

System ought to be provided sufficient funds to ensure that the Research and Development efforts are not hindered. The Committee are, however, highly perturbed to note that the Government has singularly failed to adequately fund the research efforts of our research scientists. As has been time and again brought out in previous Reports of the Committee, the allocation of Rs.12023 crore against Rs.31000 crore recommended by the Working Group for DARE for the Eleventh Plan, shows complete lack of concern of the Government towards this important aspect. They hope against hope that the situation on this front would witness a significant improvement at least during Twelfth Plan. They would like to be apprised of the action taken and results obtain in this regard at the earliest.

1.11 The Committee would like to caution the Government that climate change presents an unprecedented situation before a developing Country like India. The most worrisome aspect being the unpredictability of the dimensions of the problem; the overt dependence of Indian agriculture on monsoon; the pre-dominance of small and marginal farmers and several landless who do not have secure livelihoods; the more or less plateauing of the agricultural production; the continuing socio-economic downgrading of agriculture as a profession to cite a few.

1.12 As would be clear from the succeeding Chapters, the National Agricultural Research System is fully seized of the gravity of the problem and is also working on several solutions both long and short term, to mitigate the problems that are arising/may arise from climate change. Unfortunately, however, the requisite support of the political leadership and the policy makers is not forthcoming at the requisite levels and with due alacrity. The food security of the Country has been earned through the relentless toil of our farmers and the selfless services of our scientists in the public sector and it should not be frittered away due to unimaginative planning and wrong priorities. If we have to ensure food security for our population in the coming years, the Research and Development efforts of National Agricultural Research System in agriculture sector are to be catered to the fullest and with all promptitude. The Committee expect the Government to wake from its slumber and do the needful at least in the Twelfth Plan. The Committee also expect the Department to put their proposals before the planners and the Government more forcefully and purposefully so that their voice is heard and their financial requirements are met on priority.

CHAPTER-II

IMPACT OF ABIOTIC STRESS ON AGRICULTURE

The Committee have been informed that during 2008-09, the area under foodgrains was 122.83 million ha with highest ever production of 234.47 million tonnes. However, during 2009-10, drought-like situation with 23% deficit rainfall was experienced in most of the States. Consequently, the area under foodgrains declined to 121.37 million ha and the foodgrain production to 218 million tonnes (IVth advance estimate, 2009-10). The table below indicates acreage, production and percentage of monsoon during the period 2000-01 to 2009-10:

Years	Cropped area (million ha)	Food Production (million tonnes)	Monsoon (%)
2000-01	121.05	196	91
2001-02	122.78	212	91
2002-03	**113.86**	**174**	**81**
2003-04	123.45	213	102
2004-05	120.08	198	87
2005-06	121.60	208	99
2006-07	123.71	217	99
2007-08	124.07	231	105
2008-09	122.83	234	98
2009-10	**121.37**	**218**	**77**

2.2 The above table shows that there were no linkages between the acreage, production and monsoon during the years 2003-04, 2005-06, 2006-07, 2008-09 and 2009-10, when inquired the reasons for the same, the Department in their written submission informed the Committee that these data indicate that cropped area and foodgrains production decrease when there is deficit rainfall/drought as observed in 2009-10. However, the distribution of rainfall, both in temporal and spatial

dimensions, is also important. The other factors like input supply and agro-climatic conditions also affect foodgrain production.

2.3 When asked the reasons for not developing any mechanism so far to find out the loss in acreage production due to various abiotic stresses, the Department responded that sown acreage is largely a function of the temporal and spatial nature of precipitation each year and is not impacted in a major way by subsequent abiotic stresses. Other abiotic stresses may impact production. The correlation between each abiotic stress and its impact on production is a matter of long-term research.

2.4 To a pointed query regarding loss of acreage, the Secretary, DARE and DG, ICAR submitted during the further Oral Evidence:

> "The second point was with regard to the acreage. On this Sir, we would require some more time because we are continuously looking into the satellite data. From there also, we are taking information as to what is the kind of increase or decrease in crop coverage. So we had said that as we go along, we would come up with these figures"

2.5 Another representative of ICAR amplified further on the problem during the further Oral Evidence:

> "In addition to abiotic stress, when the crop is grown in the farmer's field, the biotic stress also comes together. Many times abiotic stress makes plant weaker. Even certain plants which we consider as resistant to certain biotic stress they become susceptible to biotic stress. Sometimes when the yield loss comes, it is just not coming for abiotic stress, there are multiple factors attributed to this loss. That is the reason we could not pinpoint exactly that this loss is because of this particular abiotic stress, we only consider when there is an extreme climate change or there is a determined climate change that we can measure"

2.6 During 2009 drought, ICAR compiled all the available research information that included varietal and emergent strategies on contingency plans due to delay in monsoon and mid-season breaks. These contingency

plans for facing anticipated eventualities were prepared and coordinated for implementation in the Ministry of Agriculture. Such pro-active steps were fortified by each State Agricultural University's agro-advisories based on weather forecasting in local languages, which helped farmers to minimize the loss of food grain production to certain extent.

2.7 Explaining it further Secretary, DARE & DG, ICAR stated during the further Oral Evidence:

> "I would like to mention that the year 2010 has experience good heavy rainfall. But several places particularly in Bihar, Jharkhand and some places in eastern UP have received deficient rainfall. But then we would also like to mention that some of these things that we are doing, as we submitted here. What we had in the year 2008-09, what has happened in drought like situation in the year 2009. We have submitted that 122 million hectares decreased to 121 in last year. But one thing is that ICAR has been doing in its technology, we call it drought proofing. We have done a lot of things during the last five years. It was cropping pattern. This time when there were adequate rains in some districts of Bihar, we recommended pulses, like *toor dal* and also *rabi* is going to be very good. That is the kind thing.
>
> I would like to submit that same situation was there in the year 2002 as we have experienced in the year 2009. But the rainfall deficit was almost the same and the good grain production was reduced. It has decreased to 9 percent, this was earlier 21 percent, production of oil seeds reduced to 22 percent, from 44 percent, sugarcane, the point is that drought proofing that we have been trying to recommend in terms of packages, cropping pattern and several other kinds of agro – advisories that we are providing, and then conservation of agricultural technology, zero tillage, etc. we are able to clearly demonstrate the drought proofing efficiency in 2009 has been a very clear contribution of the Department".

2.8 In the short term, these efforts have reduced the impact of anticipated adversities due to drought –like situations. In the long-term also, when the district level contingency plans will be implemented by the State Governments, the fruits of agricultural research will reach the farmers and would improve the knowledge and skill to face severe adversities.

2.9 Intensive agriculture in some places has caused depletion of natural resources such as water and nutrients, leading to lowered water table and nutrient imbalances in the production system. Alkalinity and salinity in large parts of north western plains have increased and soils in the north eastern hills are affected due to acidity. A large number of marginal and small farmers generally does not invest steps towards amelioration as well as in application of micronutrients which has led to increase in deficiencies of nutrients such as zinc, boron, sulphur, iron and also prevent degrading environment or pollution.

2.10 The Department of Agricultural Research and Education informed the Committee that soil fertility aspect of Agriculture has never been a neglected area in any of the ecological zones of the Country. Three All India Coordinated Research Projects (AICRP on Micro and Secondary Nutrients, AICRP on Soil Test Crop Response Correlation Studies and AICRP on Long Term Fertilizer Experiments) have been making sincere and dedicated efforts in collaboration with SAUs and ICAR Institutes and have undertaken to assess the soil fertility status of Indian soils periodically.

2.11 The Committee desired to know the details of work undertaken to map and classify the soil nutrition or health conditions and to educate the farmers to cultivate their land accordingly. The Department of Agricultural Research and Education/ICAR informed that they have prepared soil fertility maps of macronutrients (NPK) for 20 States and micronutrient maps for 10 States. Majority of the districts were low to medium in N and P and medium to high in K. The Council has undertaken preparation of GIS-based soil fertility maps (both macro and micronutrients) for different Districts/States. The fertilizer recommendations developed have become part of States' package of practices for various crops. Decision support systems have been developed by National Informatics Centre (NIC), Pune, in Tamil Nadu,

Andhra Pradesh, Maharashtra, Punjab, Chhattisgarh, Himachal Pradesh and Orissa for soil test based fertilizer recommendations for the benefit of farmers.

2.12 Elaborating further on this vital aspect a representative of the Department stated during the further Oral Evidence:

> "Sir, you mentioned about soil health, I would like to inform this august Committee that we have prepared roadmaps for 21 States and they have been created recently. Out of these, in 12 Stats, we have developed a support system which is based on the soil, crop and what the farmer would like to get, including crops yield, district-wise. Out of these 21 States, nine States have it up to Tehsil level. In a State, anybody can go to that particular Tehsil, click on it, and the information is there. If he can feed soil test values, he will get exact recommendation. Otherwise based on the values that are available, the recommendation is made. This information is crop-wise, soil-wise, and this Tehsil-wise information takes care of the agro-climatic conditions. We know that it is the decrease in the organic carbon which has a bearing on the soil health. We have initiated and we have come up with recommendations for integrated nutrient management so that one knows how much of chemical fertilizers could be substituted by organic so that soil health is maintained. We have got those recommendations for different crops and for different soils.
>
> We also have an organic farming project which has been in operation since 2004 at 13 locations in the Country plus the State Agricultural Universities. Now, we have in fact compiled all the available information. It is available with our Institute which is coordinating this at Modipuram. The information on what are the best practices for organic farming is available. There are many gaps which the farmers are not aware of. We have addressed this also".

Increasing climatic risks due to climate change

2.13 The global atmospheric concentration of Carbon Dioxide (CO_2), a Greenhouse Gas (GHG) largely responsible for global warming has increased from a pre-industrial value of about 280 ppm in 1750 AD to 379

ppm in 2005. Similarly, the global atmospheric concentration of methane and nitrous oxides, other important GHGs, has also increased considerably. The Inter-governmental Panel on Climate Change (IPCC) has shown that this has resulted in warming of the climate system by 0.74^0C between 1906 and 2005 and twelve of the last fourteen years (1995-2008) rank among the warmest years in the instrumental record of global surface temperature since 1850. Global average sea level rose at an average rate of 1.8 mm per year over 1961 to 2003 and IPCC has projected that the global annual temperature is likely to increase in the range of 1.4 to 4.5^0C by the end of this century. Overall, the temperature increases are likely to be much higher in winter (*rabi*) season then in rainy season (*kharif*). Precipitation is likely to increase; tropical cyclones will become more intense in future, with larger peak wind speeds and more heavy precipitation. It is very likely that hot extremes, heat waves, and heavy precipitation events will continue to become more frequent.

Impacts of climate change on Agriculture

2.14 Photosynthesis of several crops increases as atmospheric carbon dioxide increases. Such carbon accumulation effects are important for crops such as rice, wheat and pulses. The yields of these crops, in general, increase by 10-15% as CO_2 goes up from 380 ppm (almost current level) to 550 ppm. Despite this, associated increase in temperatures and increased variability of rainfall are likely to considerably impact food production. The IPCC report and few other global studies indicate a probability of 10-40% loss in crop production in India with increases in temperature by 2080-2100.

Small changes in temperature and rainfall causes significant effect on quality of fruits, vegetables, tea, coffee, aromatic, and medicinal plants with resultant implications on their prices and trade.

2.15 The Department of Agriculture Research and Education have informed that after the IPCC report and a few other studies, simulation

analyses were carried out under the Network Project on Climate Change with following observations:

(1) Likely loss of 4-5 million tons in wheat production with every rise of 1^{o}C temperature throughout the growing period.

(2) Reduce the irrigated wheat production by ~5% in 2030 and up to 25% in 2080 scenarios.

(3) Reduction in irrigated rice production is likely to be about 2% in 2030 scenario and up to 10% loss in different climate change scenario for 2080 time period, while the rainfed rice production is likely to benefit by about 2% in 2030 scenario but in 2080 scenario, a 8% loss is projected.

(4) Reduction in the yields of irrigated *kharif* maize is likely to be around 6.83% in 2030 scenario

(5) Global climate change may increase production of potato in Punjab, Haryana and western and central UP by 3.46 to 7.11% in 2030 scenario, but in rest of India particularly West Bengal and plateau region potato production may decline by 4 to 16%. Such climatic changes are likely to result in increased soybean yields by 8-13%. Effect of climate change on groundnut is likely to be variable with yields varying between -5% and +7% as compared to current yield.

(6) Simulation studies indicate positive effect of climate change on coconut yields Kerala, Maharastra, North-Eastern states and parts of Tamil Nadu and parts of Karnataka while they are projected to decline in Andhra Pradesh, Orissa, Gujarat and parts of Tamil Nadu and parts of Karnataka in 2020, 2050 and 2080 scenarios. In west coast, yields are projected to increase by up to 10% in 2020, up to 16% in 2050 and up to 39% by 2080 while in east coast yields are projected to decline by up to 2% in 2020, 8% in 2050 and 31% in 2080 scenario.

(7) North-ward extension of abundance of fishes oil saradine and mackerel and shift in spawning period of some species has taken place due to increase in sea surface temperature.

(8) Heat stress is projected to decrease the milk production in livestock. This would require better shelter management in livestock.

2.16 When asked the direct and indirect, short term as well as long term effects and implications of climate change and global warming on enhancement of abiotic stress in the agricultural sector in the Country and the extent to which the Government were equipped to face the challenges, the Department stated that the direct and indirect effects of climate change on enhancement of abiotic stresses such as floods, droughts, heat waves, are studied by the Ministry of Earth Sciences and its affiliated institutions, especially Indian Meteorology Department and Indian Institute of Tropical Meteorology, Pune. At the same time, Inter-Governmental Panel on Climate Change, a UN body assesses the global research on this theme and periodically produces analytical reports. These studies based on long-term climatic modeling of future have indicated that future tropical cyclones will become more intense, with larger peak wind speeds and heavier precipitation in India. It is very likely that hot extremes, heat waves, and heavy precipitation events will continue to become more frequent. That would mean greater frequency of drought and floods events.

2.17 The Committee note with a sense of trepidation the continued havoc caused by abiotic stresses to the agriculture and allied sector produce of the Country. The abiotic stresses alone as also in tandem with other factors like input supply deficiencies, agro-climatic conditions, biotic stresses, etc. continue to be a major worry for the farming community and the agriculture scientists alike since till date effective solutions for tackling them are not readily available. The extensive loss caused to food grain production by the droughts, which are abiotic stresses, during 1987 and 2002 are well documented. As admitted by the Department the cold waves, which are also a form of abiotic stress caused substantial damage to mustard, mango, guava, papaya, brinjal, tomato and potato corps during 2002. In like manner the heat stress in 2004 in the Indo-Gangetic Plains led to the wheat crop maturing earlier by 10-20 days. The Committee further note that as compared to these staggering losses during the 2009 drought, loss of food grain production was prevented to a certain extent. This happened because ICAR took several pro-active measures. These include compiling all the available research information including varietal and emergent strategies on contingency plans for facing anticipated eventualities. The efforts of ICAR were also ably supplemented by weather forecasting of agro-advisories in local languages by the State Agriculture Universities. According to the

Committee, the example drought mitigation efforts of 2009 can be a trend setter for the future strategies for tackling calamities caused by abiotic stresses. The Committee, however, feel that apart from the need of institutionalizing a coordinated multi-agency, multi-disciplinary strategy a lot needs to be done on the research and development front by the ICAR.

2.18 The abiotic and biotic stresses have as old a history as agriculture itself. The only difference now being that the climate change and global warming have fastened the pace of natural vagaries. This can be gauged from the fact that the twelve of the years between 1995 and 2008 have been the warmest in the instrumental record of global surface temperature since 1850. The Inter-Governmental Panel on Climate Control a UN body has projected that global annual temperature is likely to increase in the range of 1.4 to 4.5ºC by the end of this century, leading to increased precipitation, more intense tropical cyclones, higher peak wind speeds causing hot extremes, heat waves and heavy precipitation events more frequently. The Committee have also been informed by the Department that in the aftermath of IPCC report and other studies, simulation studies have been carried out under Network Project on Climate Change. To them, the outcome of these simulations presents a very bleak scenario in the Indian context. The irrigated wheat production may reduce by 5% in

2030 and by almost one fourth in 2080; reduction in irrigated rice production likely to be about 2% in 2030 and upto 10% upto 2080; refined rice production to increase by 2% upto 2030 but dip by 8% by 2080; irrigated Kharif maize to decrease by almost 9% by 2030; varying effects on production of potato, soybean, groundnut, etc; decreased milk production in livestock.

2.19 Even in such a scenario, the Committee draw consolation from the fact that atleast the Government are fully aware of what all problems the Country might face in future due to abiotic stress factors. What is now required is that the various Ministries/Departments of the Government have to put their heads together and devise strategies, both short term and long term, to take care of the problems arising out of or incidental to various abiotic stresses. Merely, passing around pressing issues or issues which may acquire pressing dimensions later on, just because of jurisdictional considerations or constraints is not going to pay any dividends on an all encompassing matter like abiotic stress resulting from climate change. The Government need to take a cue from the UN initiative of the Inter-Governmental Panel on Climate Change and form an inter-ministerial body consisting of all Ministries/Departments, who have some or the other mandate relevant to working out a holistic response and putting in place a suitable mechanism for tackling

climate change, abiotic stress not excluded. DARE/ICAR being the nodal body of the National Agricultural Research System, the Committee expect them to play a more proactive role in facilitating the creation of such an inter-ministerial body for devising the strategies, working out interfaces, putting a suitable mechanism in place and finally for implementation of those strategies for consoling and or mitigating the effects of abiotic stress on the agriculture and allied sectors. The Committee would like to have a detailed Action Plan in this regard from DARE detailing all the action that has already been taken and what all still needs to be done for fructification of the strategies, wherewithal and infrastructure for combating climate change and mitigating the resultant aggravation in abiotic stresses.

2.20 Coming to the immediate task ahead for DARE/ICAR, the Committee note that the intensive agriculture in various parts of the Country has caused depletion of natural resources such as water and nutrients, leading to lowered water table and nutrient imbalances in the production systems. The Government have so far prepared soil fertility maps of micronutrients (NPK) for only 20 States and micronutrient maps for 10 States. The Committee express their unhappiness over the tardy progress of mapping of soil fertility. Due to this, a large number of marginal and small farmers do not invest in application of micronutrients which has lead to increase in

deficiencies of nutrients such as zinc, boron, sulphur and iron and also degrading environment or pollution. The Committee, therefore, urge the Department of Agricultural Research and Education to complete the mapping of soil fertility of all the remaining States in a time bound manner as this step would also contribute significantly in the strategies being evolved for tackling abiotic stresses.

CHAPTER-III

ONGOING ENDEAVOURS

ICAR have taken up various crop breeding activities to overcome the effects of abiotic stresses by developing varieties which have the capability to minimize the impact of abiotic stresses. This has been made possible by utilizing both natural genetic variability in the crop and its related species through conventional means of introgressing the abiotic stress tolerant genes. Plant breeders in India have gained expertise in employing the conventional tools, integrated with non-conventional means such as bio-technological approaches, in strengthening their efforts in breeding for abiotic stress resistance. However, the major constraints at present are: (i) Research infrastructure such as state-of-the art facilities comprising phytotron (growth chambers and green houses), rainout shelters, Rhizotron**,** multi-location soil micro-climate recording systems, free air Carbon di-oxide enrichment set-up, etc.; and (ii) Capacity building for expertise enhancement in India and abroad.

3.2 The research for development of abiotic stress resistant crop varieties and animal and fish breeds needs greater infrastructure, capacity building for which adequate financial support is necessary. While some efforts are underway in terms of research projects for assessment of impact of climate change and adaptation strategies in crops, livestock and fish and on mitigation of greenhouse gases, gene allele mining, etc., it is necessary that a strong national effort is initiated to comprehensively address all aspects of abiotic stress management. The contemplated activities include application of short, medium and long range weather forecasts in agricultural risk management, establishment of controlled environment facilities for Carbon di-oxide, temperature and rainfall and adaptation research to develop crop varieties and animal/fish breeds for traits/genes for

adaptation. This requires an additional financial allocation of at least Rs.1000 crore during the current Plan period and continued allocation during the Twelfth Plan.

3.3 The National Agricultural Research System has built over the last five decades a robust system of testing, evaluating and advancing the products of crop breeding in different crops independent of the developer institution under the All India Coordinated Crop Improvement Programme (AICCIP) of ICAR. Through this programme, all the public and now private sector products of research in crop improvement get tested as well as targeted to different agro-ecologies of the Country. This system is one of the best in the world in general and near ideal when it comes to identification of most suitable varieties for different stresses and yield limiting situations. The AICCIP enables not only the evaluation of the stress resistance traits in multiple locations, but also enables the identification of varieties suitable for diverse situations of production conditions. Some of the achievements made in evolving suitable varieties, hybrids, etc. have been given for different crops in **Annexure – II**

3.4 When asked about the status of finance, human resources, infrastructure facilities, R & D infrastructure, extension network etc. available with ICAR to confront the challenges and climate change and the resultant abiotic stress, the Department in their written submission stated that ICAR has made some re-allocation of finances etc. to strengthen the research on climate change and abiotic stresses. It has a national network on climate change impacts, adaptation and mitigation with 23 research centers. In the Eleventh Plan, a National Institute on Abiotic Stress has been established to further strengthen research in this area. At the same time, several individual projects have also been approved including shelter management in livestock as an adaptation strategy for climate change.

3.5 The impact of climate change is likely to be very large and cannot be adequately met unless additional funds and human resource are made available over and above the current allocations. The additional allocation of over the next five years and hundred scientists especially recruited and trained in best laboratories of the world will be desirable. This allocation of additional research grant will be used to strengthen R & D infrastructure facilities and operational research grants particularly for genomic and phonemics. The existing infrastructure will be used for climate change as well. The extension services need to be strengthened to disseminate technologies to face climate change and resultant abiotic stresses.

3.6 ICAR had initiated a network project on climate change in the Tenth Plan period with 15 centers which were expanded to 23 during the Eleventh Plan period under this project. The impact of climate change on field crops, horticultural crops, fisheries, dairy and poultry sector is being studied using the field experiments, Controlled Environment Facilities, Free Atmospheric CO_2 Enrichment, Open Top Chamber, Temperature Growth Tunnel facilities and through crop simulation modelling.

3.7 On being queried if the genetically Modified seed can be a healthy solution for combating the abiotic stress, the Department in their written reply stated that Genetically Modified seeds can be a healthy solution for combating the abiotic stress. Work is in progress at ICAR and other institutes in the Country to develop GM crops resistant to abiotic stresses, such as drought, salinity, high temperature, cold stress, etc. Genes that are used for developing GM crops have in many cases multiple effects and have potential to provide tolerance to multiple stresses. ICAR Network Project on Transgenics in Crops (NPTC) and several projects funded by DBT are in place. GM seeds are being developed with improved tolerance to abiotic stresses in rice, wheat, mustard, groundnut, sugarcane, cotton and tomato.

3.8 From abiotic stress-wise point of view, it is important that GM crops are developed for all stresses in a single genotype. This is possible by gene pyramiding using transgenic approach, by marker-assisted selection of breeding lines and combining both. However, more emphasis needs to be given to drought tolerance than for any other type of abiotic stresses because of the water scarcity that is linked with the change in global climate. Water/phosphorous use efficiency will allow crops to grow with less water. The current water level situation in Punjab and Haryana is alarming as is arsenic problem in West Bengal. Instead of pumping more ground water, built-in drought stress tolerant crops could be a better solution which will require less water.

3.9 The ICAR has been taking several new initiatives based on the tools of modern science to develop crop varieties resistant to abiotic stresses. These initiatives include :

a) Bio-prospecting of genes and allele mining;

b) Research on conversion of C3 crops like rice and wheat to more efficient C4 type for increased productivity under abiotic stress conditions;

c) Functional genomics, QTL mapping and marker development;

d) Transgenic development using the tools of genomics and genetic engineering;

e) Establishment of National Institute of Abiotic Stress Management; and

f) Climate Resilient Agriculture.

3.10 The ICAR has initiated a mega project involving 36 research institutions for bio-prospecting of genes and allele mining for abiotic stress tolerance with a sanctioned budget of Rs. 57.132 crore for three years starting from 4 May, 2009. This is expected to be expanded in the second

phase to capitalize on the leads obtained in the first three years of the programme. Specific research strategies have been designed and are being executed to create genomic resource base and prospect new genes and alleles. Besides, efforts have been made to create relevant infrastructure and generate trained human resources in the area of research. For human resource development, 21 scientists have been identified for training in/study visit to reputed laboratories of the world. Besides, training of research staff employed in the project is being undertaken in specific areas.

3.11 The Government have sanctioned and released the following budgetary provisions for Bio-prospecting of Genes and Allele Mining project during the Eleventh Plan:

	2009-10	**2010-11**	**2011-12**	**Total**
Sanctioned Budget in Crore Rs.	32.09	14.28	10.74	57.13
Release	16.02	-	-	-

3.12 The Department of Agricultural Research and Education further informed the following specific quantifiable results of the Bio-prospecting Programme:-

(i) 1,488 microbes including 998 bacteria, 160 fungi, 200 cyanobacteria and 130 phyto and zoo-planktons isolated from extreme environments have been found tolerant to a wide range of abiotic stresses including moisture deficit, cold, heat, salinity and anoxia. Significantly, one of the extremophilic fungi is unique that grows in 35 % salinity. All these prospected microbes are valuable resources for finding new genes and alleles;

(ii) Core collection of rice, Lathyrus, mothbean and Cucumis consisting of 7227, 295, 175 and 223 diverse germplasm lines respectively have been identified and value-added by phenotypic characterization for abiotic stress tolerance;

(iii) Novel stress responsive genes have been identified from rice varieties Nagina 22 and Dangaddeshi for drought tolerance, and Pokali, Nonabokra and CSR30 for salinity tolerance, from moth bean for drought (RMO-435) and heat (RMO-40 tolerance, from Arthobactersulfures for cold tolerance, from Dromedarian camesl for cold tolerance, from cat fish for anoxic stress tolerance. Full length cDNA for two genes (Na^+K^+ATPase and carbonic anhydrase) for salt tolerance have been cloned from marine shrimp;

(iv) Functional validation of two stress responsive bzip transcription factor genes of rice has been carried out using model plant system Arabidopsis, early observations suggest that one of these genes would be promising in imparting stress tolerance. Besides, stress responsive promoter of PYL5 gene has been cloned from sorghum genotypes;

(v) New alleles have been identified for the transcription factor gene AP37 having role in drought tolerance in sorghum and for catalase 2 gene in moth bean; and

(vi) Facilities created (a) High throughput Genotyping Facility at NRCPB, New Delhi; and (b) Statistical and Computational Genomics Facility at IASRI, New Delhi.

3.13 When asked the details of funds received and actual expenditure incurred under the project funded by National Agriculture Innovation Project of ICAR with the object of isolating the necessary genes of C-3 crops like rice and wheat to more efficient C-4 type for increased productivity under abiotic stress condition, the Department informed that a sum of Rs. 2.61 crore has been received and a sum of Rs. 2.36 crore were spent during 2008-09 to 2010-11 under the said Project.

3.14 Asked further about the Plans/Schemes/Projects devised and designed specially with focus on abiotic stress resistant crop varieties by the

Department of Agriculture Research and Education and Indian Council of Agriculture Research, the Department responded that there was no specific scheme/plan project operative except project on transgenics in crops which includes abiotic stress also. In addition, development of abiotic stress tolerant varieties are integrated in Institutes/Directorate/concerned AICRPs research programmes.

3.15 The Committee were further informed that the ICAR have initiated in house project on development of transgenic wheat and rice in improved resistance to abiotic stresses. To supplement the in-house project, ICAR have also approved a Network project on Transgenics in Crops in September, 2005 with an emphasis on resistance to insect/pests, viral and bacterial diseases and for tolerance to abiotic stresses. The following institutions have been assigned with the task of development of gene constructs and development of transgenic crop varieties for resistance to abiotic stresses.

S. No.	Item	Institution
1.	Development of gene constructs	NRCPB, New Delhi
2.	Development of transgenics: Rice Wheat Mustard Tomato Chickpea Groundnut Cotton	 NRCPB, DRR, Hyderabad, CRRI, Cuttack, NRCPB NRCPB, NRCRM, Bharatpur NRCPB, IIHR, Bangalore, IIVR, Varanasi IIPR, Kanpur NRCG, Junagadh CICR, Nagpur UAS, Dhaward and NRCPB

3.16 During the Tenth and Eleventh plans, a sum of Rs. 95.93 crore was allocated and a sum of Rs.70.32 crore was spent under NPTC project only

rice and tomato were included for abiotic tolerance in the Tenth Plan, but in the Eleventh Plan, chickpea and groundnut have also been included.

3.17 They further informed the Committee that the National Institute of Abiotic Stress Management has already started functioning with following objects:

1. To assess and quantify the effects of major abiotic stresses on agriculture and develop a repository of information on abiotic stress management;

2. To develop screening techniques and evolve stress tolerant genotypes/breeding stock/strains of crops, horticulture, animals, fish and microorganisms through mining and deploying novel genes for tolerance to abioti stresses;

3. To evolve technologies for mitigation of drought, other edaphic and atmospheric stresses through frontier science tools such as nano technology, geo-informatics; etc.

4. To develop human resource through advanced training and capacity building on the use of modern tools and techniques in abiotic stress research and management;

5. To conduct policy support research on abiotic stress management in collaboration with institutes/organisations/ SAUs; and

6. To forge national and international linkages with other organizations working on abiotic stress.

3.18 The Institute will implement important research programmes in a thematic mode and will function through four schools, namely, Drought Stress Management; Atmospheric Stress Management; Adaphic Stress Management and Policy Support Research. The Institute will also focus on strategic human resource development for long term tackling of different stresses in the frontier areas with the participation of wide network of Indian and International institutes involving visiting fellowships and exchange programmes. A amount of Rs. 73.5 crore has been approved for the

Institute during the Eleventh Plan Period. Detailed information is given in **Annexure – III.**

3.19 On being queried about the present status of the Institute the Department furnished the following information:

(a) The Institute will be fully functional by the end of XI Plan/beginning of XII Plan. The approval for 71 posts including Heads of Schools, scientists and Registrar has been received from Ministry of Finance. The process of recruitment for these posts has started;

(b) In addition to Director, 6 Scientists have been posted in the Institute to carry out research. One Administrative Officer, One Finance & Accounts Officer, One Assistant Administrative Officer, 5 Technical Officers and one upper divisional clerk have also been posted in the Institute to support the research and administration. The office has started functioning from its campus; and

(c) The total sanction for the Institute is Rs. 73.50 crores during the XI Plan. Till date, an amount of Rs. 13.01 crores has been spent for the purpose.

3.20 The Committee were informed that a new Scheme on National Initiative on Climate Resilient Agriculture with an outlay of Rs. 350 crore has been initiated during the Eleventh Plan with the administrative approval of Department of Agricultural Research and Education on 6 January, 2011 and financial sanction of ICAR on 12 January, 2011. This Scheme has become operational with its launching on 1 February, 2011 and finalization of technical programme in consultation with all the partner institutions. It will be fully functional in 2011-12.

3.21 A national network entitled 'Impacts, Adaptation and vulnerability of Indian Agriculture to climate change' was launched in 2004 with the objective of quantifying the sensitivity of crops including horticultural crops and plantations, soils, water, fish and livestock to climate changes. The project has 23 partners in ICAR institutes and SAUs.

3.22 The details of BE, RE and expenditure incurred since the inception of the project is as follows:

(Rs. in Lakhs)

Indicator	2004-05			2005-06			2006-07			2007-08			2008-09			2009-10		
	BE	RE	Expdt*	BE	RE	Expdt	BE	RE	Expdt	BE	RE	Expdt	BE	RE	Expdt	BE	RE	Expdt
Crop	111.01	111.01	45.79	343.59	358.57	358.57	153.00	153.00	152.90	146.84	146.84	128.00	162.59	237.59	150.01	154.55	--	80.70
Fisheries	25.14	27.14	9.02	77.23	77.23	77.23	24.00	24.00	24.00	35.75	35.75	33.00	36.00	51.00	33.81	12.33	--	10.55
Livestock	12.30	12.30	5.08	37.00	37.00	37.00	12.00	12.00	11.95	15.86	15.86	6.88	17.86	22.86	15.26	15.72	--	11.50
Soil	7.30	7.30	1.17	28.50	28.50	28.50	12.00	12.00	11.95	0.00	0.00	0.00	0.00	0.00	0.00	14.69	--	10.50
Water	7.30	7.30	4.56	33.70	33.70	33.70	12.00	12.00	12.00	11.55	11.55	2.50	13.55	18.55	10.92	2.71	--	2.75
Total	163.05	165.05	65.62	520.02	535.00	535.00	213.00	213.00	212.80	210.00	210.00	170.38	230.00	330.00	210.00	200.00	0.00	116.00

* Note : During 2004-05 the project came into operation in December, 2004 with the launching of the project by the DDG at CRIDA. So, the expenditure was restricted to Rs. 65.62 lakhs.

3.23 When asked about the steps taken by the Department of Agricultural Research and Education to set up Meteorological Kendras in each KVK, the Department informed the Committee that there is no provision for establishing of such Kendras in KVKs. It was further stated that the setting up of Meteorological Kendra is being looked by the Indian Meteorological Department.

3.24 The Department of Agricultural Research and Education/ICAR further informed that a national conference was organized on climate change and Indian Agriculture in 2007. When queried about the details of steps taken by them as a follow up of the conference in respect of establishment of automatic weather station in each KVK for agro met observations, developmental project on agriculture intelligence and weather watch group etc. and development of new infrastructure, policies and institutional support 'Green Research Fund' etc., the Department informed that they have so far established weather stations/automatic weather Stations in following KVKs which will be funded by the IMD, National Horticulture Mission, Department of Agriculture and Cooperation, State Governments, etc:

Sl. No.	State	No. of Weather Station	Name of KVK
1.	**Zone-I**		
	Punjab	6	Amritsar, Hoshiarpur, Jalandhar, Kapurthala, Muktsar, Faridkot
	Himachal Pradesh	1	Una
2.	**Zone-II**		
	Jharkhand	13	Bokaro, Chatra, Dhanbad, Dumka, East Singhbhum, Garhwa, Giridih, Lohardga, Pakur, Palamu, Ranchi, Sahibganj, West Singhbhum
3.	**Zone-III**		
	Manipur	1	Senapti
4.	**Zone-IV**		
	Uttar Pradesh	15	Saharanpur, Ghaziabad, Rampur, Shahjahanpur, Budaun, Aligarh, Lakhimpurkheri, Etawah, Raebareli, Jhansi, Siddharthnagar, Gorakhspur, Ballia, Jaunpur & Barabanki
	Uttarakhand	2	Rudraprayag & Champawat
5.	**Zone-V**		
	Maharashtra	3	Ahmednagar, Pur & Nashik
6.	**Zone-VI**		
	Rajasthan	NIL	--
	Gujarat	NIL	--
7.	**Zone-VII**		
	Orissa	NIL	--
	Chattisgarh MP	NIL	--
8.	**Zone-VIII**		
	Karnataka	8	Raichur, Gulbarga, Uttar Kannada, Bellary, Bidar, Tunkur, Bangalore Rural, Hassan
	Tamil Nadu	5	Thiruvarur, Madurai, Virudhunagar, Trichy, Villupuram
	Kerala	2	Calicut, Kasaragod
	Goa	1	North Goa

3.25 The Department is regularly monitoring the status of crop situations and putting inputs on the ICAR website on different crop management practices including contingency planning. The Development project on agricultural intelligence and weather watch group etc. will be taken up in the National Mission on sustainable agriculture. In regard to Green Research Fund, the Department informed that a concept note has already discussed in the Multi-Disciplinary Expert Group on climate change and function of proposal is under active consideration. The present and proposed infrastructures will be utilized for conducting the research activities at difference institutes to study the impact of climate change on agriculture.

3.26 When asked about the number of farmers benefited in each of the agro-climate zones following the alternative cropping systems evolved and propagated by ICAR to face various abiotic stress either by mitigating the crop or the financial losses by alternative crops, the Department of Agricultural Research and Education stated that no specific study has been conducted on the adaption of contingency cropping strategy, but many of the less expensive strategies are being adopted by more than 30-40% of the farmers in some States which have a strong seed supply and information dissemination systems.

3.27 Asked further the reasons for failure of actual and feasible implementation of various alternative cropping systems developed by ICAR for various abiotic stress situations, the Department of Agricultural Research and Education informed that the ground level implementation of the contingency cropping systems strategy requires extensive coordination between the State department of agriculture, seed supplying agencies and the State Agricultural Universities. At present this is somewhat weak and needs to be strengthened.

3.28 On being queried about the status of the District Level Contingency Plan in the Country, the Department in their written reply stated that a total

of 575 Districts Contingency Plans have been targeted out of which 102 Plans have already been completed and 257 Plans are under preparation. The State-wise status of the District Contingency Plans is presented in following table:

State-wise status on preparation of district contingency plans (As on 24 February, 2011)

State(total district)	Targeted Plans	Plans completed	Plans under preparation	Plans yet to be taken up
Andhra Pradesh (23)	22	22	0	0
Karnataka (30)	30	20	10	0
Kerala (14)	13	1	12	0
Tamil Nadu (32)	32	25	6	1
Gujarat (26)	26	12	14	0
Maharashtra (35)	33	13	15	5
Madhya Pradesh (50)	50	0	12	38
Rajasthan (33)	32	6	23	3
Haryana (21)	21		19	2
Himachal Pradesh (12)	12		2	10
Jammu & Kashmir (22)	22		1	21
Punjab (20)	20		20	0
Uttar Pradesh (71)	69		27	42
Uttarakhand (13)	13		1	12
Bihar (38)	38		19	19
Chhattisgarh (18)	18		0	18
Jharkhand (24)	24		6	18
Orissa (30)	30		30	0
West Bengal (19)	18		18	0
Assam (27)	21		1	20
Manipur (9)	6		4	2
Tripura (4)	2		1	1
Sikkim (4)	4	2	2	0
Nagaland (11)	11		10	1
Arunachal Pradesh (16)	4		1	3
Mizoram (8)	1		1	0
Meghalaya (7)	3	1	2	0
	575	**102**	**257**	**216**

3.29 When asked about the major countries presently engaged in appreciable research in the field of developing abiotic stress resistant crop varieties and their approach, the Department informed the Committee that most of the developed countries like USA, Australia, UK, China, Japan, etc. as well as Government centres such as IRRI, CIMMYT, ICRISAT, ICARDA, etc. are engaged in development of resistant varieties through conventional methods as well as transgenics and other bio-technological approaches. The Committee were also informed that our approaches are also similar to those adopted by these developed Countries. ICAR/DARE also have collaborative projects with some of them. There is scope for common strategy in dealing the abiotic stress crops specially with CG Institutes. Already work plans are in operation with CG Institutes. One of the significant finding of such an approach is development of Swarna Sub-1 variety of rice which can tolerate the water logging submergence upto 12-15 days. Normal Swrana Variety has no tolerance. This is in collaboration with IRRI, Phillipines. This gene is being introduced in a number of other rice varieties.

3.30 On the question of the number of Awareness Programmes conducted on the theme of Abiotic Stress Management in the Country during the last 10 years by the DARE/ICAR and the impact of such Awareness Programmes, the Department of Agricultural Research and Education informed that they have conducted Awareness Programmes during 2008 at different locations across the Country and approximately 3100 farmers participated actively. The feedback of the farmers were collected and compiled in a bulletin entitled “Farmers awareness programme on climate change in India”.

3.31 To a querry regarding any impact assessment of these programmes, it was stated that the Department have not made any specific assessment of the impact of recently initiated awareness programmes, however, impact studies will be conducted in future programmes.

ONGOING ENDEVOURS

3.32 The Committee note with satisfaction that ICAR have taken up various crop breeding activities with a view to develop varieties that have the capability to minimize the impact of abiotic stresses. They are, however, constrained to observe that the efforts of ICAR face the twin roadblocks of lack of requisite infrastructure and facilities for these activities and availability of suitably trained human resource. In their considered opinion no research system can make any headway in the absence of state-of-the-art facilities and trained manpower to operate the systems. It is, therefore, but imperative that both these constraints are attended to with utmost urgency to enable the research and development activities continue unhindered in this frontier area of science. The Committee understand that all this can not be achieved till sufficient funds are placed at the disposal of the Department on priority basis exclusively to attend to the requirements of men and material for the activities and endeavours being undertaken to mitigate the effect of abiotic stresses on agriculture and allied activities. From the requirements of infrastructure and facilities communicated, it is abundantly clear to them that even the Department are yet to work out a holistic and comprehensive proposal with a long term perspective. They, therefore, desire that an exercise be carried out by the Department detailing all of their specific and precise requirements in the first instance. The financial proposals incidental to these requirements be then accordingly worked out and presented

to the Planning Commission and the Ministry of Finance. The Committee would like to advise the Department to complete these two activities with utmost speed not only due to the gravity of the problem to be tackled but also in view of the fact that the Twelfth Plan is being finalized and there is a greater chance of their proposals being given consideration at this stage rather than in the middle of the Plan. The Committee also recommend the Government to give a serious consideration to these proposals of DARE/ICAR for allocation of funds as these investments are of utmost relevance to ensure food safety and security in the years to come.

3.33 The Committee note that the ICAR as an interim measure have made some reallocation of finances, etc. to strengthen the research on climate change and abiotic stresses. The National Network to Study on Climate Change Impacts, Adaption and Mitigation has been expanded to 23 centres during Eleventh Plan period. The Committee while appreciating the constraints of ICAR in limiting this Programme to only 23 centres due to the obvious resource constraints desire that as this study would be the backbone of the strategies to counter the various consequences of climate change and abiotic stresses, the Department should approach the Planning Commission and the Ministry of Finance at the highest level to get additional funds released for these studies without any further delay. Thereafter, the Department should expand such studies to all of their centres and take

initiatives to enhance the strength of scientists in these centres and impart them the best of training to enable them to concentrate their research on tangible, effective and economical solutions to tackle the effects of climate change and abiotic stresses with a view to work out long term strategies to ensure food safety and security of the Nation.

3.34 With regard to bio-prospecting of genes and allele mining for abiotic stress tolerance it transpires that a project with an approved allocation of Rs. 57.13 crore was started in 2009-10. However only Rs. 32.10 crore was sanctioned in 2009-10of which Rs. 16.03 crore only has been released for the project. The Committee are of the firm opinion that starving this Scheme of funds in the initial stages will hamper the research activities in this vital field. They, therefore, recommend that funds once sanctioned for such pivotal projects should be released in time in the future so as to ensure that research is carried on uninterruptedly and is unaffected in any manner by paucity of funds.

3.35 The Committee find that the National Agriculture Innovation Project to increase the productivity under abiotic stress conditions has been allocated a sum of Rs. 2.61 crore for the period 2008-09 to 2010-11. Out of this an expenditure of Rs. 2.36 crore has been incurred on the said project till date. The Committee view agriculture innovation to be a constant bedrock of the future R&D in agriculture.

This area, therefore, needs to be funded adequately for well defined and cogent proposals. Accordingly, they feel that DARE need to rework on the future funds requirement for this Project and get the same released from Planning Commission with due promptitude.

3.36 The Committee note that as of now Department of Agricultural Research and Education have some projects on transgenics in crops which includes abiotic stress tolerant varieties under the Network Project of Transgenic Crops (NPTC). Due to the very specialized nature of such research, there are very few ICAR Institutes who have been assigned the task of development of gene constructs and development of transgenic crop varieties for resistance to abiotic stresses. Rice, Wheat, Mustard, Tomato, Chickpea, Groundnut and Cotton have been included for development of gene constructs and development of transgenic crop varieties for resistance of abiotic stresses. During the Tenth and Eleventh Plans, out of Rs. 95.33 crore, a sum of Rs.70.32 crore was incurred under the NPTC project. The Committee would like to caution the Department for such under utilisation of funds when avowedly there is paucity of money. They, therefore, recommend that funds allocated for the Project should be utilized in a planned manner. The Committee deliberately refrain from commenting on other aspects of transgenic crop varieties as they are separately examining the Subject 'Cultivation of Genetically Modified

Food Crops – Prospects and Effects' on which they intend to Report to the Parliament shortly.

3.37 The Committee note that the project entitled 'Impacts, adaption and vulnerability of Indian Agriculture to climate change' with the objective of quantifying the sensitivity of crops including horticultural crops and plantations, soil, water, fish and livestock to climate changes was launched in 2004. A very important component of agriculture is soil. They, however, find that the ICAR have not undertaken any projects on soil under this project during the year 2007-08 and 2008-09. They also find that the funds allocated under the projects were not fully utilized during the year 2007-08, 2008-09 and 2009-10. They, therefore, desire the Department to improve their management of finances so that not only precious resources are fully utilized but also the timelines for various components of the Project are achieved without any cost over runs.

3.38 The Committee appreciate that different crop management practices including Contingency Planning are being worked out by the Department by monitoring of the status of crops situations. 575 Districts have been targeted for the Contingency Plans and out of this 102 Plans have been completed and 257 Plans are under preparation. The Committee, however, note that 102 districts in which the Contingency Plan have been completed present a very lop-sided

picture and a large number of States are not being attended to at the requisite pace. Thus, a large number of districts in States like Madhya Pradesh, Himachal Pradesh, Jammu and Kashmir, Uttar Pradesh, Bihar, Chhattisgarh, Jharkhand and Assam are yet to be taken up by the Government for District Contingency Planning. The Committee, therefore, recommend that the Government to take up these activities in a uniform manner so that all the States can avail the benefit of Contingency Plan simultaneously. The Committee also recommend that the preparations of Plans in the remaining 216 Districts be completed by the Government at the earliest. They would like to be apprised of the progress made in this regard at the earliest.

CHAPTER – IV

EXTENSION SERVICES

SET-UP

Agriculture being a State subject, extension efforts are primarily undertaken by respective State Governments. However, frontline extension efforts by ICAR revolve round the assessment, refinement and demonstration of technology/products. The activities include on-farm testing to identify the location specificity of agricultural technologies under various farming systems, particularly under abiotic stress Ccnditions, frontline demonstrations to establish the production potentials of improved agricultural technologies on the farmers' fields, and/or training of farmers and extension personnel to update their knowledge and skills. These activities are carried out under the crop/discipline-specific All India Coordinated Research Projects (AICRPs)/ Network Projects and also through the Krishi Vigyan Kendras (KVKs).

4.2 On being asked to furnish a detailed note on the Extension System of ICAR and how effectively it has been put to use to disseminate production enhancing technologies, the Department stated that the ICAR has strengthened and structured the Krishi Vigyan Kendra system as an innovative institutional model for assessment, refinement and on-farm demonstration of agricultural technologies and training to farmers and extension personnel. The first KVK was established at Pondicherry (now Puducherry) in 1974 and till X Plan 589 KVKs were approved for establishment and out of them 551 were sanctioned till the end of Xth Plan. In the XIth Plan, 28 KVKs are to be established in new districts which were created in the recent past and one additional KVK in each of 50 larger districts keeping in view the potential of the district for agricultural growth and scope of diversification in addition to geographical area, rural population and net sown area. At present, 569 KVKs have been sanctioned and efforts

are on for establishment of remaining KVKs in the Country. It was further stated that the ICAR has a network of 61 AICRPs and 17 Network Projects in the Country to cater to the technology identification and dissemination/extension needs. Further, there is a network of 569 KVKs that work as resource and knowledge centers of agricultural technology for supporting initiatives of public, private and voluntary sector for improving the agricultural economy at the district level.

4.3 During the further Oral Evidence on 25 November, 2010, Secretary, DARE/DG, ICAR while explaining in detail the extension education service system in the Country stated:

> "As on date we have 589 KVKs and others are in the process of establishment. Till the end of this Plan we have to establish a total of 667 KVKs. Today I must say that there are agencies under which, for example under the State Agricultural Universities, there are about 298 KVKs. Of the 589 KVKs that we have today, under ICRK, there are about 47 KVKs; under the NGOs, there are 4 KVKs; PSUs have three; the State Governments have 33 KVKs and the Central Universities and others have 14 KVKs. So, this brings about 259 KVKs as on today.
>
> I would like to submit that the Country has been divided into eight zones. There are eight Zonal Project directorates at different places. They coordinates in a given State. Two to three States are put together. They are treated as one zone each. I am not going into the details. Otherwise, we have all the details of the eight zones.
>
> Basically, we have Zonal Project Directorates who are coordinating the activities of the KVKs. What we have done is that the Directors of Extension of the State Agricultural Universities have been mandated to provide the technical backstopping to all the KVKs in the zone. This has been done and this has been monitored and it is working well. We also conduct National Conference of KVKs annually. Four years are over. The fifth conference is going to be held at Udaipur next month. We sit for three long days where the experts come in both from the public and private sector, both scientists and farmers. Everybody is there.
>
> We have their interaction but what we have further done is that we have regional committee meetings. For example, we have met already five times. Sixth time we are meeting next month in Bhopal.

In each of the Regional Committee Meeting, we sit with all the KVKs in that zone – they number somewhere between 70 and 120 – interact with each of the programme coordinator and we are seeing where the deficiencies are. I would also like to submit that there had been a National Committee earlier which went into evaluation of this. At the same time, each of these KVKs undergoes a process of quinquennial review, a five yearly review where we have again farm experts coming in and they are looking into these aspects.

I would like to mention here that the main functions of the KVKs are technology, assessment and refinement. I would like to repeat here that whatever technology packages that are given by the researchers in the institutes and in the universities, have to go to the fields for evaluation. If there is any deficiency, give a feedback to the researcher so that he perfects his technology. This is the main function of KVKs.

The process is, we conduct on farm trials; we conduct frontline demonstration; we conduct training programme for extension official and we conduct training progrmme for farmers, apart from demonstration. These are the main five functions".

Performance Appraisal

4.4 When asked about the achievements of KVKs during the Eleventh Plan till date and the expectations from the System during the remaining part of the Plan, it was stated by the Department that the achievement of KVKs during the first two years of Eleventh Plan (2007-08 and 2008-09) are summarized in the following table:

S.No.	Activities	Years	
		2007-08	**2008-09**
1.	Technologies Assessed	893	520
2.	No. of Frontline Demonstration	71640	75825
3.	Training for Farmers and Farm women (in lakh)	11.74	12.42
4.	Training of Extension Functionaries (in lakh)	0.80	0.90
5.	Participants in Extension activities (in lakh)	49.63	80.69
6.	Production of Seeds (in q)	1111.64	201675
7.	Planting Material (in lakh)	91.29	133.2
8.	Livestock Strains/ Fingerlings (in lakh)	40.08	60.47
9.	Bio products/Bio fertilizers (in lakh kg)	8.94	11.97

The target of KVKs for Eleventh Plan includes 6010 technologies for on-farm trial and 3.63 lakh frontline demonstrations, training of 60.94 lakh farmers and 4.5 lakh extension personnel, creating awareness through extension activities involving 255.63 lakh farmers; and production of 60111 ton seed, 465.28 lakh planting materials and 270.00 lakh livestock strains/fingerlings for availability to the farmers.

4.5 On being asked about how the coordination is maintained amongst the Department, ICAR, Agricultural Universities and KVKs, the Secretary replied during the further Oral Evidence:

> "As regards the second point, I would like to mention that the interaction between the ICAR Institutes and the State Agricultural Universities, which actually form the National Agricultural Research Systems, over the years have been very intense. We do not find really any gap. I would like to submit two or three points in this regard. Apart from the Annual Conferences or whatever we hold, we also have the kind of arrangement that the scientists in the ICAR Institutes almost get to become some kind of faculty in the universities. The students from the universities can go and do their research related programmes in the ICAR Institutes. It is that kind of harmonisation that has taken place. The All India Coordinated Research Projects that we have in all the divisions are virtually bringing together everybody. Recently, we had the National Project on Climate Change or National Project on Transgenic Crops or the Gene Bio-prospecting. So, whatever project we taken, we integrate the researchers from across. I would like to submit, that kind of gap is not there. Even if there is some problem with regard to dealing with the Development Departments, that is also taken care of in the Biennial Regional Committee Meetings. Every quarter we meet in a given region. There are eight regions. So, that makes Biennial Regional Committee meeting in each given region where all the State Secretaries, Commissioners, Directors of concerned Departments including Department of Agriculture, Horticulture, and Fisheries come there. Even Vice Chancellors are there, Directors of the Institutes are there. So virtually, everybody is there to look at the region specific problems and to develop research priorities and R&D programmes. We have also the Annual Conference of the Vice Chancellors. In fact, next month, we are holding both the Conferences where we would get to address all the issues, be it research, education and other related aspects. I would like to submit

that to that extent, we have absolutely harmonised the total National Agricultural Research System".

4.6 Dwelling further on the aspect of the delivery of research outputs through the Extension System now in place the Secretary, DARE/DG, ICAR stated during the further Oral Evidence:

"But the point is, as the Hon'ble Chairman said, in all the new varieties that we have, there was a concern earlier that varieties are released but are not adopted it later years altogether. I would like to submit that what appeared in Central Variety Committee all this we have taken. I have got the full data. Even whatever is released in 2008, we have taken it to the farmers. I have got the complete data of what we did during this year in pulses, in different crops, in pigeon pea, urad bean, mung bean and also summer mung bean. Already we have taken these new varieties.

As regards Krishi Vigyan Kendras, I have made some submissions. I would like to say that apart from the pulse productivity demonstrations, the main problem was the reclamation of acidic soil. We talked of lime, the substitute of lime and where there was sodic soil, there ws also giypsum, with gypsum we have got another special package on phosphogypsum which is very effective. So reclamation of soil was one thing. Second thing is water productivity, water harvesting. That also we have taken up through the KVKs. During this year more than 182 KVKs were connected. Just 15 days back, we have had a special farm innovators meet. Two hundred farmers from all over the Country participated. They all presented with great enthusiasm what they had invented. There were small inventions. This also we are facilitating in every district.

Then, every year we are taking more than 200 hybrids in different seasons. This is a continuous process of evaluation and recommendation. Regarding abiotic stress, we have come across many good plant types that are able to resist some of these abiotic stresses. In addition to this, our special projects in biotechnology include novel genes and in this we already have submitted that in the Eleventh Plan we have got a Special National Project on Bioprospecting of Genes and Allele Mining, that is from extreme environments from lakes with high pH or salt content or in animals or fish or plants whatever whether it is desert or cold desert or ocean depths. So we are trying to collect those materials whether it is bacteria or insect or plant whatever it is; we are trying to look at those properties how they are able to resist some of these abiotic stresses. We are trying to continuously take some of these and trying to incorporate in plants that we desire. Also a network on Transgenics

is in place. I would also like to mention that this year, we added a platform on bioinformatics. Whatever result we find from Bio technology. We compile all such results together after analysing them. To get more results out of it, a bioinformatics platform has been put in place. We are also trying to look at several other things. We have done rice gene sequencing but now wheat genomics is another thing that we are trying to address. After considering all this, a national project on climate resilient agriculture initiative has been planned. It is already in process. This year it will be initiated. The point is mainly strategic research in the context of climate change, technologies that we have and also capacity building. I must submit here that even in this project while there is high science, there is also extension. We have also include many KVKs to take this process forward"

4.7 In a written submission the Department while apprising the Committee about the achievement of the extension services stated that the implementation of the ICAR scheme on Seed Production in Agricultural Crops has resulted in quality seed production of field crops to a record levels during 2008-09. Breeder seeds to the tune of 7162.4 tonnes of centrally released varieties and 2778.1 tonnes of state released varieties were produced. The KVKs also produced 2.01 lakh quintal seeds and 133.20 lakh planting materials for their availability to farmers.

A large number of equipments (zero till drill, strip till drill, raised bed planter, happy combo-seeder, pneumatic planter) and technology have been developed/demonstrated to suit the requirement of various categories of farmers for different agro climatic regions, for different crops and also for increasing the revenue of the farmers by value addition. A solar photo-voltaic (PV) mobile unit was designed and developed to provide complete self-sustained mobile power unit for domestic, small agricultural and other rural applications in isolated cluster of houses of arid region.

4.8 The Government have introduced the Nutrient Based Subsidy Scheme for Fertilisers w.e.f. 1 April, 2010. The proper implementation of this Scheme requires a lot many inputs on soil, nutrient status, agricultural practices, etc. During the course of further Oral Evidence the Committee

desired to know about any feedback received by the Department on the Scheme and also the action being taken by them for enhancing the efficacy of the Scheme. In response Secretary, DARE/DG, ICAR stated: He further stated:

> "As was mentioned, it was only implemented from Ist April this year. We do not have the exact feedback because the first demand is now for the *Kharif*, and now for the *Rabi.* There was already a deficit of eight million tonnes between what was being consumed and what was being produced in the Country. In the last few years, there was not much of an enhancement in terms of capacity. No new fertilizer unit was set up, but only the efficiency of some units got improved in the last ten years.
>
> But earlier nutrient based subsidy did not include the micro nutrients. Now we have micro nutrients. They are also important and they have permitted fortification. Micro nutrient deficiency are going to vary from district to district and from area to area. What we are trying is to collect this information so that we can now calculate exactly what would be the requirement on a district level and then aggregate it at State and National level. So, we have started this exercise.
>
> I would also like to inform you that we have been assigned a job of having a geo-reference database on major and micro nutrients created. We started from the April of this year and we expect to cover 170 districts upto March, 2012. We have already finished 35 districts and we are expected to finish this by 2012. This will give you the latest information of the exact status of all the major and micro nutrients. This will help us in working out the exact fertilizer requirement of the crop".

4.9 The Department of Agricultural Research and Education further informed that e-connectivity is being utilized by KVKs and ZPD, to access the e-enabled agricultural technologies available on internet/websites of Agricultural Institutes and Universities, e-mailing and voice communication with other remote sites connected under this facility. The facility is also being used for multicasting/broadcasting and web-casting with one-way video and two-way voice communication, which is used for Human Resource Development interventions of KVKs and ZPDs. A number of presentations by National Experts have been made using the facility. These

include (i) IARI technologies for *kharif* season; (ii) Coping with monsoon aberrations; (iii) Dairying in India: Problems and Prospects; (iv) Commercial cultivation of flower crops; (v) Protected cultivation of horticultural Crops; (vi) Upscaling of IPM through networking: (vii) Relevance of micronutrients in augmenting livestock productivity; (viii) Strategy for maximizing sesame and niger production under diverse agro production situations; (ix) Bio-fertilizer technology for improving crop yields and soil health (x) Training on software application for online-reporting by KVKs and ZPDs. The facility is also being utilized for conducting interactions/review meetings with Zonal Project Directors and online guidance to KVKs by senior officers of the Council.

4.10 Though there is an elaborate system of extension services in place in the Country, there is a strong view that the system has not been able to deliver the requisite services and technologies at the requisite pace. When asked about the mechanism of review, etc. within DARE/ICAR for the purpose, the Department informed that the assessment of performance of Krishi Vigyan Kendras are being done regularly at National level by the Division of Agricultural Extension by conducting Special Committees like Quinquennial Review Team; Independent Evaluation & Impact Assessment Committee; National Interface with KVKs and Annual National Conference on KVKs. In addition, the Zonal Project Directorates are also assessing the performance by organizing Annual Zonal Workshop, State level Workshop on Frontline Demonstrations, Regional KVK interface and Scientific Advisory Committee meetings at KVK level.

4.11 He however, admitted later on the subject during the Oral Evidence as under:

> "The thing is that we also have evaluated, yes there are some KVKs which need to be further strengthened. We are looking into that aspect. Infrastructure in the Eleventh Plan has been strengthened greatly, and in some cases vacancies are there. In some cases, they are the State Agricultural Universities because there they are virtually

the employers. So, now in some cases we have seen that the vacancies have not been filled up. We have taken this aspect in Vice-Chancellors' meeting, and in some cases we have written even to the Governments to ensure that these vacancies are filled.

In some cases, we understand that they need to be rally strengthened in terms of their approach. I would also like to submit here that we had a special two days meeting of those KVKs where we felt that they are not performing very well. When we are running with 589 KVKs, it is possible that there is somewhere deficiency here and there which we have addressed during this year".

4.12 On being asked about the problems besetting the Extension System and the systemic and other requirements for the revival of extension services, the Secretary informed the Committee during the Oral Evidence:

"But the basic job of extension – I am not trying to pass on the buck – the mandated requirement is it is a State Government extension machinery. Sir, in the 80's – 90's, it was going on well. But I was just submitting that what happened to it these days the vacancies are so high. There are no people available. They have been given several kinds of jobs. With the result they are not into core extension. Our job has been to back-stop as mush as possible, train as much as possible but I admit that this is not enough. In a district where we require 50,000 soil samples to be analysed – I am taking one example – we are trying to back-stop that effort. We analyse 1500 to 2000 samples in KVKs but the requirement may be of 50,000 to 60,000 or 1 lakh samples to be analysed in a given district. So, the extension work, which is the basic job of the State Government, State after State are not doing and KVKs have to perform all these and there is a problem coming up. What is the mechanism?

We are not going away from it. We have developed a complete protocol. We submitted this to the hon. Committee. We have given a Research Extension Continuum. We have given models. One model will not work throughout the Country. So, we have given region specific, commodity specific – for milk, Gehu, mustard - models. Research Extension Continuum was discussed and people have appreciated it. But in that effort we said that we will establish those models wherever necessary. We will train people with literature, with hands on training and with demonstration. For example people say you have a variety yielding 7 tonnes but the yield is 3 tonne. We said that we will demonstrate".

4.13 A representative of the Department further added on this aspect during the further Oral Evidence that:

> "Sir, so far as extension is concerned, we discuss this everywhere, but there is a system in place, that the extension work is the responsibility of the State Government, because 5000 scientists in one ICAR can not go everywhere. Hence, two mechanisms – one regarding Seed Production Extension under which we have to produce breeder seeds and that foundation - 1 and foundation - 2 and certified seeds reach the farmers through the State Governments. For this several large corporations have been formed. In some states corporations are functioning. But, in Bihar it has been shut down. Thus they did not get the seeds, resulting in crisis. As our DG said based on the experience of this open pollinated seed, not hybrid, if supplied in a village it will multiply for three generations and retain the purity. Due to this effort in Bihar this year 11 percent, the work which we also began when I was there, you also saw the emphasis laid on seed production. I had used the Pusa seed also. It is because of all this Bihar had 11 percent growth rote. Due to which our hon'ble Chief Minister got several awards. If our research is not fruitful, how come there is growth? But as you said we have to address the problems. If state department and other arms perform their role timely, in a coordinated manner and it reaches the farmers only then benefit would accrue. In this way, as you referred to the *ATMA*, when we analyse our work and bring about better co-ordination, and if all our available technology reaches the farmers, in my estimate the production can increase up to 1.5 times. This is my firm conviction".

4.14 Inspite of the fact that agriculture is a State Subject and thereby the extension efforts are being primarily undertaken by the State Governments, the fact still remains that ICAR at the apex of the National Agriculture Research System (NARS) have a pivotal role in the assessment, refinement and demonstration of technology/products. For this purpose, the ICAR has a network of 61 All India Coordinated Research Projects and 17 Network Projects in the Country to take care of technology identification and dissemination/extension requirements. The State Agriculture Universities are also an integral component of the extension system and the field level dissemination of the extension services is the responsibility of Krishi Vigyan Kendras (KVKs). The first KVK was establish in Puducherry in 1974. The Committee find that their numbers, over the years, increased to 589, as on date. The Department plan to establish a total of 667 KVKs by end of the Eleventh Plan. The Committee also note that out of 589 KVKs operational now, some are under the ICAR, some under SAUs, some with the State Governments. The remaining KVKs are under PSUs, Central Universities and NGOs. As a part of the perspective planning, the Department intend to establish one additional KVK in each of the 50 larger districts keeping in view the potentional of the district for agricultural growth and scope of diversification in addition to the

geographical area, rural population and net sown area. The Committee appreciate this long overdue initiative of DARE/ICAR to increase the number of KVKs in the Country. Knowing fully well the state of connectivity and access of rural areas with a KVK, at district level, the Committee strongly feel that the norms of establishing a KVK need an urgent review with the intention of improving the accessibility of the farmers to them. This is their considered opinion would enhance the reach and spread of the extension services run by the KVKs. They, therefore, desire the Department to immediately get down to the task of preparing an action plan for this purpose and getting it fructified on priority as the Twelfth Plan is already on the anvil.

4.15 The Committee note with satisfaction that the extension services system of NARS has been able to transfer several technologies/equipment for demonstration as well as for actual use to suit the requirements of various categories of farmers in different agro-climatic regions for different crops. These have led to value addition of the agriculture produce and consequently the income of the farmers alongwith improving this. They have also been able to availability of breeder seeds in sufficient quantities. They further note with satisfaction that the KVKs system as a part of its goal of rendering agriculture technologies and training farmers through

development and demonstration is providing e-connectivity amongst the KVKs to facilitate access to the e-enabled agricultural technologies to the KVKs and ZPDs. This also enables them to access the e-enabled agricultural technologies available on internet/websites of Agriculture Institutes and Universities, e-mailing and voice communication with other remote sites connected. The Committee desire that all KVKs should be provided e-connectivity as early as possible enabling the farmers to avail the benefits of various latest technologies related to agriculture sector.

4.16 The Nutrient Based Subsidy Scheme for fertilizers was introduced by the Government with effect from 1 April, 2010. The Committee find that DARE/ICAR as of now lack exact feedback on this Scheme as it has been implemented only recently. The Committee are, however, of the view that to effectively implement the Nutrient Based Subsidy Scheme for fertilizers, the Government would require substantial inputs from NARS on the soil health and related matters, nutrient status of soil, the agricultural practices, etc. DARE/ICAR have to, therefore, do a lot of spade work in this direction. The Committee note that DARE/ICAR have been assigned the job of having geo-reference database on major and micro nutrients created. They have already commenced work on the Project from April this year and intend to cover 170 districts by March, 2012. The geo-reference

databasing will help in working out the exact fertiliser requirement of a crop in a district. The Committee, therefore, desire that this task be completed by DARE/ICAR on top priority basis in a highly time bound manner to not only attain the target of 170 districts this year is fully met within the stipulated timeline but also accomplish the geo-reference databasing of major and micro nutrients for the remaining districts at the earliest.

4.17 Keeping the farmers constantly updated on weather information can play a major role in improving the agriculture production in the Country. The matter has already been touched upon by the Committee in the previous Chapter of this Report. The Committee find that there are very few Kisan Vikas Kendras in which weather stations have so far been established by the Indian Meteorological Department. The Committee, therefore, recommend the Department of Agricultural Research and Education to take up the issue of setting up of weather stations/automatic weather stations with the Indian Meteorological Department so that all the KVKs are provided with agromet observatory and are in a position to provide farmers weather updates timely and in the event of any natural calamities enable them to take a pre-emptive course of action to save their precious produce from falling prey to the fury of nature.

4.18 Having assessed the performance of the present extension system on the basis of various inputs received by them, the Committee, have a distinct feeling that the Extension Services in the Country are at present not in an optimal state of readiness to cope with the responsibilities that will enjoin upon them in view of the fast paced developments, due to climate change and global warming. The Department have also admitted as much about the deficiencies in NARS and consequently in extension services due to paucity of funds, lack of infrastructure and shortage of human resource etc. In such a scenario, it is but apparent that the challenges posed to agriculture and allied sectors, climate change and resultant abiotic stresses cannot be met upto the desired level causing avoidable distress to the farming community. Furthermore, such an eventuality also has serious implications for the food security and safety of the Country.

4.19 The NARS has now to be oriented on a two way system where technologies and products are disseminated downwards and data base and feedbacks are generated upwards from the lowest tier. In this endeavour, the KVKs because of their district level positioning and, therefore, their limitation of reach and spread cannot be the ultimate panacea. The Committee, therefore, feel that another tier below the KVKs needs to be developed under them especially under those KVKs having a wider area to cover. In their considered view, an

entity at the block level called Krishi Vigyan Up-kendra, etc. can act as the terminal point for dissemination of technologies and other outputs of extension services in a more effective and time bound manner than the district level KVKs. They can also act as the generation/collection points for database and feedback not only for DARE/ICAR but for the other Ministries/Departments of the Government who have some or the other stake in agriculture, in a far comprehensive manner at the block levels. As far as funding of such block level entities is concerned, DARE can think of working out the modalities for the purpose in coordination with Department of Agriculture and Cooperation for including it as a component under Rashtriya Krishi Vikas Yojana. They desire to be apprised of the progress made in this regard.

NEW DELHI;
29 August, 2011
7 Bhadrapada 1933 (Saka)

BASUDEB ACHARIA
Chairman,
Committee on Agriculture

ANNEXURE- I
(Para 1.5 refer)

(a) State-wise Drought Prone Areas

Sl. No.	State	Reference Year	Drought prone area*
1	Andhra Pradesh	2008	4,691
2	Bihar	2004	319
3	Chattishgarh	2004	1,863
4	Gujarat	2002	5,844
5	Haryana	2006	394
6	Himachal Pradesh	2000	88
7	Jammu & Kashmir	2000	142
8	Jharkhand	2000	1,023
9	Karnataka	2006	6,558
10	Madhya Pradesh	2004	5,260
11	Maharashtra	2002	13,003
12	Orissa	2004	1,178
13	Rajasthan	2006	9,576
14	Tamil Nadu	2005	1,556
15	Uttar Pradesh	2006	1,741
16	Uttaranchal	2004	321
17	West Bengal	2000	1,334
Total			**54891**

* Rainfed area in districts covered under Drought Prone Area Programme (DPAP) and/or Desert Development Programme (DDP) in each State has been aggregated.

(b) Flood Prone Area in Eastern Region

S. No.	States	Area (Mha)
1	Bihar	4.26
2	Assam	3.15
3	West Bengal	2.65
4	Orissa	1.40
5	Madhya Pradesh	0.26
6	Uttar Pradesh	7.34

(c) Salt affected soils in India (ha)

State	Saline	Sodic	Total
Andhra Pradesh	77598	196609	274207
Andaman & Nicobar Island	77000	0	77000
Bihar	47301	105852	153153
Gujarat	1680570	541430	2222000
Haryana	49157	183399	232556
Karnataka	1893	148136	150029
Kerala	20000	0	20000
Madhya Pradesh	0	139720	139720
Maharashtra	184089	422670	606759
Orissa	147138	0	147138
Punjab	0	151717	151717
Rajasthan	195571	179371	374942
Tamil Nadu	13231	354784	368015
Uttar Pradesh	21989	1346971	1368960
West Bengal	441272	0	441272
Total	**2956809**	**3770659**	**6727468**

(d) Extent and distribution of salt affected soils in different Agro-climatic Zones (Planning Commission) in India.

Zone No.	Name of the Zone	Salt affected area (000 ha)
1	Western Himalayan Region	Nil
2	Eastern Himalayan Region	Nil
3	Lower Gangetic Plains Region	800.00
4	Middle Gangetic Plains Region	606.00
5	Upper Gangetic Plains Region	1080.00
6	Trans- Gangetic Plains Region	974.50
7	Eastern Plateau & Hills Region	22.00
8	Central Plateau & Hills Region	915.81
9	Western Plateau & Hills Region	562.13
10	Southern Plateau & Hills Region	681.21
11	East Coast Plains and Hills Region	1276.01
12	West Coast Plains and Hills Region	73.95
13	Gujarat Plains and Hills Region	1214.40
14	Western Dry Region	359.02
15	The Island Region	Nil

(e) Acid soils in India (M ha)

State	Area (mha)	Cultivated are (mha) with pH < 5.5	Districts having pH < 5.5
Assam	21.23	Assam-1.54 Other NEH States -1.3	Dibrugarh, Sibsagar, Lakhimpur, Bongaigaon, Nagaon, Kamrup, Darrang, Golpara, Cachar, Jorhat, Golaghat, Tinsukia and Sonitpur
Meghalaya			East and West Khasi hills, Jaintia hills and East Garo hills
Nagaland			Kohima, Tuensang, Mokokchung and Mon
Mizoram			Champhai, Aizwal, Kolaship, Lunglei and Saiha
Arunachal Pradesh			West Siang, Upper and Lower Subansiri, West Kameng and Changlang
Manipur			Churachandpur, Ukhrul, Chandel and Tamenlong
Tripura			West Tripura, Sought Tripura and Dhalia
Sikkim			North and West Sikkim
West Bengal	4.76	1.5	Bankura, Midnapur, Purulia, Birbhum, West Dinajpur, Jalapaiguri, Murshidabad, Burdwan, Cooch Behar and Malda
Jharkhand	6.77	0.4	Dumka, Jamtara, East Singhbhum, Ranchi, Gumla and Garhwa
Orissa	8.67	4.0	Cuttack, Kendrapara, Jagarsinghpur, Jajpur, Dhenkanal, Anugul, Koraput, Nawarangpur, Khurda, Nayagarh, Puri and Mayurbhanj
Kerala	3.76	3.2	Trivandram, Alleppey, Ernakulam, Trichur, Palghar and Cannanory
Maharashtra	4.54	0.02	Ratnagiri and Thane
Himachal Pradesh	1.78	0.07	Kangra, Kullu, Mandi, Simla and Solan
Madhya Pradesh	11.72	--	--
Bihar	2.36	--	--
Tamil Nadu	4.85	--	--
Karnataka	3.31	--	--
Goa	0.30	--	--
Chhatisgarh	10.84	--	--
Uttrakhand	3.48	--	--
Jammu & Kashmir	1.57	--	--
Total	89.94	12.03	--

Source : Sharma & Sarkar (2005)

ANNEXURE-II

(Para 33 refers)

Crop-wise list of varieties resistant to different abiotic stresses developed by NARS

A. Wheat

Wheat variety	Abiotic Stress Tolerance	Agro-climatic zone
HW 2004	Drought	Central
HD 2643	Heat (late sown)	NEPZ
HD 2285	Heat (late sown)	NWPZ
HD 4672	Drought	Central
HI 1500	Drought	Central
DL 788-2	Heat (late sown)	Central
WR 544	Heat (Very late sown)	NWPZ
PBW 175	Drought	NWPZ
PBW 396	Drought	NWPZ
HD 2932	Heat (late sown)	Peninsular and Central Zones
HD 2888	Drought	NEPZ
RAJ 3765	Heat (late sown)	NWPZ
LOK 1,	Drought	CZ
WH 147	Heat tolerant, IR	MP, Haryana, Rajasthan
HD 2781	Drought	Peninsular Zone
KRL 210	Saline and alkaline soils	North Western Plains
KRL 213	Saline and alkaline soils	North Western Plains
KRL 14	Saline and alkaline soils	North Western Plains
KRL 17	Saline and alkaline soils	North Western Plains

B. Rice varieties developed by the NARS for Fragile Ecosystems

Ecosystem	**Total Varieties Released**	**Prominent Varieties**
Rainfed Upland (RUP) – drought tolerant	**123**	N22, Vandana, AAUDR-1, Vira Vkas Dhan 10, Birsa Bikas Dan 12, CR Dhan 40 Kalinga III, Anjali, Sadabahar, Virendra
Rainfed Shallow Lowland (RSL) - Moderate drought	**126**	CR Sugandh Dhan 3

Ecosystem	Total Varieties Released	Prominent Varieties
tolerant		
Semi Deep Water (SDW) Tolerant to waterlogging	14	Jalmagna, Jal Lahari, Barh Avarodhi, Hanseswari
Deep Water (DW) Tolerant to waterlogging	15	
Irrigated Saline and Alkaline Soils (IRSA)	27	CSR23, CSR27, CSR30, CSR36, Amalmana
Aerobic (ARB) Restricted water availability	2	MAS 946-1, Rasi
Submergence	6	Savitri, Ponmani, Gayatri, Tulasi, Sarala, Durga, Varshadhan
Salinity	2	Lunishree, Sonamani, CSR10, CSR 13, CSR 23, CSR 27, CSR 30, CSR 36

Note: Nearly 24/44 million ha rice area falls under fragile ecosystems listed above. Development of improved varieties suited for such ecosystems has improved productivity of these regions substantially.

C. Pearl Millet hybrids and varieties for drought situations

Hybrids	Release	Area of adaptation
GHB 719	2007	Rajasthan, Haryana and Gujarat
GHB 538	2005	Western Rajasthan and drier part of Gujarat and Haryana
HHB 67 Improved	20.05	Western Rajasthan and drier part of Gujarat and Haryana
HHB 68	1993	Haryana
HHB 67	1990	All India
HHB 60	1988	Haryana
HHB 197	2008	Haryana
Pusa Composite 443 (MP 443)	2009	Rajasthan, Harayana, Gujarat

D. Pulses tolerant to abiotic stresses

Crop	No. of varieties	Variety	Abiotic Stress Tolerance
Chickpea	7	RSG 44, RSG 888, S26, BGD 72, Vijay, Pusa 362, Pusa 1103	Drought (Terminal moisture stress)
	2	PDG 4, Pusa 4444	Cold injury
	2	ICCV6, Karnal Chana 1	Salinity
	3	DCP-92, CNG 16, Pusa 240	Lodging conditions
Mothbean	3	CZM 1, CZM 2, CZM 3	Drought and high temperature

E. Mustard varieties tolerant to abiotic stresses

Crop	Variety	Area of adaptation	Year of release	Suitability
Brassica juncea	Pusa Agrani	Zone II and Zone V	1998	Early maturing, high temperature tolerant at seedling stage
	Pusa Mahak	Zone II and Zone V	2005	Early maturing, high temperature tolerant at seedling stage
	Pusa Vijay	NCR, Delhi	2008	High temperature tolerance at seedling stage
	Pusa Tarak	NCR, Delhi	2008	Early maturing, high temperature tolerance at seedling stage
	Vardan	Zone III	1985	Late sown, high temperature tolerance at maturity
	Kanti	UP	2003	High temperature tolerance at seedling stage, early maturing, UP
	Ashirwad	Zone-III	2005	Late sown, high temperature tolerance at maturity
	Narendra Rai	Zone III	1990	Salt tolerant
	Narendra Ageti Rai-4	UP	2001	High temperature tolerance at seedling stage, early maturing, UP
	CS-54	Zone II	2005	Sodic and saline soils
	RLM-619	Zone II	1985	High temperature tolerance
	RGN-13	Rajasthan	2003	Highly resistant to frost & tolerant to high temperture.
	RGN-48	Zone II	2005	Rainfed, tolerant to frost
	RGN-145	Zone - II	2008	Late sown, high temperature tolerance at maturity
	RN-505	Rajasthan	2005	Late sown, high temperature tolerance at maturity

Crop	Variety	Area of adaptation	Year of release	Suitability
	YRN-6 (Nav Gold	Zone II	2006	Late sown, high temperature tolerance at maturity
	RH-30	Zone II	1985	Rainfed, irrigated late sowings, high temperature tolerance at maturity
	RH-781	Zone II	1991	Tolerant to drought and frost in
	Swarnjyoti	Zone III and Haryana	2003	Late sown conditions, high temperature tolerance at maturity
Brassica carinata	Kiran	UP and Uttranchal	1998	Rainfed
	IGC-10 (Pusa Swarnim)	Haryana, Punjab, UP, HP, J & K, Rajasthan	2003	Rainfed
	NPC-9	NCR Delhi	2006	Rainfed and marginal areas
Brassica rapa cv. Toria	Agrani	West Bengal	1982	Rainfed
	Panchali	Eastern zone	1988	Rainfed
	Anuradha	Orissa	2002	Rainfed and irrigated
	T-9	Across country	1975	rainfed & irrigated conditions
	PT-507	UP	1990	Drought tolerant
	M-27	Eastern zone	1978	Rainfed
	TH-68	Haryana	1991	Rainfed
Eruca sativa	T-27	Haryana	1976	Rainfed areas (Light soils)

F. Salinity/Drought tolerant rootstocks

Grapes: Dogridge, 110R, St George

Citrus: Cleopatra Mandarin-Strain Grabton and Strain Narana
Schaub Rough Lemon, Rangpur Lime Texas
Cleopatra Mandarin- Tirupati, Coorg and Morocco strains (High tolerant)

Pea: New Line perfection

G. Drought tolerant rootstocks

Citrus: Rangpur Lime, *Poncirus trifoliata*, Droyer citrange
Coconut: Kalpa Dhenu – Tolerant to drought regular bearer
Potato: Drought tolerant varieties are being developed through a technique known as Isotope Ratio Mass Spectrophotometry (IRMS). It has to be tried to find out water use efficiency and transpirational rate (high water mining capacity) and 5 strains viz., CP 1785, 1775, 1920, 3073 and 2414 were identified. Using these and CPRI's commercial varieties like Kufri Chandramukhi, Kufri Bahar and Kufri Badshah, CPRI has been able to develop population which are under screening to identify drought tolerant genotypes.
Tomato: EC 520071, EC 520061, WIR 13706 and WIR 13717

H. Heat tolerant varieties

Tomato: Arka Meghali, Pusa Sadabahar, Supa Bug, Pant T4 and Pusa Sheetal (Both low and high temperature toterance)
Cauliflower: Pusa Deepali, Kashi Kunwari
Pea: E-6, BRP-5, Kashmiria Local (Udaipur)
Muskmelon: Punjab Sunheri
Potato: Kufri Surya can tuberize even up to 22°C whereas in normal varieties, tabularization do not occur beyond 20°C. This heat tolerant variety can be extended to the non-traditional area of cultivation such as Andaman & Nicobar Islands, parts of Kerala and Tamil Nadu.
Tomato: EC 538138, PF1, EC 501707 and EC 570027

ANNEXURE – III
(Para 3.18 refers)

Financial Implications of National Institute of Abiotic Stress Management

(Rupees in lakhs)

Head	XI Plan requirement (2007-2012)
	A. Recurring
Pay & Allowances and Wages	1209.00
Travelling Allowances	60.00
HRD	50.00
Contingencies	1094.50
Total A	2413.50
	B. Non-recurring
Equipment	2189.50
Furniture and fixtures	100.00
Vehicles	66.00
Information Technology	120.00
Library	100.00
Works	2361.00
Total B	4936.50
Grand total (A+B)	**7350.00**

APPENDIX-I

COMMITTEE ON AGRICULTURE

(2009-10)

MINUTES OF THE SECOND SITTING OF THE COMMITTEE

*****

The Committee sat on Wednesday, the 16th September, 2009 from 1100 hours to 1300 hours in Room No. 62, Parliament House, New Delhi.

PRESENT

Shri Basudeb Acharia – Chairman

MEMBERS
LOK SABHA

2. Shri Narayan Singh Amlabe
3. Shri K.C. Singh 'Baba'
4. Shri Thangso Baite
5. Shri Jayant Chaudhary
6. Smt. Ashwamedh Devi
7. Shri Biren Singh Engti
8. Shri Sk. Nurul Islam
9. Shri Naranbhai Kachhadia
10. Shri Prabodh Panda
11. Shri Premdas
12. Shri Vittalbhai Hansrajbhai Radadiya
13. Shri Nripendra Nath Roy
14. Shri Uday Singh
15. Shri Jagdish Thakor
16. Shri Hukmdeo Narayan Yadav

RAJYA SABHA

17. Shri Narendra Budania
18. Shri Satyavrat Chaturvedi
19. Shri A. Elavarasan
20. Shri Sharad Anantrao Joshi
21. Shri Vinay Katiyar
22. Shri Mohd. Ali Khan
23. Shri M. Rajasekara Murthy
24. Shri Bharatsinh Prabhatsinh Parmar
25. Shri Khekiho Zhimomi

SECRETARIAT

1. Shri S. Bal Shekar - Joint Secretary
2. Shri P.V.L.N. Murthy - Director
3. Shri P.C. Koul - Additional Director

REPRESENTATIVES OF MINISTRY OF AGRICULTURE
(DEPARTMENT OF AGRICULTURAL RESEARCH & EDUCATION)

1. Dr. Swapan Kumar Datta - Deputy Director General (CS)
2. Dr. A.K. Singh - Deputy Director General (NRM)
3. Dr. P.K. Agarwal - National Professor (AR)

2. At the outset the Chairman informed the members about the sad demise of eminent agricultural scientist, Prof. Norman Ernest Borlaug. The Committee passed a Resolution appreciating the significant contribution of Prof. Borlaug to the Green Revolution in India and also stood in silence for a while in the memory of the departed soul.

3. The representatives of the Ministry of Agriculture (Department of Agricultural Research and Education) were, thereafter, ushered in. The Chairman welcomed them to the sitting of the Committee and asked them to introduce themselves.

4. The representatives of the Department then made an audio-visual presentation on the subject 'Development of Abiotic Stress Resistant Crop Varieties- Review of R&D efforts in the Country'. They also briefed the Committee on the latest developments on the subject, the world over, and the R&D efforts made/on the anvil in the Country.

5. The members sought several clarifications on various aspects of the subject. The representatives of the Department responded to the same.

6. The Chairman thanked the witnesses for appearing before the Committee as well as for furnishing valuable information desired by the Committee on the subject. He also directed them to send at the earliest information on points which had remained unclarified during the sitting or on which information was not readily available, to the Secretariat of the Committee.

A verbatim record of the proceedings has been kept separately.

The Committee then adjourned.

APPENDIX-II

COMMITTEE ON AGRICULTURE

(2009-10)

MINUTES OF THE SIXTEENTH SITTING OF THE COMMITTEE

The Committee sat on Thursday, the 21st January, 2010 from 1510 hours to 1720 hours in Room No. 53, Parliament House, New Delhi.

PRESENT

Shri Basudeb Acharia - Chairman

MEMBERS

Lok Sabha

2. Shri Narayan Singh Amlabe
3. Shri K. C. Singh `Baba'
4. Shri Biren Singh Engti
5. Sk. Nurul Islam
6. Shri Prabodh Panda
7. Shri Prem Das
8. Shri Vitthalbhai Hansrajbhai Radadiya
9. Shri Bhoopendra Singh
10. Shri Uday Singh
11. Shri Hukmdeo Narayan Yadav

Rajya Sabha

12. Shri Sharad Anantrao Joshi
13. Shri Mohd. Ali Khan
14. Shri M. Rajasekara Murthy
15. Shri Khekiho Zhimomi

SECRETARIAT

1.	Shri S. Bal Shekar	-	Joint Secretary
2.	Shri P.V.L.N. Murthy	-	Director
2.	Shri P.C. Koul	-	Additional Director

REPRESENTATIVES OF MINISTRY OF AGRICULTURE
(DEPARTMENT OF AGRICULTURAL RESEARCH & EDUCATION)

1.	Dr. S. Ayyappan,	Secretary, DARE & DG, ICAR
2.	Shri Rajiv Mehrishi,	Additional Secretary (DARE) & Secy (ICAR)
3.	Dr. S. K. Datta,	DDG (CS &AS)
4.	Dr. H.P Singh,	DDG (Horticulture)
5.	Dr. K.D. Kokate,	DDG (Extension)
6.	Dr. Arvind Kumar,	DDG (Education and Fisheries)
7.	Dr M.M. Pandey,	DDG (Engineering)

2. At the outset the Hon'ble Chairman welcomed the members to the Sitting of the Committee. Thereafter, the Committee took up the Draft Report on Demands for Grants (2009-2010) relating to the Ministry of Food Processing Industries for consideration. After some discussion it was decided to defer the consideration of the Report to the next Sitting of the Committee.

3. The Chairman, then directed that the representatives of the Ministry of Agriculture (Department of Agricultural Research & Education) be ushered in.

(At around 1520 hours the officials of DARE took their seats in the Room)

4. The Chairman welcomed the representatives of Department to the Sitting of the Committee and conveyed best wishes on behalf of the Committee and on his behalf to Dr. S. Ayyappan for assuming the charge as Secretary, DARE and Director General, ICAR. He then asked them to introduce themselves.

5. The Committee then took Oral Evidence of the representatives of the Department in connection with examination of the subject `Development of Abiotic Stress Resistant Varieties and Dissemination of Production Enhancing Technologies – Review of R&D and Extension Efforts in the Country'. The members sought several clarifications on the various aspects of the Subject. The representatives of the Department responded to them.

6. The Chairman, thereafter, thanked the witnesses for appearing before the Committee as well as for furnishing valuable information desired by the Committee on the Subject. He also directed them to send, within a week, information on points which could not be clarified by them during the Sitting to the Committee Secretariat.

A verbatim record of the proceedings has been kept separately.

The Committee then adjourned.

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APPENDIX-III

COMMITTEE ON AGRICULTURE
(2010-11)

MINUTES OF THE TENTH SITTING OF THE COMMITTEE

The Committee sat on Thursday, the 25th November, 2010 from 1520 hours to 1700 hours in Committee Room 'B', Parliament House Annexe, New Delhi.

PRESENT

Shri Basudeb Acharia - Chairman

MEMBERS
Lok Sabha

2. Shri Narayansingh Amlabe
3. Shri Jayant Chaudhary
4. Smt. Shruti Choudhary
5. Smt Ashwamedh Devi
6. Smt. Paramjit Kaur Gulshan
7. Shri Naranbhai Kachhadia
7. Shri Premdas
9. Shri Hukmadeo Narayan Yadav

Rajya Sabha

10. Shri Satyavrat Chaturvedi
11. Shri Mohd. Ali Khan
12. Shri Upendra Kushwaha
13. Shri Bharatsinh Prabhatsinh Parmar
14. Shri S. Thangavelu

SECRETARIAT

1. Shri P.V.L.N. Murthy - Director
2. Shri P.C. Koul - Additional Director

REPRESENTATIVES OF MINISTRY OF AGRICULTURE
(DEPARTMENT OF AGRICULTURAL RESEARCH & EDUCATION AND ICAR)

1.	Dr. S. Ayyappan,	Secretary (DARE) & Director General (ICAR)
2.	Dr. S. K. Datta,	Deputy Director General (CS), ICAR
3.	Dr. K.M.L. Pathak,	Deputy Director General (AS), ICAR
4.	Dr. A.K. Singh	Deputy Director General (NRM), ICAR
5.	Dr. H.P Singh,	Deputy Director General (Hort.), ICAR
6.	Dr. Arvind Kumar,	Deputy Director General (Edn.), ICAR
7.	Dr M.M. Pandey,	Deputy Director General (Engg.), ICAR
8.	Dr. B. Meenakumari,	Deputy Director General (Fy.), ICAR
9.	Dr. V. Venkatasubramanian,	Assistant Director General (Extn.), ICAR
10.	Dr. Bangali Baboo	National Director (NAIP), ICAR
11.	Dr. A.K. Vasisht	Assistant Director General (PIM), ICAR
12.	Dr. T.P. Rajendaran	Assistant Director General (PP), ICAR
13.	Dr. H.C. Joshi	Principal Scientist & Head, Environmental Science Division,IARI, Pusa, New Delhi.
14.	Dr. P. Ananda Kumar	Project Director, National Research Centre on Plan Biotechnology

2. The Sitting commenced with the Chairman welcoming the Members of the Committee and representatives of the Department of Agricultural Research & Education and ICAR to the Sitting. After the customary introduction of the representatives of the Department of Agricultural Research & Education and ICAR, the Committee took Oral Evidence on the subject 'Development of Abiotic Stress Resistant Crop Varieties and Dissemination of Production Enhancing Technologies - Review of R&D and Extension Efforts in the Country'.

3. During the course of the Oral Evidence, the Members raised several queries on various aspects of the subject and the representatives of the Department responded to them.

4. Before the Sitting concluded, the Chairman thanked the witnesses for appearing before the Committee. He also directed them to send information on points on which information could not be provided by them during the Sitting to the Secretariat of the Committee by 3 December, 2010.

A verbatim record of the proceedings has been kept separately.

The Committee then adjourned.

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APPENDIX-IV

COMMITTEE ON AGRICULTURE

(2010-11)

MINUTES OF THE FORTIETH SITTING OF THE COMMITTEE

*****

The Committee sat on Monday, the 29th August, 2011 from 1500 hours to 1530 hours in Committee Room 'B', Parliament House Annexe, New Delhi.

PRESENT

Shri Basudeb Acharia – Chairman

MEMBERS

Lok Sabha

2. Shri Narayansingh Amlabe
3. Shri Thangso Baite
4. Shri Jayant Chaudhary
5. Smt. Shruti Choudhary
6. Smt. Paramjit Kaur Gulshan
7. Shri Naranbhai Kachhadia
8. Shri Premdas
9. Shri Hukmadeo Narayan Yadav

Rajya Sabha

10. Shri Narendra Budania
11. Shri Vinay Katiyar
12. Shri Mohd. Ali Khan
13. Shri Rajpal Singh Saini
14. Shri S. Thangavelu

Secretariat

1. Shri P.V.L.N. Murthy - Director
2. Shri P.C. Koul - Additional Director

2. At the outset, the Chairman welcomed the members to the Sitting of the Committee. Thereafter, the Committee took up the Draft Report on the Subject 'Development of Abiotic Stress Resistant Crop Varieties and Dissemination of Production Enhancing Technologies – Review of R&D and Extension Efforts in the Country' for consideration. After some discussion, the Committee adopted the draft Report.

3. The Committee, then, authorized the Chairman to finalise the above Draft Report in the light of the factual verification got done from the concerned Department and present the same to the Parliament.

The Committee then adjourned.

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