Material for Lok-Sabha provisional starred question Dy.No.25 on "Climate change and agriculture "

Q (a). Whether the Government has made any assessment of the impact of climate change including changing monsoon pattern on the agricultural sector in the country and the manner in which agricultural productivity / produce has been affected there on ? and

(b) if so, details thereof, crop wise, region wise

Yes

The assessment of the impact of climate change in terms of temperature, rainfall pattern on different crops and regions were made. The following are some of the salient points in detail;

- The south west monsoon is critical to the kharif crop, which accounts for more than 50% of the food-grain production and 65% of the oilseeds production in the country. The interannual monsoon rainfall variability in India leads to large-scale droughts and floods, resulting in a major effect on Indian food grain production

- After an adverse agro-climatic condition faced by Indian Agriculture during 2002–03 (due to 19% decline in summer monsoon rainfall in 2002), resulting in steep decline in the food grains production by about 18 percent from the preceding year. The country's food grains production during 2002– 03 had slumped to 174.19 Mt, due to widespread drought, from the record level of 212.02 Mt in 2001–02.

- The analysis of data for the period 1901 to 2005 suggests that the annual mean temperature increased by 0.51°C. The long-term variation of the mean annual temperature of the country for the period 1875 to 2004 was in the order of 0.03°C per decade while for the period 1971 to 2004 it was around 0.22°C per decade indicating greater warming in the recent decades.
- Analysis of long term (1952-2007) mean annual temperature trends of 47 locations spread across the country indicated increasing trend in the central and southern parts

and north eastern region. While decreasing trend is observed in some parts of Gujarat, Konkan region, NW parts of Madhya Pradesh and Eastern Rajasthan.

- Increase in temperature can reduce crop duration, increase crop respiration rates, affect the equilibrium between crops and pests, hasten nutrient mineralization in soils, decrease fertiliser use efficiencies, and increase evapo-transpiration. Increase in carbon dioxide is however, beneficial for several crops such as wheat, rice, legumes and oilseeds. Crops such as maize, jowar, bajra, and sugarcane do not benefit from increased carbon dioxide.
- Impact of 1 – 2^{o}C increase in mean air temperature caused rice yields decreased by about 0.75 ton/ha in efficient zones and 0.06 ton/ha in coastal regions, where as the increase of 0.5 ^{o}C temperature in winter reduced the wheat crop duration by 7 days and yield decreases by about 0.45 ton/ha
- Extreme weather events have their way of impacting the crops. A study has been conducted on total failure of onion crop in Maharashtra state. The results indicate that during 1997 rabi due to high temperatures in bulb formation stage and 1998 kharif because of high rainfall induced purple blotch and Stemphylium blight diseases are the main reasons for the crop failure.
- Mean seasonal temperature of > 33 ^{o}C and < 27 ^{o}C reduced rice yield in the field experiments. Early reproductive stage was most sensitive to high temperature and yield declined due to reduction in panicles /m2, grains/panicle and spiklet fertility. Plants exposed to continuous heat were relatively more adapted with less reduction in yield.
- High temperature >35 ^{o}C around flowering increased pollen sterility in rice and temperature >32 ^{o}C reduced pollen germination on stigma. Aromatic rice was more sensitive than non-aromatic rice.
- Recent trends in weather, climate, production and productivity of coconut and pepper: Warming trends in most of the coconut growing areas; Dry spells are in increasing trends in Karnataka and Kerala whereas reducing trends in coastal AP and coastal MS; Coconut productivity increased over past 50 years except recent declining trends in maidan Karnataka and Coimbatore dist (TN) due to consecutive droughts; General warming trends coincided with decreasing pepper productivity.
- The shift of apple belt upwards due to decreasing chilling hour's requirements of the crop has been observed in apple growing areas of Himachal Pradesh due to increase in temperature trends during November to March months. The new areas of apple

cultivation have appeared in Lahaul and Spitti and upper reaches of Kinnaur district of Himachal Pradesh,

- Simulation studies indicate a possibility of loss of 4-5 million tons in wheat production with every rise of 1 ^{o}C temperature throughout the growing period even after considering carbon fertilization (but no adaptation benefits. Simple adaptations such as change in planting dates and crop varieties could reduce these losses to 1-2 million tons.
- Changes in climate are expected to create both positive as well as negative impacts on rice yield of Tamil Nadu. Impact is more during Kharif season (Southwest monsoon) than in Rabi (Northeast monsoon) season. During Kharif season in 2020, 10 to 15 per cent reduction in rice yield is expected due to increase in temperature and change in rainfall. In 2050, 30 to 35 percent yield reduction and in 2080, up to 80 percent yield reduction is expected in Tamilandu.
- Ricardian approach was used to analyse the impact of climate change using cross section and time series data for the Tamilnadu state. Paddy is projected to decrease both in terms of area and productivity, resulting in lower production levels of about 13 percent in 2050 and 9 percent in 2020 from existing levels. Sugarcane is projected to decrease by 9.45 and 13.4 percent in terms of area and productivity in short term and about 13 and 9 percent in terms of area and productivity in the long term. Area under groundnut is projected to decrease by 5.12 and 3.65 percent in medium and

(c) The steps being taken by the government to address the issues relating to climate change adaptation and mitigation in the agricultural sector?

Initiatives of ICAR

- Considering the possible impacts climate change could have on Indian agriculture and economy, ICAR has launched in 2004 a National Network entitled 'Impacts, Adaptation and Vulnerability of Indian Agriculture to Climate Change'. The major objectives of this Network are to quantify the sensitivity of crops including horticultural crops and plantations, soils, water, fish and livestock to global climatic changes. This project had 15 partner institutes during X plan: The project is continuing during XI plan period with more to focus on adaptation strategies to cope up the climate change in the coming years. Greater emphasis of developing socio-economic vulnerable indices for planning

improved mitigation strategies has been given priority. The programme will be operated at 26 centers during XI plan period where in additional crops like soybean, potato, pulses, groundnut, vegetable crops that could not be covered in the earlier plan will be taken up. It has also been planned to monitor GHG emissions throughout the year at the different locations in the country.

- This trend clearly indicates the reduced factor of productivity in case of the rice-wheat cropping systems. These variations in trends of productivity indicate the effects of other biophysical and Socio-economic components, which needs to be eliminated before embarking on assessing the impacts of climate change and its variability on growth and yield of crops

General Adaptation strategies envisaged

- changing inputs such as crop varieties and/or species and using inputs with increased resistance to heat shock and drought; altering fertilizer rates to maintain grain or fruit quality consistent with the climate; and altering amounts and timing of irrigation and other water management practices; altering the timing or location of cropping activities;
- Using seasonal climate forecasting to reduce production risk.

Other adaptation strategies

- Utilizing water management to prevent water logging, erosion and nutrient leaching in areas where there is an increase in rainfall;
- making wider use of technologies to 'harvest' water, to conserve soil moisture (e.g. crop residue retention) and to use water more effectively in areas where there is a decrease in rainfall;
- diversifying income by integrating into farming activities additional activities such as livestock raising
- A longer-term planned approach for adaptation is therefore needed to secure sustainable livelihoods of smallholder farmers. It has to incorporate additional information, technologies and investments, infrastructures and institutions and integrate them with the decision-making environment.

- Insurances, safety nets and cash transfers to reduce vulnerability to shocks are also part of the solution. Adaptation strategies can vary, and may be very location specific. They can also involve significant costs and, if the measures are not properly targeted, can produce negative impacts on the poorest and those with insecure access to land
- Some adaptation options may increase competition for existing resources – for example, improving plant productivity may increase water demand for irrigation systems in Dryland areas, which decreases the availability of water for those who have no access to irrigation schemes
- Some adaptation measures may also increase the price of land, particularly in the rental market, thus affecting landless smallholders.