58

STANDING COMMITTEE ON AGRICULTURE
(2017-2018)

SIXTEENTH LOK SABHA

MINISTRY OF AGRICULTURE AND FARMERS WELFARE
(DEPARTMENT OF AGRICULTURAL RESEARCH AND EDUCATION)

FIFTY EIGHTH REPORT

"ICAR-CENTRAL TUBER CROP RESEARCH INSTITUTE - A PERFORMANCE REVIEW"

LOK SABHA SECRETARIAT
NEW DELHI

August, 2018/Shravana, 1940 (Saka)

FIFTY EIGHTH REPORT

STANDING COMMITTEE ON AGRICULTURE

(2017-2018)

(SIXTEENTH LOK SABHA)

MINISTRY OF AGRICULTURE AND FARMERS WELFARE
(DEPARTMENT OF AGRICULTURAL RESEARCH AND EDUCATION)

"ICAR-CENTRAL TUBER CROP RESEARCH INSTITUTE - A PERFORMANCE REVIEW"

Presented to Lok Sabha on	03.08.2018
Laid on the Table of Rajya Sabha on	03.08.2018

LOK SABHA SECRETARIAT

NEW DELHI

August, 2018/Shravana, 1940 (Saka)

COA No. 380

Price : Rs.

Published under Rule 382 of the Rules of Procedure and Conduct of Business in Lok Sabha (Fourteenth Edition) and Printed by

<CONTENTS>

COMPOSITION OF THE STANDING COMMITTEE ON AGRICULTURE (2015-16)

Shri Hukm Deo Narayan Yadav - Chairperson

MEMBERS

LOK SABHA

2. Prof. Ravindra Vishwanath Gaikwad
3. Shri Sanganna Karadi
4. Shri Nalin Kumar Kateel
*5. Smt. Raksha Nikhil Khadse
6. Md. Badaruddoza Khan
7. Shri C. Mahendran
8. Dr. Tapas Mandal
9. Shri Janardan Mishra
10. Shri Ajay Nishad
$11. VACANT
12. Shri Nityanand Rai
13. Shri Mukesh Rajput
14. Shri Konakalla Narayana Rao
15. Shri C.L. Ruala
16. Shri Arjun Charan Sethi
17. Shri Satyapal Singh (Sambhal)
18. Shri Virendra Singh
19. Shri Dharmendra Yadav
20. Shri Jai Prakash Narayan Yadav
21. Shri B. S. Yeddyurappa

RAJYA SABHA

^22. VACANT
23. Shrimati Renuka Chowdhury
#24. Sardar Sukhdev Singh Dhindsa
25. Shri Janardan Dwivedi
@26. Shri Meghraj Jain
27. Shri Vinay Katiyar
28. Shri Mohd. Ali Khan
29. Shri Ram Nath Thakur
30. Shri Shankarbhai N. Vegad
31. Shri Darshan Singh Yadav

***Smt. Raksha Nikhil Khadse, MP Lok Sabha, nominated to the Committee w.e.f. 13.04.2016 *vice* Prof. Richard Hay who ceased to be the Member of the Committee w.e.f. 13.04.2016.**

$ Vacant due to sad demise of Shri Dalpat Singh Paraste w.e.f. 01.06.2016

^ Vacant due to retirement of Shri A.W. Rabi Bernard from the Membership of Rajya Sabha w.e.f. 29.06.2016 vide CB-I Note dated 28.06.2016

 # Sardar Sukhdev Singh Dhindsa, MP Rajya Sabha, nominated to the Committee w.e.f. 23.05.2016 vide Lok Sabha Bulletin- Part II, No.3581 dated 23.05.2016.

@ Shri Meghraj Jain, MP Rajya Sabha, nominated to the Committee w.e.f. 28.07.2016 vide Rajya Sabha Bulletin- Part II, dated 28.07.2016.
Shri Rajpal Singh Saini from the Membership of Rajya Sabha w.e.f. 04.07.2016 vide CB-I Note dated 28.06.2016

COMPOSITION OF THE STANDING COMMITTEE ON AGRICULTURE (2016-17)

Shri Hukm Deo Narayan Yadav - Chairperson

MEMBERS

LOK SABHA

2. Prof. Ravindra Vishwanath Gaikwad
3. Shri Sanganna Karadi
4. Shri Nalin Kumar Kateel
5. Smt. Raksha Khadse
6. Md. Badaruddoza Khan
7. Shri C. Mahendran
8. Dr. Tapas Mandal
9. Shri Janardan Mishra
10. Shri Devji Patel
11. Shri Nityanand Rai
12. Shri Mukesh Rajput
13. Shri Neiphiu Rio
14. Shri Konakalla Narayana Rao
15. Shri C.L. Ruala
16. Shri Arjun Charan Sethi
17. Shri Satyapal Singh (Sambhal)
18. Shri Virendra Singh
19. Shri Dharmendra Yadav
20. Shri Jai Prakash Narayan Yadav
21. Shri B. S. Yeddyurappa

RAJYA SABHA

22. Shri Sambhaji Chhatrapati
23. Sardar Sukhdev Singh Dhindsa
24. Shri Janardan Dwivedi
25. Shri Meghraj Jain
26. Shri Vinay Katiyar
27. Shri Mohd. Ali Khan
28. Shri Ram Nath Thakur
29. Shri R. Vaithilingam
30. Shri Shankarbhai N. Vegad
31. Shri Darshan Singh Yadav

COMPOSITION OF THE STANDING COMMITTEE ON AGRICULTURE (2017-18)

Shri Hukmdev Narayan Yadav - Chairperson

MEMBERS

LOK SABHA

2. Shri Sanjay Dhotre
3. Prof. Ravindra Vishwanath Gaikwad
4. Shri Sanganna Amarappa Karadi
5. Shri Nalin Kumar Kateel
6. Smt. Raksha Tai Khadase
7. Md. Badaruddoza Khan
8. Shri C. Mahendran
9. Dr. Tapas Mandal
10. Shri Janardan Mishra
@11. Shri Praveen Kumar Nishad
12. Shri Devji M. Patel
13. Shri Nityanand Rai
14. Shri Mukesh Rajput
15. Shri Konakalla Narayana Rao
16. Shri C.L. Ruala
17. Shri Arjun Charan Sethi
18. Shri Virendra Singh
19. Shri Dharmendra Yadav
20. Shri Jai Prakash Narayan Yadav
#21. VACANT

RAJYA SABHA

22. Sardar Sukhdev Singh Dhindsa
*23. Shri Rajmani Patel
*24. Shri Narayan Rane
*25. Shri Kailash Soni
26. Shri Mohd. Ali Khan
27. Shri K.K. Ragesh
28. Shri Ram Nath Thakur
29 Shri R. Vaithilingam
*30. Shri Harnath Singh Yadav
31. Dr. Chandrapal Singh Yadav

@ Shri Praveen Kumar Nishad, MP Lok Sabha nominated *vice* Shri Nephiu Rio, MP Lok Sabha w.e.f. 27.04.2018 vide Bulletin Part II No. 6866 dated 27.04.2018

 # Vacant due to resignation of Shri B.S. Yeddyurappa from the Membership of Lok Sabha w.e.f. 18.05.2018 vide Bulletin Part-II Table Office (B) No. 6885 dated 19.05.2018

******vice* **Shri Janardan Dwivedi, Shri Meghraj Jain, Shri Vinay Katiyar and Shri Shankarbhai N. Vegad, who ceased to be the Member of the Committee on their retirement from Rajya Sabha on 27.01.2018, 02.04.2018, 02.04.2018 and 02.04.2018 respectively.**

SECRETARIAT

1.	Shri D.S. Malha	-	Joint Secretary
2.	Shri Arun K. Kaushik	-	Director
3.	Shri Sumesh Kumar	-	Under Secretary

INTRODUCTION

I, the Chairperson, Standing Committee on Agriculture (2017-2018) having been authorized by the Committee to submit the Report on their behalf, present this Fifty Eighth Report (Sixteenth Lok Sabha) on the subject "ICAR-Central Tuber Crop Research Institute - A Performance Review" pertaining to the Ministry of Agriculture and Farmers Welfare (Department of Agricultural Research and Education).

2. The Standing Committee on Agriculture had selected the subject for examination during 2015-16. As the examination of the subject could not be completed during 2015-16, the subject was again selected for examination by the Committee during 2016-17, evidence of the representatives of Ministry of Agriculture and Farmers Welfare (Department of Agricultural Research and Education) was held on 26.05.2017. This subject was again taken up for examination during the current term and the report is being finalized.

3. The Report was considered and adopted by the Committee at their Sitting held on 31.07.2018.

4. For facility of reference, the observations/recommendations of the Committee have been printed in bold at Part-II of the Report.

5. The Committee wish to express their thanks to representatives of the Ministry of Agriculture and Farmers Welfare (Department of Agricultural Research and Education) for furnishing requisite information to the Committee in connection with examination of the subject.

6. The Committee would also like to place on record their deep sense of appreciation for the invaluable assistance rendered to them by the officials of Lok Sabha Secretariat attached to the Committee.

NEW DELHI;
02 August, 2018
11 Shravana, 1940 (Saka)

HUKMDEV NARAYAN YADAV
Chairperson,
Standing Committee on Agriculture

ABBREVIATIONS

AAS	:	Atomic Absorption Spectrophotometer
AKMU	:	Agricultural Knowledge Management Unit
AICRP	:	All India Coordinated Research Project
ASRB	:	Agricultural Scientists Recruitment Board
ANN	:	Artificial Neural Networks
AVRDC	:	Asian Vegetable Research and Development Center
CAGR	:	Compound Annual Growth Rate
CIAT	:	Chartered Institute of Architectural Technologists
CMD	:	Cassava Mosaic Disease
CSR	:	Corporate social responsibility
CPRI	:	Central Potato Research Institute
CTCRI	:	Central Tuber Crops Research Institute
CGIAR	:	Consultative Group for International Agricultural Research
DARE	:	Department of Agricultural Research and Education
FPU	:	Flour Production Unit
FCMU	:	Fried Chips Manufacturing Unit
HYPM	:	Half Yearly Progress Monitoring
ICAR	:	Indian Council of Agricultural Research
ICED	:	International Conference on Eating Disorders
IHC	:	International Horticultural Congress
ICT	:	Information and Communication Technology
ICMV	:	Indian cassava mosaic virus
IET	:	Initial Evaluation Trial
IITA	:	International Institute of Tropical Agriculture
IIRS	:	Indian Institute of Remote Sensing
KVK	:	Krishi Vigyan Kendra
MLT	:	Multi Location Trial
NAAS	:	National Academy of Agricultural Sciences
NRDC	:	National Research Development Corporation

NRI	:	Non-Resident Indian
NUCS	:	Underutilized Crop Species.
OTELP	:	Orissa Tribal Empowerment and Livelihood Programme(
QUEFTS	:	Quantitative Evaluation of the Fertility of Tropical Soils
RTC	:	Root and Tuber Crops
R&T	:	Root and Tuber
RKVY	:	Rashtriya Krishi Vikas Yojana
SAUs	:	State Agricultural Universities
SLCMV	:	Sri Lankan cassava mosaic virus
SMU	:	Snack food Manufacturing Unit
SPS	:	Sweet -Potato Starch
SSNM	:	Site Specific Nutrient Management
URT	:	Uniform Regional Trial
USDA	:	United States Department of Agriculture
USAID	:	United States Agency for International Development
VPN	:	Virtual Private Network

CHAPTER 1

Introduction

1.1. Biodiversity is considered fundamental for ecological sustainability. Presence of ecological diversity can be vital for ecosystem functioning and sustainability in case of adverse climatic condition. Harvesting of varied agricultural crops can also be useful for sustainable agricultural production and the attainment of food and nutritional security. The more diverse farming systems are, the more resilient they are in the face of biotic and abiotic stresses and enhancing food and nutrition security. In addition to provisioning for food, maintaining biodiversity in agriculture is important for providing regulatory ecosystem services such as nutrient cycling, carbon sequestration, soil erosion control. reduction of greenhouse gas emissions and control of hydrological processes. However. despite the evident advantage of a biologically diversified farming system over a period of time, policies by different Countries, has promoted, mono cropping, wherein, only a few crop species are utilized for food production.

1.2. Modern agricultural systems promote the cultivation of high-input and high-yielding crop species, with the intensification of a limited number of species. This has caused a decline in crop diversity in agricultural systems across the world. Of particular concern, the cultivation of traditional crops has declined and continues to decline globally, yet such crops offer greater genetic biodiversity, and have potential to improve food and nutritional security. This is particularly important to ensure food and nutritional security for the current increasing population in a world of finite resources. Modern agricultural systems that promote cultivation of a very limited number of crop species have relegated indigenous crops to the status of neglected and underutilized crop species (NUCS). These NUCS such as coarse cereals, tuber crops and grain legume etc. have potential to reduce food and nutrition insecurity, particularly in case of climatic variability which are being witnessed in recent years due to global warming. These crops can emerge as effective instruments in our efforts to make agriculture adaptive to climate changes associated with Global warming. This is because of their adaptability to low input agricultural systems and nutritional composition.

1.3. Root and tuber crops (RTC), including cassava, sweet potato, yams, potato and other minor root crops are important to the agriculture and food security of many countries and overall are a component of the diet for 2.2 billion people in developing countries. The Department of Agricultural Research and Education in their background note has stated that tuber crops are the 3rd important food crops alter cereals and pulses. They are either a staple or secondary staple for l/5lh of the world population Tropical tuber crops. which include cassava sweet potato yams and aroids are cultivated in 4.5% area under vegetables contributing to 5.7% total vegetable production. They contribute to about 6% of the world‘s dietary calories, and are also an important source of animal feed and raw material for industrial products. The group called tropical ‘root and tuber crops' consists of both dicots like sweet potato (lpomoea batatas (L.) Lam), cassava/tapioca (Manihot esculenta Crantz) and monocots like yams (Dioscorea spp.) and edible aroids like taro (Colocasia esculenta (L.) Schott.), tannia (Xanthosoma sagittifolium (L.) Schott) and elephant foot yarn (Amorphophallus paeoniifolius (Dennst.) Nocolson). Technically. the important edible products harvested from yams are tubers; from cassava and sweet potato are roots while aroids give corms or cormels. Root and tuber (R&T) crops are the third important food crops for mankind after cereals and legumes, and are a staple or subsidiary food for about one-fifth of the world population.

1.4. The Department has further stated that Cassava and sweet potato rank among the top 10 food crops produced in developing countries in terms of volume of production. This clearly shows that tuber crops are going to have more significance in the future with our country expecting a population of 1.69 billion by 2050, when the food grain requirement will be 448 million tons. Moreover the predicted climate change may reduce the productivity of food grains. The wheat and rice yield is projected to decline by 5-11% in 2050. Tropical tuber crops are resilient to climate change. It is also predicted that fossil fuel reserve will be exhausted by 2050 and hence there will be huge demand for food crops in the energy sector. It is also predicted that the cereal consumption in India will decline from the present 60% of total calorie uptake to 48% by 2050, and there will be considerable increase in vegetable consumption including tuber crops. Most of the root and tuber crops are rich in minerals vitamins antioxidants and

dietary fiber. Considering the importance of Root and Tuber crops for ensuring food security and promoting a diversified agriculture system, it is pertinent to promote cultivation of these craps through scientific research including agronomy, breeding post-harvest handling and value addition, and linking farmers to markets.

ICAR-Central Tuber Crops Research Institute (ICAR-CTCRI)

1.5. To facilitate production and utilization of tropical tuber crops in the country, the ICAR-Central Tuber Crops Research Institute (lCAR-CTCRI) was established at Thiruvananthapuram in 1963 under the aegis of Indian Council of Agricultural Research (ICAR) The Central Tuber Crops Research institute (CTCRI), a constituent Institute under the Indian Council of Agricultural Research (lCAR) is the only research orld dedicated solely to the research on tropical tuber crops The institute was established with a vision for study on Root and tuber crops for ensuring a better health, wealth generation and inclusive growth The Institute is working with mission to integrate root and tuber crops as a sustainable farming system component to ensure food and nutritional security of the Nation/and livelihood improvement of rural population and mandated for basic, strategic and applied research on genetic resource management, crop improvement sustainable production and utilization of tropical tuber crops: coordinate research and validation of technologies through AICRP on tuber crops.

1.6. When asked about possibility of opening of sub-station of CTCRI in other States in the Country, the representative of the Department stated as under:

> **"जैसा हमने बताया कि हमारा मुख्या केंद्र त्रिवेंद्रम में है और उसकी एक शाखा भुवनेश्वर में है। लेकिन हमारे पास** 15 **राज्यों में** 12 **ए.आई.सी.आर.पी. केंद्र भी है, वहां पर भी इसमें शोध होता है और हमारी जो प्रजातियां या तकनीकी डेवलप की जाती है, उनका मूल्याङ्कन करके यह बताया जाता है कि अमुक क्षेत्र में अमुक प्रजाति चलेगी या नहीं चलेगी । हम लोग इसमें भी प्रयासरत है और कोशिश कर रहे है कि अन्य राज्यों में भी इसके उत्पादन की विरसुत श्रृंखला बनायीं जा सके, ताकि इसकी व्यावसायिकता और बढ़ायी जा सके।"**

Financial Performance

1.7. When asked to submit details about financial allocations and expenditure to the ICAR-CTCRI during XII Plan, the Department submitted as under:

Rs. In Lakhs

Year		Budget Estimate	Revised Estimates	Expenditure
XII Plan				
2012-13	Plan	700.00	500.00	499.99
	Non plan	1512.00	1353.00	1313.01
2013-14	Plan	600.00	528.00	528.00
	Non plan	1413.00	1341.27	1341.27
2014-15	Plan	550.00	360.00	359.98
	Non plan	1399.00	1513.00	1512.97
2015-16	Plan	560.00	509.00	509.00
	Non plan	1523.00	1520.86	1517.19
2016-17	Plan	526.00	385.00	385.00
	Non plan	1795.00	1691.10	1691.00
Total	**Plan**	**2936.00**	**2282.00**	**2281.97**
	Non plan	**7642.00**	**7419.23**	**7375.54**
	Total	**10578.50**	**9701.23**	**9657.51**
2017-18	Unified budget	2245.80	2254.80	2248.93

1.8. On enquired about percentage of fund requirement met by the Institute by their internal sources, the Department submitted as under:

Year	Target (Rs. Lakhs)	Resource Generation (Rs. Lakhs)	% *
2012-13	24.00	32.25	1.75
2013-14	58.75	50.65	2.71
2014-15	30.47	44.32	2.37
2015-16	34.55	44.31	2.91
2016-17	41.47	71.81	3.45
2017-18	45.62	92.73	4.11

* of Non plan expenditure

Fund Surrendered

1.9. When asked to submit details about surrendered funds during 2015-16 and 2016-17 by the ICAR-CTCRI, the Department have informed that CTCRI have utilized 100% of allocations during 2015-16 and 2016-17 and furnished following details:

Head of Account CAPITAL	RE 2015-16	Expenditure 2015-16	RE 2016-17	Expenditure 2016-17	RE 2017-18	Expenditure 2017-18
Works						

A. Land						
B. Building						
i. Office building	53.07	53.07	141.03	141.03	11.00	11.00
ii. Residential building						
iii. Minor Works	-	-	-	-	-	-
Equipments	102.90	102.90	21.42	21.42	-	-
Information Technology	10.99	10.99	10.91	10.91	-	-
Library Books and Journals	10.07	10.07	0.47	1.07	-	-
Vehicles & Vessels					-	-
Livestock					-	-
Furniture & Fixtures	27.97	27.97	15.08	15.08	-	-
Others					-	-
Total – Capital	205.00	205.00	188.91	189.51	11.00	11.00
Establishment Expenses						
Travelling Allowance						
A. Domestic TA / Transfer TA	32.00	32.00	24.00	24.00	30.04	30.04
B. Foreign TA						
Research & Operational Expenses						
A. Research Expenses	66.00	66.00	24.52	24.52	33.68	33.68
B. Operational Expenses	93.00	93.00	65.86	65.86	66.20	66.20
Administrative Expenses						
A. Infrastructure	65.00	65.00	56.45	56.45	98.32	98.32
B. Communication	3.50	3.50	4.38	4.38	5.17	5.17
C. Repairs & Maintenance						
i. Equipment, Vehicles & Others	-	-	-	-	10.37	10.37
ii. Office building	5.00	5.00	-	-	80.28	80.28
iii. Residential building					0.33	0.33
iv. Minor Works					15.05	15.05
D. Others (excluding TA)	33.50	33.50	10.93	10.93	30.01	30.01
Miscellaneous Expenses						
A. HRD	5.19	5.19	5.29	5.29	4.83	4.83
B. Other Items (Felloships, Scholarships etc.)						
C. Publicity & Exhibitions	0.80	0.80	0.20	0.20	3.69	3.69
D. Guest House – Maintenance					2.49	2.49
E. Other Miscellaneous	-	-	-	-	1.34	1.34
TOTAL REVENUE	**304.00**	**304.00**	**191.63**	**192.23**	**381.80**	**381.80**
GRAND TOTAL (CAPITAL + REVENUE)	**509.00**	**509.00**	**381.13**	**381.13**	**392.80**	**392.80**

Revenue Receipt

1.10. When asked about steps being taken by the ICAR-CTCRI to augment financial resources apart from budgetary Grants for research and development, the Department have submitted following sources for revenue generation:

1. Sale of quality planting materials
2. Sale of tubers
3. Sale of technologies through IPTMU
4. Consultancy and Contract Research Projects
5. Graduate, post-graduate and Ph.D. students programmes
6. Techno-incubation centre training fees

1.11. When asked to furnish details about targets and achievements of revenue generation of institutes of ICAR-CTCRI during the last five years, the Department submitted following details:

Rs. in lakh

	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Targets	24.00	33.90	30.47	34.55	41.47	45.62
Achievements	35.25	50.65	44.32	44.31	71.81	92.73

1.12. When asked to submit details of fee received by ICAR-CTCRI for consultancy/training services provided to other organizations during 2015-2018, the Department submitted following details:

Year	Fee received (Rs. Lakhs)
2015-16	25.00
2016-17	32.00
2017-18	59.46

1.13. On the query of the Committee regarding utilization of revenue generated by ICAR-CTCRI during the last five years, the Department submitted following details:

Year	Utilization (Rs. Lakhs)
2012-13	41.01
2013-14	66.14
2014-15	95.84
2015-16	102.26
2016-17	NIL
2017-18	NIL

**Excess utilization met from the interest earned from the STD*

1.14. When asked to furnish details of numbers and revenue generated from contract research/consultancy services/training provided by the Institute during the last five years, the Department submitted as under:-

Year	Fee received (Rs. Lakhs)
2015-16	25.00
2016-17	32.00
2017-18	59.46

1.15. When asked about steps being taken by the ICAR-CTCRI for tapping Corporate

Social Responsibility funds for Agriculture Research and Extension, the Department submitted as under:

"Efforts are being taken to tap funds for CSR fund".

Production and Marketing of Root and Tuber crops

1.16. When asked to furnish state-wise details of production, export and import of various Root and Tuber Crops and products in the country during the last four years, the Department submitted as under:-

Cassava area and production:

	2013-14		2014-15		2015-16		2016-17	
State	Area (x 1000 ha)	Production (x 1000 tons)	Area (x 1000 ha)	Production (x 1000 tons)	Area (x 1000 ha)	Production (x 1000 tons)	Area (x 1000 ha)	Production (x 1000 tons)
Tamil Nadu	120.6	4975.6	86.1	2699.8	90.51	2810.03	82.07	2603.22
Kerala	71.1	2581.4	87.6	1207.2	86.94	1212.80	87.64	1179.87
AP	18.3	365.2	17.0	258.0	10.98	164.77	8.82	132.33
Nagaland	6.2	92.3	6.2	92.3	4.91	70.06	5.24	76.99
Meghalaya	5.3	32.0	5.6	34.4	5.41	33.30	6.35	40.15
Assam	3.1	27.6	3.3	30.1	3.17	29.18	4.49	42.11
TOTAL (including others)	**228.3**	**8139.4**	**207.6**	**4372.7**	**203.5**	**4344.16**	**196.18**	**4095.63**

Sweet potato Area and Production

State	2013-14		2014-15		2015-16		2016-17	
	Area (`000 ha)	Production (`000 tonnes)	Area (`000 ha)	Production (`000 tonnes)	Area (`000 ha)	Production (`000 tonnes)	Area (`000 ha)	Production (`000 tonnes)
Odisha	42.0	396.2	42.0	391.4	40.84	385.55	40.8	384.51
West Bengal	22.8	236.0	22.8	242.4	22.71	239.81	22.7	240.62
Uttar Pradesh	17.5	230.5	17.5	331.4	17.07	225.87	17.18	227.25

Assam	6.1	30.5	6.1	32.9	5.41	29.15	10.21	55.93
Meghalaya	4.5	15.6	4.5	16.3	4.55	16.42	4.65	17.85
Chhattisgarh	3.4	35.8	3.4	37.8	3.69	38.23	5.57	200.03
Karnataka	2.3	34.2	2.3	35.2	2.40	31.04	2.54	36.02
Madhya Pradesh	2.8	49.5	2.8	60.0	4.09	80.17	4.20	50.57
Nagaland	1.6	23.4	1.6	23.4	1.00	14.93	0.96	14.04
All India (Including Other states)	**106.0**	**1088.0**	**107.0**	**1228.0**	**126.38**	**1454.33**	**134.88**	**1638.84**

1.17. On the query of the Committee regarding study conducted by the ICAR-CTCRI to explore scope for enhancing production of Root and Tuber crops in different parts of the country, the Department submitted as under:-

> "A number of studies were conducted to explore scope for enhancing production of root and tuber crops. Exploratory surveys, soil and natural resource inventory as well as studies using geoinformatics tools were done and identified areas that will become suitable for future area expansion. RKVY funded projects are initiated in the states of Odisha and Kerala."

1.18. When asked about study conducted by the ICAR-CTCRI or any other government agencies to explore market potential for Indian Root and Tuber crops in foreign countries, the Department submitted as under:-

> "The ICAR-CTCRI has conducted studies to find out the market potential for R&T crops. The starch and sago production in India is projected to reach 0.4 and 0.3 million tons respectively in 2020. Bangladesh, Malaysia, Sri Lanka, middle east countries, UK, USA, Australia, some African countries, Italy, Belgium, Singapore are the important countries where we have future export prospects."

Development and Release of New Varieties of Root and Tuber crops

1.19. When asked about target fixed by ICAR-CTCRI for development and release of

new varieties of Root and Tuber crops/hybrids during XII Plan, the Department submitted as under:-

Sl. No.	Varietal Trait	Target (No)
1	High yield and high starch cassava varieties	2
2	K use efficient and good culinary cassava variety	1
3	High yield, good culinary quality and yellow fleshed cassava variety	1
4	Orange fleshed, β-carotene rich sweet potato variety for food, nutrition security and processing	1
5	Purple fleshed, anthocyanin rich sweet potato variety food, nutrition and processing	1
6	High yield and good culinary quality sweet potato varieties	3
7	Anthracnose disease resistant yam variety	1
8	Purple fleshed yam variety for food and nutrition security	1
9	Taro varieties tolerant to leaf blight, drought, salinity stress and rich in micronutrients	2
10	High yield and good culinary quality yam variety	1
	TOTAL	**14**

1.20. When asked to furnish a detailed note on achievements of ICAR-Central Tuber Crop Research Institute (ICAR-CTCRI) in development of improved varieties of Root and Tuber crops during the last five years, the Department submitted as under:-

> "Sixty high yielding varieties of different R&T crops developed and released include 16 of cassava, 18 of sweet- potato, 14 of yams, 9 of taro, 2 of elephant foot- yam and 1 of Chinese potato. High yielding and high starch containing cassava varieties , H165 and H226, contributed in a big way in the establishment of starch and sago industries in and around Salem district of Tamil Nadu. For starch industry, three triploid varieties— Sree Harsa, Sree Athulya, and Sree Apoorva —with high dry matter and extractable starch content were developed. And even the first cassava mosaic disease (CMD) resistant variety Sree Padmanabha, was developed and released by the institute. Short -duration cassava varieties, Sree Jaya and Sree Vijaya, ideal for cultivation in rice fallows

of Kerala,have also been developed by the CTCRI. Highest productivity of cassava in the world with 36 tonnes/ha is a testimony of good quality Indian varieties."

1.21. The Department have further informed that high- yielding varieties of sweet-potato, Gouri and Sankar released by the Regional Centre, Bhubaneswar, are suitable for cultivation in the eastern and north- eastern states. A high carotene sweet- potato variety, Sree Kanaka and Bhu Kanti (ST-14) (β-carotene 9-10 mg 100/ g fresh weight) was released for popularizing in poverty stricken, nutrient- deficient regions of the country. Similarly, an anthocyanin rich greater yam variety, Sree Neelima, developed is with good culinary and nutritive quality. Sree Dhanya is a novel dwarf white yam which reduces cultivation cost due to its non-climbing habit. *Sree Shilpa, with its medium sized, smooth and oval tubers and excellent cooking quality, is the first hybrid of greater yam, produced in the world*. A high -yielding greater yam accession, DA 199, with an average yield of 40 tonnes/ha was released under the name Sree Karthika. Sree Padma with high yield (41 tonnes/ha) and Sree Athira, the first hybrid, are improved elephant foot- yam varieties, while Sree Kiran is the first hybrid taro released in India. Sree Kiran has a tuber yield of 17.5 tonnes/ ha and good cooking quality.

1.22. On the query of the Committee regarding system in place at ICAR-CTCRI to monitor performance and productivity of new Root and Tuber crops/hybrids released by the institutes, the Department submitted as under:-

"All new hybrids developed will be tested for their performance in Initial Evaluation Trial (IET), Multi Location Trial (MLT) and Uniform Regional Trial (URT) in various selected locations under AICRP (Tuber Crops). All released varieties are being tested in Institute farm as well as through progressive farmers for their performance."

1.23. When asked to furnish details of commercialization of Root and Tuber crops/hybrids released by the ICAR-CTCRI during XII plan, the Department submitted as under:-

"Out of the 14 varieties of root and tuber crops released during the XII plan, 11 varieties have been commercialized through contract farming and the revenue earned is Rs. 48.00 lakhs."

1.24. When asked about efforts being taken by the ICAR-CTCRI to enhance awareness about new crop varieties and hybrids among farmers, the Department submitted as under:-

"The ICAR-CTCRI, Thiruvananthapuram and its Regional Centre at Bhubaneswar has been collaborating with different state governments and taken up projects to popularize the newly released varieties of root and tuber crops. The RKVY, State Planning Board, OTELP, Department of Tribal Development, Department of Agriculture, Department of Horticulture etc. of different states coordinated with ICAR-CTCRI in popularization. Besides these, under Tribal Sub Plan, the Institute has taken up programmes to popularize these varieties in north eastern states of India."

Production technologies

1.25. When asked to furnish a detailed note on achievements of ICAR-Central Tuber Crop Research Institute (lCAR-CTCRI) in development of improved methods for production of Root and Tuber crops during the last five years. the Department submitted as under:-

"Quality planting material production technology for Cassava, Sweet Potato, Elephant Foot Yam and other tuber crops have been standardized by the Institute. Mini-sett technology for tuber crops was developed at the Institute is very popular among farming community. Management practices for intercropping cassava with coconut, arrowroot with coconut, yams with maize, and yams and edible aroids with coconut, banana and rubber have been standardized. Precision nutrient management technologies such as drip fertigation for cassava and elephant foot -yam and drip irrigation for elephant foot- yam have been developed. Soil fertility management practices for all these crops were substantially improved with the development of soil- test based fertilizer

recommendations as well as site specific nutrient management (SSNM) practices developed using calibrated QUEFTS model. The model based approach resulted in development of nutrient recommendation zonation maps as well as customized fertilizers for cassava, elephant foot- yam, sweet- potato and yams.

Organic Farming of Tuber Crops

1.26. When asked to about steps being taken by the ICAR-CTCRI for research on organic farming of Root and Tuber crops, the Department submitted as under:-

"Series of field experiments were conducted to compare varietal response, yield, quality and soil properties under organic farming over conventional system in these crops. The industrial as well as domestic varieties of cassava, the elite and local varieties of elephant foot -yam and taro and the three species of *Dioscorea* (yams) responded similarly to both the systems. Elephant foot -yam was the most responsive to organic management, followed by yams and cassava. Organic management promoted yield by 10-20% . The tuber quality improved with higher dry matter, starch, crude protein, K, Ca and Mg contents. In taro, slight yield reduction (5%) was noticed under organic farming. The anti-nutritional factors, oxalate content in elephant foot -yam and cyanogenic glucoside content in cassava lowered by 21 and 12.4%, respectively. Due to organic farming in elephant foot- yam, cost-benefit analysis indicated net profit 28% higher with additional income of Rs 47,716/ ha . A learning system was developed using artificial neural networks (ANN) to predict performance of elephant foot- yam organic production system under various agroclimates. Methodology for climate change impact assessment of cassava, sweet- potato, elephant foot -yam and yams using ECOCROP model has been developed, and the model was calibrated for these crops for Indian conditions using geoinformatics tools."

1.27. Further submitting on the above issue, the Department submitted as under:

"The long term fertility experiment in cassava clearly proved the superiority of

balanced integrated application of farmyard manure @12.5tonnes/ ha along with NPK @ 100:50:100 kg/ ha in improving tuber yield, tuber quality and soil chemical properties. Research work conducted for the past 12 years helped develop **organic farming** technology for cassava, yams, elephant foot- yam and taro. Low input management strategy was developed for cassava; nutrient-use efficient cassava genotype identified for inclusion in low input management strategy and a K efficient cassava variety was released recently as Sree Pavithra. Nutrient rich organic manure through composting of cassava starch factory solid waste (thippi) was developed. Zeolite materials with high cation exchange capacity were synthesized from fly ash for enhanced soil nutrient retention. "

1.28. When the Committee drew the attention of the Department towards need of research on more varieties of Root & Tuber Crops, the representative of the DARE stated as under:-

'सर, आप सबकी तरफ से बहुत सारे सुझाव आए हैं, क्योंकि आप लोग हिंदुस्तान के अलग-अलग इलाके से रिप्रेजेंट करते हैं। आपका काफी अनुभव भी है और लोगों के साथ आप काफी ताल्लुकात रखते हैं। यह ठीक है कि हमारे साइंटिस्ट कुछ लिमिटेड क्रॉप्स के ऊपर अनुसंधान कर रहे हैं, जैसा कि इन्होंने बताया कि 22 क्रॉप्स के ऊपर ये लोग अनुसंधान कर रहे हैं और ज्यादातर 10 क्रॉप्स के ऊपर इनका ध्यान है।'

Research on Marginalized/wild varieties of Root and Tuber Crops

1.29. When attention of ICAR was drawn about need of identification and Research on Root and Tuber crops which are found in wild or being cultivated marginally in various parts of the country, the representatives of the Department stated as under:

'जैसा कि आपने बताया कि पानी के अंदर जो ट्यूबरक्रॉप्स है, उसके बारे में भी अनुसंधान करने की जरूरत है। हम आईसीएआर की तरफ से कोशिश करेंगे कि यह जो कमी है, इसके ऊपर कोई विशेष ध्यान देकर एक रिसर्च प्रोजेक्ट बनाएंगे और जितने इस टाइप के ट्यूबर क्रॉप्स विभिन्न प्रदेशों में और एरियाज में हैं, उसके लिए एक स्पेशल टीम बनाकर उसका अनुसंधान करने की दिशा में कदम बढ़ाएंगे।'

Research on Nutritional and Medicinal aspects of Root and Tuber Crops

1.30. On the query of the Committee regarding need of research on nutritional and medicinal values of Root & Tuber Crops, the representatives of the Department has stated as under:

> 'आपने बताया कि कई सदियों से हमारे पुराने लोग जंगल में जो कंद-मूल है या फल-मूल है, उसका आहार लेकर चुस्त रहते थे, तो उसके बारे में अनुसंधान करने की जरूरत है। जो न्यूट्रिशनल वैल्यू है, उसके ऊपर भी विशेषकर स्टडी की जाए। जैसा कि बताया कि इसका जो कड़ापन है, यह मिसकंसेप्शन है कि इसे खाने से डाइबिटीज बढ़ती है, उसके बारे में अनुसंधान करके लोगों को सही इन्फार्मेशन देने के लिए हम खासकर कोई रिसर्च प्रोजेक्ट तैयार करेंगे। बाकी जो सुझाव आपकी तरफ से आए हैं, हम उनके बारे में जरूर ध्यान देंगे।'

1.31. When attention of ICAR was drawn about need of Research on incidences of infertility among Jarawa Community of A & N Islands who consume diosceria (Root & Tuber Crop), the representatives of the Department has stated as under:

> "There is a problem not only among the Jarawa community but another community in Kerala which lives in Nilambur forest. They are called Chola Naikans. They are only 376 people in number now. The Agricultural Production Commissioner, Government of Kerala, requested us to send a delegation to the forest and find out what exactly is the problem. So, I along with three others stayed there and we could identify dioscoria. We are still analyzing that one. It is actual dioscoria but in there also anti-fertility content is fairly high. This content can create problem with our fertility. उसी की वजह से शायद हो सकता है। जंगल से अभी हम ट्यूबर लेकर आए हैं, प्रोटैक्टेड कंडीशन में उसे ग्रो कर रहे हैं। We are going to analyze it and come out with a solution as to what exactly can be done. "

<u>Disease affecting Production and Root and Tuber crops</u>

1.32. Root and Tuber crops being vegetatively propagated, biotic causal agents are very easily transmitted /transported, and this leads to disease proliferation. On the query of the Committee regarding diseases affecting production of Root and Tuber crops in the country, the Department submitted as under:-

"The important biotic constraints are mosaic disease, tuber-rot, mite, whitefly and mealy bug in cassava, weevil in sweet potato, anthracnose and mosaic in yam, leaf blight in taro, collar rot and mosaic in elephant foot yam and storage pests."

1.33. When asked to furnish success achieved by the ICAR-CTCRI in development of pathogen and pest resistant varieties of Root and Tuber crops, the Department submitted as under:-

Sl. No.	**Resistance**	**Variety**
1	Cassava mosaic disease resistant variety	Sree Padmanabha
2	Taro leaf blight resistant varieties	Muktakeshi Bhu Kripa
3	Anthracnose resistant yam	Sree Swathy

1.34. When asked about steps being taken by the ICAR-CTCRI for research on early detection of disease affecting Root and Tuber crops, the Department submitted as under:-

"Diagnostic techniques have been standardized for important viral and fungal diseases — cassava mosaic disease, cassava tuber- rot, sweet- potato feathery mottle, sweet- potato leaf curl, dasheen mosaic in elephant foot- yam and taro, yam mild mottle virus, yam badna virus, anthracnose in yam, taro leaf -blight and collar -rot in elephant foot- yam. Dipsticks were developed manually based on *DsMV* specific IgG-gold conjugate. The test was found highly sensitive and was capable of detecting virus with very low titre. Full genome of cassava mosaic viruses (*ICMV* , *SLCMV*), sweet- potato leaf -curl virus and dasheen mosaic virus have been sequenced. Transgenic plants resistant to cassava mosaic virus have been developed using *Rep* gene of Indian cassava mosaic virus. They showed delay in symptom expression. "

Protection technologies

1.35. When asked to about steps being taken by the ICAR-CTCRI in development of protection technologies for Root and Tuber crops, the Department submitted as under:-

"Packages for eco-friendly management of important fungal diseases like cassava tuber- rot, elephant foot- yam collar- rot, taro blight and insect -pests of sweet- potato, cassava and stored product have been developed. The sweet-potato variety, Sree Bhadra, has been identified as a trap crop for nematode management. Insecticidal principles from secondary metabolites of seeds, leaves and tuber- rinds of cassava have been isolated and formulated as **biopesticides** against a spectrum of insect- pests of field crops. Varieties of sweet- potatoes have been identified against weevils, and kairomones responsible for chemo-signalling to weevil have also been isolated."

Use of Chemical Fertilizers and Pesticides for cultivation of Root and Tuber Crops

1.36. On the query of the Committee regarding study conducted by the ICAR-CTCRI to analyze extent of use of chemical fertilizers by the Root and Tuber Crops farmers in the country, the Department submitted as under:-

"Studies conducted by ICAR-CTCRI has estimated the amount of chemical fertilizers used by Root and Tuber Crops farmers in the country.

Sl. No.	Chemical fertilizer	Quantity (tons)
1	Urea	30000
2	Mussooriephos / Rajphos	20000
3	DAP	30000
4	Potash	35000

1.37. On the query of the Committee regarding steps taken by the ICAR-CTCRI to develop Region specific Integrated Nutrient Management package for cultivation of Root and Tuber Crops in the country, the Department submitted as under:-

"The ICAR-CTCRI has developed site specific nutrient management (SSNM) technology using computer programmes to calculate the exact quantity of fertilizers required for getting a particular yield for all major growing regions of the country. Fertilizer calculation charts, decision support system and mobile app were developed to help the farmers to calculate the quantity of different fertilizers."

1.38. On being asked about support provided by the ICAR-CTCRI to the Root and Tuber crop farmers for preparation of soil health card, the Department submitted as under:-

"Every year, the ICAR-CTCRI collects soil samples from Root and Tuber Crops farmers, and analyse the samples and prepares Soil Health Card. An awareness programme is being conducted on World Soil Day and the cards are distributed on the occasion. We also support the state departments and KVKs in analyzing the micronutrients with the equipment, Atomic Absorption Spectrophotometer (AAS) available at ICAR-CTCRI."

1.39. On the query of the Committee regarding study conducted by the ICAR-CTCRI to analyze extent of use of chemical pesticides by the Root and Tuber Crops farmers in the country, the Department submitted as under:-

"Most of the farmers do not apply any chemical pesticides on a large scale. Since it is not a serious problem of Root and Tuber Crops farmers, the ICAR-CTCRI has not done any study in this respect."

1.40. When asked about steps taken by the ICAR-CTCRI to develop Region Specific Integrated Pest Management package for cultivation of Root and Tuber Crops in the country, the Department submitted as under:-

"The ICAR-CTCRI has developed Integrated Pest and Disease Management strategy for all important pests and diseases. The following packages were developed.

1. Integrated disease management of cassava mosaic disease
2. Integrated management of tuber rot of cassava

3. Integrated management of sweet potato weevil
4. Integrated disease management of collar rot of elephant foot yam
5. Integrated disease management of yam anthracnose
6. Integrated disease management of taro leaf blight

1.41. When asked to furnish details of package developed and training provided to the farmers during the last five years, the Department submitted as under:-

Sl. No.	Year	Topic	No. of farmers trained
1	2012-13	Integrated pest and disease management of tropical tuber crops	350
2	2013-14	Integrated pest and disease management of tropical tuber crops	424
3	2014-15	Integrated pest and disease management of tropical tuber crops	285
4	2015-16	Integrated pest and disease management of tropical tuber crops	386
5	2016-17	Integrated pest and disease management of tropical tuber crops	442
6	2017-18	Integrated pest and disease management of tropical tuber crops	836*
	Total		**2653**

Food Processing Industries Based on Root and Tuber Crops

1.42. Starchy roots and tuber crops play a pivotal role in the human diet. They add variety to the diet in addition to offering numerous desirable nutritional and health benefits. When asked about uses of Root and Tuber Crops, the Department submitted as under: -

1. Direct human consumption

2. Savory snacks
3. Baked products
4. Industrial products
5. Biomolecules with pesticidal action
6. Pasta and noodles
7. Functional foods
8. Starch graft co-polymers

1.43. When asked about the percentage of processing of Root and Tuber Crops in the country, the Department submitted as under:-

"Cassava, sweet potato, elephant foot yam, taro and arrowroot are processed in different parts of the country. About 40% of the total production is processed before its use.

State	% of processing
Tamil Nadu	90
Kerala	40
Andhra Pradesh	90
Karnataka	80
Odisha	60
West Bengal	40
Bihar	40
Other states	30

1.44. When asked to furnish details of food processing industries based on the use of Root and Tuber Crops, the Department submitted as under:-

Sl. No.	Product	Industry

	Starch and sago	More than 500 factories in Tamil Nadu and Andhra Pradesh
	Tuber crops based fried snack foods	14 small entrepreneurs in Kerala and Tamilnadu
	Improved technology for fried cassava chips	M/s Tierra Food India Pvt. Ltd , Ernakulam
	Extruded snack foods from cassava and rice flour	
	M/s Kalady Rice Millers Consortiuim Pvt. Ltd., Ernakulam	M/s Kalady Rice Millers Consortiuim Pvt. Ltd., Ernakulam
	Cassava pappad	M/s Boosters International, Tamil Nadu
	Gluten free bread	M/s Belgaum Minerals, Hindalga Road, Belgaum
	Cold water miscible starch from cassava	M/s Vensa Biotek Ltd., Samalkot, Andhra Pradesh
	Biopesticides	Patented through NRDC on 05.02.2012 and licensed to 6 KVKs

1.45. On being asked about assessment made by ICAR-CTCRI regarding potential of Food Processing and other Industries based on use of Root and Tuber Crops in the country, the Department submitted as under:-

"Tuber crops have got a very important role in future food processing industry market. The overall bakery market is valued at Rs 150 billion in 2015 and growing at 12-15% CAGR annually. Breads are the major baked food consumed in India with a market size of Rs. 82. 40 billion in 2015. The biscuits and cookies industry in India, valued at Rs. 145 billion in 2014, has been growing at a CAGR of over 10% in the last three years. This industry will be worth nearly Rs. 279 billion by 2019, with a CAGR of 14%."

1.46. When asked to furnish details of functional food based on Root & Tuber crops developed by the ICAR-CTCRI, the Department submitted as under:-

"A major problem in post- harvest utilization of cassava is the poor shelf- life of tubers, which is a serious concern for cassava industry. The very low protein content in cassava (0.3-0.6%) is another drawback in its use as food. An array **of** value- added technologies, which include nutritionally fortified snack foods, technology for fried chips manufacturing, technology for minimal processing of cassava for exporters have been developed. Gluten-free spaghetti was developed from blends of sweet- potato flour with native and pretreated rice flour. Spaghetti with a low glycaemic index (55.7) was developed from annealed rice flour- sweet- potato flour-whey protein concentrate- *gaur* gum blend. A low starch digestibility (glycaemic index: 54.58) noodle was developed using NUTRIOSE® FB06. Technology was perfected for developing high protein starch noodles from sweet -potato starch (SPS). Besides, the resistant starch content in SPS noodles could be enhanced through fortification with banana starch (40%) or resistant starch (RS) enhanced (annealed) cassava starch (50%), which also had low *in-vitro* starch digestibility and medium glycaemic index. Bioactive compound fortified sweet- potato flour and starch noodles with high antioxidant activity were developed using betanin, anthocyanin, carotene, curcumin or their combinations. Betanin (1%) fortified flour noodles was found best with high antioxidant activity and sensory quality. Betanin+ anthocyanin (0.5% each) fortified starch noodles showed a very high antioxidant activity. A cassava-rice based extruded product was developed under a contract research project sponsored by M/s Kalady Rice Millers Consortium and was released by the firm in brand name 'LALA' on 31 July 2014. Besides, a number of industrial products like high fructose syrup, cold water miscible starch, modified starches with altered viscosity, higher gel strength, improved film forming capacity, clarity, lower retrogradation tendency and higher tack have been developed. They have wide applications as binders, fillers, emulsion stabilizers, consistency modifiers and adhesives.

Green Technologies from Cassava Starch

1.47. On the query of the Committee regarding other potential use of Root & Tuber Crops apart from functional food and steps taken by the Institute for Research on those

aspects, the Department submitted as under:-

"The institute has developed and patented a technology (NRDC 9810152, European patent 1996) for manufacturing starch -based biodegradable plastics. Cassava starch was blended with polyolefin to make functional plastic articles while inducing biodegradability in appropriate environment. The starch incorporated **plastic films** (up to 25-40%) possess adequate mechanical strength and flexibility and can be processed just like normal plastics, i.e., heat-sealed, printed, coloured etc. The granules and finished products can be stored almost like synthetic plastics and biodegradable under soil burial conditions. It is patented in India and abroad.

The technology can be easily adopted by the existing plastic manufactures using conventional machines. The plastic film can be used for preparing disposable carry bags, aprons, gloves, caps as well as nursery bags, mulch bags, garbage bags etc. Further refinement of native and modified cassava starch based biodegradable films with increased hydrophobicity, better barrier properties and improved physico-mechanical properties are in progress. Poly (lactic acid)-cassava starch composite based moulded articles were prepared by injection moulding and blow films methods. These can be used as disposable articles for various purposes. A semi-synthetic cassava (tapioca) starch based superabsorbent polymer has been developed. The polymer is effective in soil moisture retention and it also improved soil properties such as porosity, water -holding capacity and nutrient status. It can be used as a soil additive, especially under controlled conditions such as in green houses for plant nurseries, ornamental and medicinal plants for saving irrigation water."

1.48. Further elaborating on the above issue, the Department has submitted as under:-

"From cassava starch bioethanol can be produced. Fresh cassava tubers, dry chips/flour or starch can be used for production of ethanol. The process consists of three steps — liquefaction, saccharification and fermentation. One tonne of

fresh cassava tubers with a starch content of >26-28% would yield around 140-150 litres of 96% alcohol while one tonne of dry chips / flour would yield around 430-440 litres of 96% alcohol, under ideal conditions (Old patented technology). The CTCRI has recently developed an improved technology for bioethanol production from cassava starch using novel enzymes, derived from genetically engineered microorganisms. The process is time saving and less energy consuming, and can yield 680 l ethanol from 1 tonne of dry chips / flour."

1.49. When asked about steps taken by the ICAR-CTCRI for developing technologies for production of bio-degradable plastics and ethanol from Root and Tuber Crops developed by the institutes have been commercialized, the Department submitted in negative.

1.50. While elaborating on the reasons for failure of the ICAR-CTCRI to commercialize technology for bio-degradable plastic from Cassava, the representatives of the Department stated as under:

"Sir, it is possible. It was the initial result. So, we thought that once the result has come out and we validated it at our centre. Once we confirm the findings, then we thought it would be ideal to have the patent right for India. Therefore, we have done this. But we are in the process to scale it up to exploit it at the commercial level. We are into the process and since it involves huge amount of investment, this is not in our capacity, in terms of Budget capacity of this institute to take up this kind of activity. However, if sufficient Budget is available, then we can take it up also."

1.51. When asked to furnish details of projects for development of machineries/technologies for food processing Industries based on Root and Tuber crops undertaken by the ICAR-CTCRI, the Department submitted as under:-

1. Cassava chipping machines – hand operated, pedal operated and motorized
2. Mobile starch extraction plant
3. Industrial rasper for extraction of starch
4. Centrifugal granulator for cassava based feed

5. Cassava harvester
6. Cassava peeling knife
7. Pilot plant for liquid adhesive

1.52. On the query of the Committee regarding project undertaken by the ICAR-CTCRI to analyze the need of good manufacturing practices in food processing Industries based on Root and tuber crops in the country, the Department submitted as under:-

"Good manufacturing practices have been developed for Savory snacks, Baked products, Industrial products, Pasta and noodles, Functional foods and Starch graft co-polymers."

Use of Root & Tuber Crops as Animal Feed

1.53. When asked about the steps being taken for research on use of Root & Tuber crops as animal feed, the representative of the Department stated as under:-

"Sir, we are already in the process of doing this. We have already included it in our research programme. Hopefully, in an year or two, we would be coming up with some protocol and some mechanism how this could be incorporated to convert this into the feed which could be used in your areas for feeding the pigs and other animals or whatever suitable."

Research Cooperation and Collaboration

1.54. On the query of the Committee regarding policy of ICAR in general and ICAR-CTCRI in particular for Research Cooperation and Coordination with National and International Research Institutes, State Governments and Industrial sector, the Department submitted as under:-

"The ICAR-CTCRI collaborates with various State Agricultural Universities (SAUs), State Departments of Agriculture, Horticulture, Tribal Development etc. and related Industries in developing, validating and scaling up the technologies developed. At International level, the Institute has collaboration with CGIAR

institutes such as CIAT, CIP and IITA besides organizations such as CIRAD, USDA, NRI, ETH etc."

1.55. When asked to furnish details of research projects being undertaken by the ICAR-CTCRI in partnership with International Research Institutes during the last five years, the Department submitted as under:-

Sl. No.	
1	CIP, Lima, Peru
2	CIAT, Cali, Colombia
3	CIRAD, France
4	ETH, Switzerland
5	NRI, UK

1.56. When asked to furnish steps taken by the ICAR-CTCRI to enhance research cooperation and collaboration with various ICAR research Institutes and other State level research institutes in agriculture sector, the Department submitted as under:-

1.	ICAR-CPRI, Shimla	Fertilizer best management practices by site specific nutrient management
2.	ICAR-CPRI, Shimla	Climate smart agriculture practices for tropical tuber crops
3.	IIRS, Dept. of Space, Govt. of India, Dehradun	Cassava area estimation using remote sensing

1.57. On the query of the Committee regarding steps taken by the ICAR-CTCRI to enhance cooperation and collaboration with State Governments in order to disseminate information about the research outcome of the Institute among farmers, the Department submitted as under:-

1.	Distribution of quality planting materials and training to farmers on agrotechniques in north-eastern states under Tribal Sub-Plan
2.	Distribution of quality planting materials and training to farmers on agrotechniques in Kerala under Tuber Crops Development Project funded by Government of Kerala
3.	Distribution of quality planting materials of sweet potato and training to

	farmers on agrotechniques in Odisha under OTELP

1.58. When asked about policy of ICAR for contract research for private sector and steps taken by the ICAR-CTCRI to enhance the collaboration with private sector for contract research, the Department submitted as under:-

"Based on the requirements of the end users of ICAR-CTCRI technology, the Institute undertake contract research to solve specific problems faced by them and a list of such project during the past 5 years is given.

Sl. No.	Product	Industry	Amount (Rs)
	Tuber crops based fried snack foods	14 small entrepreneurs in Kerala and Tamilnadu	340000.00
	Improved technology for fried cassava chips	M/s Tierra Food India Pvt. Ltd , Ernakulam	540000.00
	Extruded snack foods from cassava and rice flour	M/s Kalady Rice Millers Consortiuim Pvt. Ltd., Ernakulam	250000.00
	Cassava pappad	M/s Boosters International, Tamil Nadu	195000.00
	Gluten free bread	M/s Belgaum Minerals, Hindalga Road, Belgaum	
	Cold water miscible starch from cassava	M/s Vensa Biotek Ltd., Samalkot, Andhra Pradesh	50000.00
	Biopesticides	Patented through NRDC on 05.02.2012 and licensed to 6 KVKs	125000.00

1.59. On the query of the Committee regarding steps taken by the ICAR-CTCRI to market crop varieties, machineries, pesticides etc. developed by the institutes in national and international markets, the Department submitted as under:-

1. Publicity through ICAR-CTCRI website about varieties, pesticides and machinery.
2. Sixteen technologies have been communicated to Agriinnovate

Scientific/Technical/Administrative Manpower in ICAR- Central Tuber Crop Research Institute

1.60. When asked to furnish the details of approved and existing number of Scientific, Technical and Administrative personnel at ICAR-CTCRI, the Department submitted as under:-

	Sanctioned	Filled	Vacant	% Vacant
Scientific	52	47	5	**10**
Technical	47	39	8	**17**
Administrative	31	25	6	**19**
Supporting	55	42	13	**24**
Total	**185**	**153**	**32**	**17**

1.61. On the query of the Committee regarding steps being taken by the DARE to fill such vacancies at ICAR-CTCRI, the Department submitted as under:-

"Examination has been conducted to fill the vacancies of Technical staff."

1.62. When asked about policy of ICAR for selection of adequately qualified scientific, technical and administrative in order to support its research activities at ICAR-CTCRI, the Department submitted as under:-

"Efforts are underway to select qualified personnel in the vacant posts."

1.63. On the query of the Committee regarding steps taken by the ICAR to attract best available talents in the world for research position at ICAR-CTCRI, the Department submitted as under:-

"The ARS examination as well as Direct Selection to Senior and Principal Scientists give ample opportunities to attract best available talents to ICAR-CTCRI."

Research Students at ICAR-CTCRI

1.64. When asked to furnish details of Doctoral, post-docs and other researchers who are being supervised by the scientist at ICAR-CTCRI, the Department submitted as under:-

Sl. No.	Item	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
	M.Sc. - Enrolled	17	13	14	12	40	43
	Male	6	5	6	4	12	3
	Female	11	8	8	8	28	40
	Ph.D. - Enrolled	5	6	5	5	4	5
	Male	2	2	3	2	2	2
	Female	3	4	2	3	2	3
	Post-Doctoral Students	-	-	1	2	2	3

1.65. On the query of the Committee regarding policy of ICAR in general and ICAR-CTCRI in particular to attract students from foreign countries to pursue Doctoral and post-docs research at institute, the Department submitted as under:-

"Since ICAR-CTCRI is the only Institute in the world conducting research exclusively on Tropical Tuber Crops, requests are coming from different countries to do PhD and Post Doctoral research at the Institute. During 2014-15, one student from Kenya underwent three months research programme at the Institute."

1.66. When asked to furnish details of such foreign students pursing research at ICAR-CTCRI during the last five years, the Department submitted as under:-

"During 2014-15, one student from Kenya underwent three months research programme at the Institute."

1.67. On the query of the Committee regarding patents/prototypes/crop hybrids

received/developed by the doctoral or post doctoral students enrolled at institute during the last five years, the Department submitted in negative.

PERFORMANCE ANALYSIS OF ICAR- CENTRAL TUBER CROP RESEARCH INSTITUTE

1.68. On the query of the Committee regarding policy for evaluation of performance of scientist at various research Institutes under ICAR, the Department submitted as under:-

> "All scientists are required to submit their Annual Performance Appraisal Report on 15 March every year which gives scope for evaluation of all research work done by the scientist. The general proforma developed by ICAR is used for the purpose. Moreover, scientists will have to submit their research performance online in Half Yearly Progress Monitoring (HYPM) website at 6 months intervals which will be evaluated by the concerned HOD as well as Director."

1.69. When asked about any study to analyze performance of its various Institutes, the Department submitted as under:-

> "The HYPM reports submitted by all scientists and evaluated by HOD and Director of the Institute are being analyzed by ICAR to evaluate the performance of the Institutes."

1.70. When asked to furnish performance details of ICAR-CTCRI, the Department submitted as under:-

		Inputs		Outputs			
Sl. No	**Institute**	**Grants-in aid during XII Plan (Rs Lakhs)**	**Scientific Personnel**	**Business Generated From the industry**	**Technologies Developed**	**Publications**	**Patents filed/obtained.**
1	ICAR-CTCRI	Plan-2278.10 Non-plan-	52		42	265	2 (patents) 3 (copyrights)

		7008.53 Total – 9286.63					

1.71. When asked about contribution of scientists of ICAR-CTCRI in public policy formulation in agriculture sector in general and Root and tuber crop in particular, the Department submitted in negative.

1.72. When asked to furnish details of performance of scientists at ICAR-CTCRI and Regional Station, Bhubaneswar, the Department submitted as under:-

Sl. No.	Name	Designation	Contract research generated from the industry	Technologies Developed	Publication (Journals)	Patents filed/obtained
1.	Archana Mukherjee	Director	1	10	70	
2.	Arun Kumar P.	Scientist			3	
3.	Arutselvan R	Scientist			3	
4.	Asha Devi A.	Principal Scientist		5	35	
5.	Asha K. I.	Principal Scientist		4	32	
6.	Ayyagari V V Koundinya	Scientist			4	
7.	Bansode Venkatraman Vishwanath	Scientist			5	
8.	Byju G.	Principal Scientist	1	9	65	2
9.	Chintha Pradeepika	Scientist		1	6	
10.	Hanume Gowda K.	Scientist			6	
11.	Harish E.R.	Scientist		1	5	
12.	James George	Project Coordinator	1	10	35	
13.	Jayaprakas C.A.	Principal Scientist	1	4	23	1
14.	Jeeva M.L.	Principal Scientist		5	45	

15.	Jyothi A.N.	Principal Scientist	2	6	60	2
16.	Kalidas Pati	Scientist (SS)			11	
17.	Kesava Kumar H.	Scientist			12	
18.	Krishna Radhika N.	Senior Scientist			10	
19.	Krishnakumar T.	Scientist			4	
20.	Laxminarayana K.	Principal Scientist		6	55	
21.	Makesh Kumar T.	Principal Scientist		6	45	
22.	Mohan C.	Principal Scientist		6	25	
23.	More Sanket Jijabrao	Scientist			5	
24.	Muthu Raj R.	Senior Scientist		4	15	
25.	Namrata Ankush Giri	Scientist			7	
26.	Nedunchezhiyan M.	Principal Scientist	2	10	67	
27.	Prakash P.	Scientist			12	
28.	Ramesh V.	Principal Scientist		7	45	
29.	Rao K.R.	Principal Scientist		7	50	
30.	Ravi V.	Head		10	65	
31.	Ray R.C.	Principal Scientist		12	97	
32.	Sajeev M.S.	Principal Scientist	4	11	51	
33.	Sangeetha B.G.	Scientist			7	
34.	Santhosh Mithra V.S.	Principal Scientist		8	41	3
35.	Saravanan Raju	Senior Scientist		3	37	
36.	Senthil Kumar K.M.	Scientist			15	
37.	Sheela Immanuel	Principal Scientist			45	
38.	Sheela M.N.	Head		13	47	
39.	Sheriff J.T.	Head	5	9	51	
40.	Shirly Raichal Anil	Principal Scientist		7	48	
41.	Sirisha Tadigiri	Scientist			7	
42.	Sivakumar P.S.	Senior Scientist		5	39	
43.	Sreekumar J.	Principal Scientist		6	35	

44.	Srinivas T.	Principal Scientist		6	47	
45.	Suja G.	Principal Scientist		9	65	
46.	Sunitha S.	Principal Scientist		4	48	
47.	Suresh Kumar J.	Scientist			6	
48.	Susan John K.	Principal Scientist	1	9	61	
49.	Veena S.S.	Principal Scientist		3	37	
50.	Vijay Bahadur Singh Chauhan	Scientist			5	
51.	Visalakshi Chandra C.	Scientist			5	
52.	Vivek Hegde	Scientist			6	

1.73. On the query of the Committee regarding norms set by the ICAR for scientist about publications in International / National Scientific Journals, the Department submitted as under:-

"ICAR and ASRB has fixed norms for each category of scientist to be eligible for promotion and specific number of publications in International / National journals is made mandatory."

1.74. On the query of the Committee regarding adherence to norms by the ICAR-CTCRI, the Department submitted as under:-

"The ICAR-CTCRI follows the norms strictly and the scientists of the Institute publish papers in International and national journals with very good ratings."

1.75. When asked to furnish details of such publications/papers by the scientists of ICAR-CTCRI, the Department submitted as under:-

"During 2015-16, there were 51 publications in International / National Journals of which 17 were in journals with NAAS rating above 6.0, important ones are given below.

Sl. No.	**Name and designation of Scientist**	**Paper Published**			
		International	**Impact**	**National**	**Impact**

		Journal	Ranking (NAAS)	Journal	Ranking (NAAS)
1	Ravi V.	1	9.10		
2	Makeshkumar T.	2	8.3	1	6.3
3	Suja G.	1	7.5	1	6.4
4	Byju G.	1	7.3	2	6.4
5	Jyothi A.N.	2	7.4	1	6.7
6	Laxminarayana K.	1	6.3	1	6.4
7	Nedunchezhiyan M.			1	5.6
8	Archana Mukherjee	2	7.2		

1.76. When asked to furnish details of training/research collaboration/conference participation attended by the scientist/technical staffs of ICAR-CTCRI during the last five years, the Department submitted as under:-

Sl.No.	Scientist	Date	Country	Programme
1	G. Padmaja M.S. Sajeev	30 April to 7 May, 2012	Bangladesh	Imparting training on value addition and post harvest machineries in sweet potato under the USAID project on Improving income, nutrition and health through potato and sweet potato and vegetables. Implemented by International Potato Centre (CIP) and The World Vegetable Centre (AVRDC).
2	M.N.Sheela G. Byju T. Makeshkumar M. Nedunchezhiyan	18 - 22 , June, 2012	Uganda	Participated in the second Global Cassava Partnership Initiative meeting - 21st century (GCP21-II)
3	M.N. Sheela G. Byju T. Makeshkumar	23 - 24 June, 2012	Uganda	Training program on “Integrated breeding procedure software for cassava” organized under Generation Challenge program.
4	J.T. Sheriff	17 -19 July, 2012	UK	Kick-off meeting of EU funded project on

				"Improving the livelihood of smallholder farmers through better access to growth markets." at Natural Resources Institute, University of Greenwich.
5	R.S.Misra M. Anantharaman	27 August to 1 September, 2012	China	Regional Workshop on Food Security through Asian Roots and Tuber Crops (FoodSTART)
6	J.T. Sheriff Shirly Raichal Anil	23 - 28 September, 2012	Nigeria	16th ISTRC Symposium held at Federal University of Agriculture
7	T. Srinivas	15 - 27 September, 2012	Egypt	Training program on Seed Enterprise Management and Seed Marketing as a consultant
8	C. Mohan	20 - 31 August, 2012	Belgium	International Advanced Course on Modern Breeding Techniques for Improvement of Sweet potato held at Ghent University
9	James George	21 to 23 January, 2013	China	2nd Starch World Conference 2013 (Invited Speaker).
10	S. K. Chakrabarti	23 February to 8 March, 2014 29 April to 1st May, 2013.	Cornell University, Ithaca, United State of America and Co operative programs in Washington DC and New York city.	Meeting on late blight disease resistance development efforts by the partners to review the progress of research work done so far and decide future research activities under the CPRI
11	M. L. Jeeva C. A. Jayaprakas	3-5 October, 2013	Accra, Ghana	The First Global Conference on Yams "Yams 2013"
12	M. L. Jeeva C. A. Jayaprakas	18-29 November, 2013	CIAT, Columbia	The International course: Cassava witches'- broom disease diagnostic methods &

				alternatives for the integrated management of the disease at International Centre for Tropical Agriculture during
13	V. S. Santhosh Mithra M. Nedunchezhiyan	23 February to 1March, 2014	Manila, Philippines	Regional workshop on "Yield gap analysis of potato and sweet potato under changing climate" organized by CIP under FoodStart project
14	R.C. Ray	15- 18 August 2014	Bien Hoa city, Vietnam	2nd Asian Food Safety and Security Associations (AFSA) held at Dong Nai University of Technology
15	P. Sethuraman Sivakumar	18 August 2013 to 13 August 2014	Tallahassee, USA	Fulbright Postdoctoral Research at the Eating Behavior Research Clinic, Department of Psychology, Florida State University, Tallahassee, USA
16	P. Sethuraman Sivakumar	27–29 March 2014	New York, USA	Attended the International Conference on Eating Disorders (ICED 2014): "Coming of Age as a Global Field" held at New York, USA
17	M. N. Sheela, K. Susan John, K.I. Asha S. Sunitha	17- 22 August 2014	Brisbane, Australia	Attended and presented oral research papers at the 29th International Horticultural Congress (IHC-2014)
18	K.I. Asha	8-19 September 2014	Ghent, Belgium	Attended the "Advanced Course on Modern Breeding Techniques for Cassava" held at the Ghent University, Faculty of Bioscience Engineering, Coupure Links Ghent, Belgium
19	Shirly Raichal Anil	23-27 September	Dhaka, Bengladesh	Sweet Potato Breeder's Meeting for South Asia

		2014		and South-East Asia
20	K. Susan John	15-17 October 2015	Sao Paulo, Brazil	Participated and presented oral research paper in the 4th International Zn Symposium- Improving crop production and human health
21	M. N.Sheela	7-8 November 2015	Zurich, Switzerland	Attended the Review Meeting of the Indo-Swiss Cassava Network project
22	S.K. Chakrabarti, M. N. Sheela, Archana Mukherjee, J.T. Sheriff, T. Makeshkumar Shirly Raichal Anil	18-22 January 2016	Nanning, China	Participated and presented papers in the World Congress on Tropical Tuber Crops
23	T. Makeshkumar	9 November -9 December 2015 9 November 2015-8 April 2016	ETH, Zurich, Switzerland	Scientific exchange visit for understanding the genetic transformation of cassava under the Indo–Swiss Cassava Network Project
24	M. N. Sheela T. Makeshkumar	7-8 December 2015	ETH, Zurich, Switzerland	Attended the First Review Meeting of the Indo– Swiss Cassava Network Project
25	J.T.Sheriff	12-15 May 2015	Blantyre, Malawi	Attended the Third Annual Project Meeting of European Commission funded project on Improving the livelihoods of small holder cassava farmers through better access to growth markets (Cassava GMarkets)

1.77. When asked to furnish scientist-wise details of students supervised for PhD and Post Doctoral research at ICAR-CTCRI, the Department submitted as under:-

Sl. No.	Scientist	No. of Ph.D. students	No. of Post Doctoral Students
1	Ravi V.		1
2	Byju G	4	
3	Suja G	2	
4	Susan John K	3	
5	Mohan C	2	
6	Makeshkumar T.	4	1
7	Jeeva M.L.	3	1
8	Jayaprakas C.A.	3	1
9	Jyothi A.N.	3	
10	Nedunchezhiyan M.	1	
11	Archana Mukherjee	3	
12	Rao K.R.	1	
13	Ray R.C.	2	

Infrastructure at ICAR-CTCRI

1.78. On the query of the Committee regarding adequacy of Research Infrastructure such as labs, necessary equipments, land for field trials etc. at ICAR-CTCRI, the Department submitted as under:-

"The Institute has state-of-the-art laboratories for DNA Sequencing, Molecular Marker Study, Tissue Culture, Bioinformatics, Soil Fertility and Plant Nutrition, Soil Physics, Geoinformatics, Transgenics, Virus Diagnostics, Biopesticides, Food Processing and Starch Biochemistry. The laboratories are equipped with genetic analyser, gel documentation system, real time quantitative PCR, ELISA reader, thermal cycler (PCR), cryostat, graphite furnace AAS, leaf area meter, chlorophyll fluorescence meter, automated soil CO_2 flux system, automatic N digestion and distillation system, electroantennogram, HPLC, HPTLC, GLC, Fibre Analyser, Image Analyser, Tintometer, Refractometer, Food Extruder, Food Texture Analyser, DSC, Rheometer, FTIR, Rapid Viscoanalyser, Diode Array Spectrophotometer, FT-NIR Spectrometer and automatic weather station.

The Institute has established a full-fledged Local Area Network and a VPN connectivity is established for Global Access to the servers. Agricultural Knowledge Management Unit (AKMU) was established with 17 workstations with

centralized facilities for printing, scanning etc. The Unit became one of the nodal points of National Knowledge Network of India (NKN) for effective sharing of scientific resources. The Institute has a modern library with more than 18,000 volumes, and current subscription of 42 journals besides reprints and eprints on tuber crops."

1.79. When asked about pendency requirement for advanced research equipments at ICAR-CTCRI for lack of funds, the Department submitted as under:-

Division	Item	No	Amount (Rs. lakhs)	Justification
ESS	Agrobotics and Computer Simulation Laboratory: Control board, frames, motors, electronic speed controller, transmitter/receiver, battery and charger, propeller, radio control Tx/Rx and telemetry, servo wires, crimping unit, battery connectors, wires, connectors and heat shrink, vibration isolation gel, GP mount, screw drivers, soldering iron, storage containers. simulation and learning software, raspberryPI, weight sensor, robot control board, containers, lids, channel tube3,D printer, Robot navigation software, Camera for the drone, Laptops, Desktops(2 No.), UPS (5 KV), Laser printer, Drone, Infrasound sensors (24 No.), Wind speed		30.00	ICAR-CTCRI has developed crop simulation models of important tuber crops like cassava, sweet potato and elephant foot yam and the electronic device E-Crop to implement these models under field conditions. Based on this experience and expertise in this field, a lot of electronics works are being carried out in the Institute. Many important projects involving a lot of electronic works are also planned. Since there is no electronics lab facility in the Institute, such works are getting done through consultants outside the institute by paying huge amount of money. Hence setting up this facility in the Institute is very essential so that many problem solving technologies by applying electronics can be developed in the institute itself at a lower cost.

	sensors(24 No.), Vertical blowers(24 No.), Solar panel & Battery(24 No.)			
RC	Ploidy Analyser	1	25.00	Ploidy estimation (at ICAR-CTCRI RC, Bhubaneswar)
CP	Oxygen Diffusion Rate Meter and accessories	1	15.00	Urgently required for the ongoing institute project for validating with the water transmission properties and soil physical properties changes induced by tillage treatments
CP	Profile moisture meter, TDR based with accessories	1	10.00	To measure the volumetric soil moisture over different depths especially the zone wherein the changes in soil properties and nutrient movement changes are expected
CP	Erdas Imagine & Arc GIS licenses	1	20.00	For geoinformatics work related to climate change modeling, site specific nutrient management and fertilizer best management practices
All Divisions and RC	Desktop/Laptop Computer	50	25.00	Many new scientists have joined our Institute and many of Technical officers are not provided with systems. Now most of the office procedures are through ERP and systems are essential to carryout the office work
PME	Tablet Computer	30	10.00	ICAR has made Scientific Data Management compulsory and all data need to be stored electronically by individual scientist as well as by PME Cell. In order to facilitate scientists to directly record their data in the field as well as for morphometric studies etc. Tablet Computer is highly essential.
		TOTAL	**135.00**	

1.80. When asked details about the accredited institute labs by National accreditation agency, the Department submitted as under:-

"ICAR-CTCRI is an ISO 9001:2008 certified organization."

Technology Transfer and dissemination of Information

1.81. When about the developed system for technology transfer to the industry and farmers by ICAR-CTCRI, the Department submitted as under:-

"The ICAR-CTCRI has a separate Section of Extension and Social Sciences and the scientists in the Section take up research projects and other activities such as training, participation in exhibitions, on-farm demonstrations etc. to transfer the newly developed technologies to the stakeholders. We also organize scientist-industry interface to attract entrepreneurs to take the new technologies."

1.82. On the query regarding steps taken by the Institute for dissemination of research outcome among farmers and industry, the Department submitted as under:-

"The ICAR-CTCRI has a separate Section of Extension and Social Sciences and the scientists in the Section take up research projects and other activities such as training, participation in exhibitions, on-farm demonstrations etc. to transfer the newly developed technologies to the stakeholders. We also organize scientist-industry interface to attract entrepreneurs to take the new technologies."

1.83. The Department has informed as under:

"The ICAR-CTCRI received financial support of Rs 10 million from the Govt of Kerala under Small Farmers' Agribusiness Consortium, for setting up of the Centre.

The Centre has three major processing units — (i) Flour Production Unit (FPU) (ii) Snack food Manufacturing Unit (SMU) and (iii) Fried Chips Manufacturing Unit (FCMU) to undertake the following activities—

(a) edible grade flour production from cassava- tubers and its further processing into value- added snack foods, including fried snack foods and oil -free extruded ready-to-eat snacks;

(b) production of low glycaemic pasta products as food for diabetic and obese people as well as nutritionally enhanced pasta for children and youth; and

(c) manufacturing fried cassava- chips and strips with good texture and taste, respectively."

1.84. While elaborating on ICT Initiatives undertaken by the ICAR-CTCRI, the Department has submitted as under:

"Three crop models — SPOTCOMS, MADHURAM and SIMCAS—have been developed to predict accurately crop growth and yield in response to environmental factors such as water stress, nutrient application etc. The databases developed include TUBERSEARCH and TUBERHELP.

The Institute has also developed decision support systems for site specific nutrient management (CASSNUM version 1.1), variety identification (VARIETY FINDER) as well as for pest, disease and nutrient deficiency identification (OUSHADHAM and CASSAVAPROTECTOR). Tuber information cafe is another online tool that gives all vital and necessary information about all tuber crops cultivated in India. Online cassava market is a very novel online tool which is a virtual meeting place for buyers and sellers of cassava and cassava products. This enables them for interaction and sale of their products. A CASSAVAEXPERT SYSTEM has also been developed that provides solutions to various problems faced by cassava farmers. The latest application of ICT in tuber crops R&D is the development of an electronic crop (E-crop); an electronic equipment to give real time agro-advisory to clients."

Planning For the Future

1.85. When asked to furnish research focus for future of ICAR-CTCRI, the Department has submitted as under:-

(i) Cassava mosaic disease – variability, diagnostics, vector relation and management

Cassava mosaic disease (CMD), caused by the Indian cassava mosaic virus (ICMV) or the Sri Lankan cassava mosaic virus (SLCMV), is a very serious disease that limits its yield. It occurs in more severe form in Tamil Nadu and also in Kerala, and causes yield losses ranging from 20to 50% or even up to 80%. The main reason for the spread of the disease is due to the indiscriminate and repeated use of the infected planting material and by the rapid spread through whiteflies. Most of the varieties presently cultivated are highly susceptible to CMD. Continuous vegetative propagation resulted in very high virus load and led to clonal deterioration of these varieties. In the recent times, disease severity increased enormously which led to the degeneration of planting material and reduction in yield. Hence there is an urgent need to address this complex issue. The strategies include identification of pathogen variability, development of quick and easy diagnostic techniques to detect pathogen in the planting material, development of resistant varieties through breeding and transgenic approach and identification of markers linked to CMD resistance, role of vector and their biotypes and management of this disease through production of virus free planting material, nutrient management, vector management and finally by developing integrated disease management strategies.

(ii) Development of cassava starch based novel products and functional foods from other tuber crops

The project aims at developing cassava starch based biodegradable films and thermoplastic starch for packaging applications and starch- based functional polymers for food, pharmaceutical and agricultural applications. Development of functional and nutritionally fortified snack food is also planned.

(iii) Other priority research projects

a) Conservation and utilization of germplasm of tuber crops for sustaining production.

b) Genetic improvement of tuber crops through conventional breeding and molecular approaches.

c) Integrated crop, water and nutrient management for improving productivity of tropical tuber crops.

d) Studies on the impact of climate change and devising mitigation strategies for sustaining productivity of tuber crops.

e) Ecofriendly strategy for management of insect- pests in tuber crops.

f) Development and refinement of integrated disease management and forecasting system for improved tuber crops production.

g) Development and refinement of post- harvest handling, storage and processing techniques for minimization of losses in tropical tuber crops and production of value- added products.

h) Improving knowledge and skill of stakeholders for sustainable production of tuber crops.

1.86. When asked that ICAR-CTCRI has made any assessment of funds to achieve target set for the future, the Department submitted as under:-

"Proposed EFC of ICAR-CTCRI for 2017-18 to 2019-20

HEAD OF EXPENDITURE	**BE PROPOSAL (Rs. Lakhs) Excluding Grants-in-Aid Salary and Pension**			
	2017-18	**2018-19**	**2019-20**	**TOTAL**
A - Grants-in-aid Capital				
Land	0.00	0.00	0.00	0.00
Works*	131.71	10.00	12.00	153.71
Equipments	0.00	19.00	21.00	40.00
Information & Technology	0.00	1.00	1.00	2.00
Library Books & Journals	0.00	2.00	2.00	4.00

Vehicles & Vessels	0.00	0.00	0.00	0.00
Livestock	0.00	0.00	0.00	0.00
Furniture & Fixtures	0.00	3.00	3.00	6.00
Others	0.00	0.00	0.00	0.00
Total Capital (A)	**131.71**	**35.00**	**39.00**	**205.71**
B – Grant in aid – Revenue				
Research Expenses	35.00	100.00	115.00	250.00
Operational Expenses	48.79	115.00	136.00	299.79
Administrative Expenses				
TA				
HRD – Domestic	2.50	2.00	2.00	6.50
HRD - Foreign				
Publicity and exhibition	3.00	1.00	1.00	5.00
Guest house maintenance				
Other misc.				
Sub-total (B)	**89.29**	**218.00**	**254.00**	**561.29**
Total Capital (A) + Revenue (B)	**221.00**	**253.00**	**293.99**	**767.00**
C-TSP	**10.00**	10.00	10.00	30.00
D- NEH	**2.00**	5.00	5.00	12.00
Grand total (A + B + C + D)	**233.00**	**268.00**	**308.00**	**809.00**

PART-II

RECOMMENDATIONS/ OBSERVATIONS OF THE COMMITTEE

1. Human community during their course of evolution and spread across the world had shown ingenuity while choosing sources of nutritional food. Traditionally, root and tuber crops had been one of the most important sources for food and nutritional security for communities across the world. These crops with the capacity to survive in adverse climatic conditions and minimum resource input requirement are rich source of dietary energy such as carbohydrates. These crops also use to add to agricultural diversity to farming system making enhancing resilience in case of adverse climatic conditions. However, with advent of modern agriculture system which promote high input intensive cultivation of limited number of high yielding crop species, a decline was observed in crop diversity in agricultural systems across the world, relegating Root and Tuber crops as marginalized crops. The Committee are of view that Root and Tuber Crops with their inherent potential to withstand adverse climatic change, may emerge as important plank to ensure food and nutritional capacity in the country in coming decades when challenges of climatic changes associated with global warming will become more severe. The Committee in successive paragraphs have analyzed the performance and preparedness of ICAR-Central Tuber Crops Research Institute (ICAR-CTCRI) which is the only research organization in the World dedicated solely to the research on tropical tuber crops.

2. The Committee note that ICAR-Central Tuber Crops Research Institute (ICAR-CTCRI) was established in 1963 at Thiruvanatpuram with a vision for study on Root and tuber crops for ensuring better health, wealth generation and inclusive growth. The Institute is working with a mission to integrate root and tuber crops as a sustainable farming system component to ensure food and nutritional security of the Nation and livelihood improvement of rural population. The Committee have been informed that Institute has mandate for basic, strategic and applied research on genetic resource management, crop improvement, sustainable production and utilization of tropical tuber crops. It is also responsible for coordinating research and validation of technologies through AICRP on tuber crops. The Committee also note that ICAR-CTCRI has a regional station at Bhubaneswar and coordinating AICRP- on Root and Tuber crops. The Committee were informed that Institute is able to test the efficacy of new crop varieties of Root and Tuber Crops and technologies in other parts of the Country through 12 All Indian Coordinated Research Projects in various parts of the Country.

Financial Performance

3. The Committee note that the institute has been provided Rs. 97.01 Crore at RE stage as against Rs. 105.78 crore provisioned at Budget estimates during XII plan. The Committee also note that there was decline in allocations under plan head to the Institute over the years as allocations under this head progressively decreased from a high of Rs. 7.0 Crore during 2012-13 to Rs. 5.26 crore during 2016-17. Allocations under Plan head to the institute during XII plan period were

further reduced from Rs. 29.36 crore at BE stage to Rs. 22.82 crore at RE stage. Further, the Institute was provided Rs.22.45 crore during the 2017-18.

The Committee also note that despite success of Institute to overachieve target for internal revenue generation (Rs.3.36 crore against the target of Rs.2.34 crore) during XII plan, these were not more than 1.75 to 4.11% of total Expenditure that clearly indicate that target were set too low.

The Committee are of view that ICAR-CTCRI being only institute in the world dedicated for research on Tuber crops in the world, has tremendous responsibility to provide leadership in cutting age research in their field of expertise. The Committee are also of the considered view that Root and tuber crops has potential to provide solution for shortfall in food production due to climatic changes associated with the global warming. These crops have potential to emerge as an alternative to staple food in future. Therefore, the Institute will require investment in capital head such as establishment of laboratories, procurement of latest scientific equipments etc. to achieve excellence in their endeavor. The Committee, therefore, recommend the Government to enhance allocations under capital head to the Institute in upcoming fiscals. The Committee also desire the ICAR to analyze revenue generation potential of Institute and enhance the target so that investment on R & D could be monetized for the benefit of the Country.

<u>Development and Release of New Varieties of Root and Tuber crops</u>

4. The Committee note that ICAR-CTCRI has developed sixty high yielding varieties of different R&T crops including 16 of cassava, 18 of sweet- potato, 14 of yams, 9 of taro, 2 of elephant foot- yam and 1 of Chinese potato during the last five years. It has also developed three triploid varieties— Sree Harsa, Sree Athulya, and Sree Apoorva with high dry matter and extractable starch content were for starch industry. The Committee also note the Institute was also able to develop first cassava mosaic disease (CMD) resistant variety Sree Padmanabha and short duration cassava varieties viz. Sree Jaya and Sree Vijaya ideal for cultivation in rice fallows of Kerala. The Committee were also informed that high yielding and high starch containing cassava varieties viz. H165 and H226 contributed in a big way in the establishment of starch and sago industries in and around Salem district of Tamil Nadu. The Committee also note that the Institute has been able to earn a revenue of Rs. 48.00 lakhs from commercialization of11 varieties of Root and Tuber crops/hybrids released by the ICAR-CTCRI during XII plan.

The Committee also note that ICAR-CTCRI has a system in place at ICAR-CTCRI to monitor performance and productivity of new Root and Tuber crops/hybrids released by the institutes. All new hybrids developed are tested for their performance in Initial Evaluation Trial (IET), Multi Location Trial (MLT) and Uniform Regional Trial (URT) in various selected locations under AICRP (Tuber Crops). All released varieties are also tested in Institute farm as well as through progressive farmers for their performance. The Committee were also informed that ICAR-CTCRI and its Regional Centre at Bhubaneswar collaborate with

different State Governments and take up projects to popularize the newly released varieties of root and tuber crops. The Institute has taken up programmes under Tribal Sub-Plan to popularize these varieties in north eastern states of India.

The Committee further note that the Institute has standardized production technology for quality planting material of Cassava, Sweet Potato, Elephant Foot Yam and other tuber crops. Mini-sett technology for tuber crops was developed at the Institute is very popular among farming community. Management practices for intercropping cassava with coconut, arrowroot with coconut, yams with maize, and yams and edible aroids with coconut, banana and rubber have been standardized. Precision nutrient management technologies such as drip fertigation for cassava and elephant foot -yam and drip irrigation for elephant foot- yam have been developed. Soil fertility management practices for all these crops were substantially improved with the development of soil- test based fertilizer recommendations as well as site specific nutrient management (SSNM) practices developed using calibrated QUEFTS model. The model based approach resulted in development of nutrient recommendation zonation maps as well as customized fertilizers for cassava, elephant foot- yam, sweet- potato and yams. The Committee also note that the Institute has dveloped a methodology for climate change impact assessment of cassava, sweet- potato, elephant foot -yam and yams using ECOCROP model and the model was calibrated for these crops for Indian conditions using geoinformatics tools.

The Committee appreciate the work being done by the ICAR-CTCRI for the development of high yielding varieties of Root & Tuber Crops. However, the Committee are of view that there is large scope for expansion of farming of R & T Crops in other parts of Country especially in eastern States. The Committee, therefore, desire the Institute to proactively work with State Government to identify potential areas which are suitable for farming of Root & Tuber Crops and take steps to educate farmers about high yielding varieties and improved production techniques for farming of Root & Tuber Crops. The Committee also desire the Institute to take a project for identification of varieties of fruits and tuber crops being grown in various parts of the Country and document their properties and traditional uses by the local communities.

Research on Medicinal and Nutritional aspect of Root & Tuber Crops

5. The Committee observe that Root and Tuber Crops, apart from being used as a staple food, were traditionally being used for treatment of various diseases/ailments in various parts of the Country. However, the Committee feel that ICAR-CTCRI is yet to take any project for research on nutritional and medicinal aspects of Root and Tuber Crops. The Committee, therefore, recommend the Institute to take steps for promotion of research on nutritional and medicinal aspects of Root and Tuber Crops being grown in various parts of the Country. The Committee also desire that the Institute to take a project for compilation of traditional uses of Root and Tuber Crops in the Country. The Committee would like to be apprised of the steps taken in this regard within three months of the presentation of the Report.

Enhancement in Production of Root and Tuber Crops

6. The Committee note that there was annual production of 4095000 tons Cassava and 1638000 tons sweet potato were produced in the Country during 2016-17. The Committee were informed that Tamil Nadu, Kerala and Andhra Pradesh were major producer of Cassava whereas Odisha, West Bengal, Chhattisgarh and Uttar Pradesh were major producer of the sweet potato in the Country. The Committee are of view that in order to exploit the opportunity for market for Starch and other produce based on Root and Tuber Crops in the International Market, the Country needs to enhance production of Root and Tuber Crops in the other parts of the Country. The Committee are view that there is significant scope for enhancement in the area of production in Root and Tuber Crops in non-traditional States, however, there will be need for handholding of farmers in order to encourage them for cultivation of Root and Tuber Crops. The Committee, therefore, desire that the Institute take steps for identification of areas suitable for cultivation of Root and Tuber Crops in non-traditional States in the Country and make an assessment of support, which will be required by the farmers for the shift to cultivation of Root and Tuber Crops. The Committee would like to be apprised of the steps taken in this regard within three months of the presentation of the Report.

Organic Farming of Tuber Crops

7. **The Committee note that ICAR-CTCRI is focussing on research for development of organic farming methods for Root & Tuber Crops. The Committee were informed that research work conducted for the past 12 years helped develop organic farming technology for cassava, yams, elephant foot-yam and taro. The Institute were able to develop a learning system using artificial neural networks (ANN) to predict performance of elephant foot- yam organic production system under various agroclimates. The institute has observed increase in yield by 10-20% with organic management. The tuber quality improved with higher dry matter, starch, crude protein, K, Ca and Mg contents.. The anti-nutritional factors, oxalate content in elephant foot -yam and cyanogenic glucoside content in cassava lowered by 21 and 12.4%, respectively. Due to organic farming in elephant foot- yam, cost-benefit analysis indicated net profit 28% higher with additional income of Rs 47,716/ ha. The Committee also note that the Institute has developed organic farming technology for cassava, yams, elephant foot- yam and taro. The Institute was also successful in developing nutrient rich organic manure through composting of cassava starch factory solid waste (thippi) and synthesis of Zeolite materials from fly ash with high cation exchange capacity for enhanced soil nutrient retention.**

The Committee appreciate the work of Institute on research on organic methods for cultivation of Root & Tuber Crops. However, the Committee would like the Institute to disseminate the organic farming methods and technology among farmers in order to safeguard natural resources from harmful effects of chemical fertilizers and pesticides. The Committee would like to be apprized

about steps taken in this direction within three months of presentation of this Report.

Disease affecting Production and Root and Tuber crops

8. **The Committee note that Root & Tuber Crops being vegetatively propagated are highly susceptible to disease proliferation due to easy transmission of biotic causal agents and this leads to serious problems. The important disease among Root & Tuber crops are mosaic disease, tuber-rot, mite, whitefly and mealy bug in cassava, weevil in sweet potato, anthracnose and mosaic in yam, leaf blight in taro, collar rot and mosaic in elephant foot yam and storage pests. The Committee were further informed that Cassava mosaic disease (CMD) caused by the Indian cassava mosaic virus (ICMV) or the Sri Lankan cassava mosaic virus (SLCMV) is a very serious disease that limits its yield. It occurs in more severe form in Tamil Nadu and also in Kerala, and causes yield losses ranging from 20to 50% or even up to 80%. The main reason for the spread of the disease is due to the indiscriminate and repeated use of the infected planting material and by the rapid spread through whiteflies.**

The Committee also note that ICAR-CTCRI has been able to develop Sree Padmanabha, Muktakeshi Bhu Kripa and Sree Swathy varieties which are resistant against Cassava mosaic disease, Taro leaf blight disease and Anthracnose disease in yam respectively. The Committee were informed that the Institute has plan for development of Eco-friendly strategy for management of insect- pests in tuber crops and development and refinement of integrated

disease management and forecasting system for improved tuber crops production. Various bio-control agents were also developed to control many of the pests and diseases of Root and Tuber crops.

The Committee also note that the Institute has standardized a Diagnostic techniques for important viral and fungal diseases — cassava mosaic disease, cassava tuber- rot, sweet- potato feathery mottle, sweet- potato leaf curl, dasheen mosaic in elephant foot- yam and taro, yam mild mottle virus, yam badna virus, anthracnose in yam, taro leaf -blight and collar -rot in elephant foot- yam. Dipsticks were developed manually based on DsMV specific IgG-gold conjugate. The Committee were informed that test was found highly sensitive and was capable of detecting virus with very low titre. Further, the Committee also note that the Institute were able to sequence full genome of cassava mosaic viruses (ICMV , SLCMV), sweet- potato leaf -curl virus and dasheen mosaic virus and Transgenic plants resistant to cassava mosaic virus have been developed using Rep gene of Indian cassava mosaic virus.

The Committee appreciate the success of the Institute in developing pest resistant varieties of Root & Tuber crops, development of diagnostic kits and development of Transgenic plants resistant to cassava mosaic virus . The Committee are of view that susceptibility of Root & Tuber crop farming towards disease is major stumbling block in achieving the aim to enhance production and productivity of Root & Tuber crops in the Country. Further, climatic changes associated with global warming may led to proliferation of new kinds of pest affecting Root & Tuber crops. The Committee, therefore, desire the Institute to focus their attention for development of disease resistant varieties of Root &

Tuber crops which can withstand climatic changes associated with global warming.

The Committee are also of view that there is need to replace existing varieties of Root & Tuber Crops which are susceptible to disease and make available saplings of disease free varieties among farmers. The Committee, therefore, desire the Institute to make plan for this and collaborate with State Governments concerned and Central Government for availability of funds for distribution of sapling among farmers and other necessary extension services.

Industries Based on Root and Tuber Crops

9. **The Committee note that Root & Tuber crop apart from direct human consumption, can be used as raw material for food processing Industries such as Savory snacks, Baked products, Pasta and noodles and Functional foods. Root & Tuber crops are also main raw material for Starch based industries. The Committee further note that about 40% of the total production of Cassava, sweet potato, elephant foot yam, taro and arrowroot is processed before its use in different parts of the country. However, the Committee note that level of processing of Root & Tuber crops in the Country varies from 90% in Tamil Nadu to 40% in States like Bihar.**

The Committee were informed that ICAR-CTCRI proactively cooperate with Industries based on Root & Tuber Crops and had developed many products such as Tuber crops based fried snack foods, Improved technology for fried cassava chips, Extruded snack foods from cassava and rice flour, Cassava papad, Gluten

free bread, Cold water miscible starch from cassava and bio-pesticides. The Committee were informed that the Institute has also developed many technologies and machineries such as hand operated, pedal operated and motorized Cassava chipping machines, Mobile starch extraction plant, Mobile starch extraction plant, Industrial rasper for extraction of starch, Centrifugal granulator for cassava based feed, Cassava harvester, Cassava peeling knife and Pilot plant for liquid adhesive which are very helpful for the Industries based on Root & Tuber Crops. The Committee also note that ICAR-CTCRI has developed good manufacturing practices for Savory snacks, Baked products, Industrial products, Pasta and noodles, functional foods and Starch graft co-polymers which may be very useful to standardizing manufacturing practices and maintaining hygiene in food processing Industries based on Root and tuber crops in the country.

The Committee are of view that there is huge potential for Food products and snacks based on Root and Tuber Crops as these are healthy and rich in nutrition. However, there is need to make consumer aware of health benefits of Root & Tuber crops. Further, there is need to develop snacks and other products based upon dietary and taste preferences of consumers in various parts of the Country. The Committee, therefore, recommend the Institute to take a survey for analyzing dietary and taste preferences of consumers in various parts of Country. This survey may become the basis of further research on preparation of region specific snacks and other products based on Root & Tuber crops. Further, the Institute should also explore the possibility of a joint campaign involving industry and Central and State Government for enhancing awareness about health

benefits of Root & Tuber crops in the Country. The Committee would like to be apprized about steps taken in this regard within three months of presentation of this Report.

Use of Root and Tuber Crops as Animal Feed

10. The Committee note that Root and Tuber Crops are being used Animal Feed especially for Piggery in other Countries. However, the Committee surprised to note that the ICAR-CTCRI has not taken steps for research on development of animal feed from Root and Tuber Crops. The Committee, therefore, desire the Institute to start a research project for exploring the possibilities for development of animal feed based on Root and Tuber Crops being grown in the Country.

Green Technologies from Cassava Starch

11. The Committee note that the institute has developed and patented a technology for manufacturing starch -based biodegradable plastic from Cassava. The starch incorporated plastic films (up to 25-40%) possess adequate mechanical strength and flexibility and can be processed just like normal plastics, i.e., heat-sealed, printed, coloured etc. The granules and finished products can be stored almost like synthetic plastics and biodegradable under soil burial conditions. The Committee were informed that this technology can be easily adopted by the existing plastic manufactures using conventional machines. The Institute has prepared Poly (lactic acid)-cassava starch composite based moulded articles by injection moulding and blow films methods. These can be used as disposable articles for various purposes. Further, a semi-synthetic cassava (tapioca) starch based superabsorbent polymer has been developed which is effective in soil moisture retention and can be used as a soil additive, especially under controlled conditions such as in green houses for plant nurseries, ornamental and medicinal plants for saving irrigation water.

The Committee also note that the the CTCRI has developed an improved technology for bioethanol production from cassava starch using novel enzymes, derived from genetically engineered microorganisms. The process is time saving and less energy consuming, and can yield 680 litre ethanol from 1 tonne of dry chips / flour of Cassava. However, the Committee are distressed to note that the Institute is yet to commercialize these technologies. The Committee were informed that lack of sufficient budget is preventing the Institute to scale up the

project and make it viable for commercial production. The Committee are of view that there is huge market for eco-friendly products which can be alternative for non-biodegradable plastic and Institute should have proactively scouted for partners in Private sector which could have invested in project for scaling up this important technology. Further, there must be enough Government support for scaling up of technologies in the important area of eco-friendly products. The Committee, therefore, recommend the institute to take steps for search of partners in private sector for projects of scaling up of technologies for bio-degradable plastic and bio-ethanol from cassava. The Committee also recommend the Government to make available sufficient funds for these important projects, if Institute fails to find Private investment. The Committee would like to be apprized about steps taken in this direction within three months of presentation of this Report.

Research Cooperation and Collaboration

12. Research Cooperation and Collaboration is becoming one of the most significant features of scientific and technological activities in the 21st century. This era is being characterized as Big Science, in which the scale and comprehensiveness of research projects have increased, thereby, increasing the resource dependencies between scientists. Collaboration among scientists of various research institutes help in minimizing fund requirement, avoiding duplication of research efforts and enhancing research output. The Commmittee note that the ICAR-CTCRI collaborates with various State Agricultural Universities (SAUs), State Departments of Agriculture, Horticulture, Tribal Development etc.

and related Industries in developing, validating and scaling up the technologies developed. At International level, the Institute has collaboration with CGIAR institutes such as CIAT, California, CIP, Lima and IITA besides organizations such as CIRAD, France, USDA, NRI, UK, ETH, Switzerland etc. The Committee were informed that the Institute has collaborated with ICAR-CPRI, Shimla and IIRS, Dept. of Space, Govt. of India, Dehradun for Fertilizer best management practices by Site specific nutrient management, Climate smart agriculture practices for tropical tuber crops and Cassava area estimation using remote sensing.

The Committee appreciate the steps being taken by the Institute for promoting collaborative research with other Institutes of national and international prominence. However, the Committee observe that Institute has not taken any steps for collaborative research with other research agency for up scaling of technology for bio-degradable plastic and bio-ethanol Cassava. Keeping in view of paucity of funding for advanced research work and need of specialized knowledge, the Committee are of view that there is need enhance collaborative research work for optimization of resources and research outcome. The Committee find that ICAR-CTCRI has not taken steps to enhance collaboration with other National institute such as CFTRI which has expertise in the field of food processing technologies or with Central Institute of Plastics Engineering & Technology (CIPET) which has expertise in plastic engineering or with Indian Institute of Petroleum which has expertise in Petroleum products. The Committee, therefore recommend the ICAR-CTCRI to explore possibilities for collaborative research work with these institutes in order to take projects of bio-

degradable plastic, Bio-ethanol Cassava and food processing technologies and make them industry worthy. The Committee also desire the Department of Agricultural Research and education to prepare clear guidelines for collaborative research work with other National and International Research Institutes before approving research proposal in order to avoid duplication of efforts and optimizing fund utilization.

Research Students at ICAR-CTCRI

13. The Committee note that ICAR-Central Tuber Crops Research Institute is a recognized centre by the University of Kerala, Kannur University, MG University, MS University and Utkal University for undertaking Doctoral programme. Several of the Scientists of ICAR-CTCRI have been recognized as Research Guides by these universities. ICAR-CTCRI also imparts 1-2 months hands-on training especially in the fields of bio-technology and microbiology to Undergraduate and Postgraduate students leading to submission of dissertation as a part of course curriculum. The Committee were informed that 96 students of M.Sc. were enrolled in institute during 2012-2017, whereas, 25 students and 5 students were enrolled for Ph.D programme and Post- Doctoral studies respectively during the same period.

The Committee observe that despite being only Institute in the world conducting research exclusively on Tropical Tuber Crops, the institute has failed to attract adequate students from foreign countries as only one student from Kenya underwent three months research programme at the Institute during 2014-15. The Committee also observe that none of doctoral or post doctoral students

enrolled at institute were able to develop crop hybrid or receive patent for significant research outcome during the last five years. The Committee are of considered view that apart from research, an Institute should also aim to train adequate numbers of students and impart them research orientation in order to make available qualified and trained manpower for Industries. Further, availability of a talented and diversified pool of students are pre-requisite for enhancing the quality of research outcome. The Committee, therefore, desire the Institute to make effort for enhancing the numbers of research students at ICAR-CTCRI and its research station at Bhuvneshwar. The Committee recommend the Department of Agricultural research and Education to explore the possibility for research fellowship at ICAR-CTCRI to students in order to attract talents students from the Country and abroad.

PERFORMANCE ANALYSIS OF ICAR- CENTRAL TUBER CROP RESEARCH INSTITUTE

14. The Committee note that ICAR has a policy for evaluation of performance of scientist at various research Institutes under ICAR and scientists are required to submit their Annual Performance Appraisal Report on 15 March every year which gives scope for evaluation of all research work done by the scientist. Scientists are also required to submit their research performance online in Half Yearly Progress Monitoring (HYPM) website at 6 months intervals which is evaluated by the concerned HOD as well as Director. The Committee have been informed that ICAR-CTCRI were able to develop 42 technologies and got 2 patents and 3 copyrights during Twelfth Plan (2012-17). The Committee also note

that 52 scientists of the Institute have published 265 publication during Twelfth Plan. The Committee note that ICAR and ASRB has fixed norms for each category of scientist to be eligible for promotion and specific number of publications in International / National journals is made mandatory. The Committee were informed that there were 51 publications by the Scientists of Institute in International / National Journals of which 17 were in journals with NAAS rating above 6.0 during 2015-16. The Committee also note that 13 scientists has supervised 13 students for PhD and 4 Scientists supervised 4 students for Post Doctoral research at ICAR-CTCRI.

The Committee note that none of scientists of ICAR-CTCRI have contributed for public policy formulation in agriculture sector in general and Root and tuber crop in particular. The Committee also observe that individual performance of scientists varies widely. The Committee note that only 4 scientists of the institute were able to file/ Obtain 8 patents, whereas, 9 scientists of the institute were able to bring 18 contract research and 32 scientists of the institute were able to develop 217 technologies. Considering the performance of scientists of ICAR-CTCRI, the Committee are of view that there is need to enhance capacity of scientists who are not able to perform according to the norms set by the ICAR. The Committee, therefore, recommend the Department to analyze the reasons for varying performance of scientists and take steps for corrective action including training in order to enhance research outcome of the Institute. Further, the Committee also desire the Department to recognize the better performers and provide them suitable incentives in order to enhance their morale. The Committee would like the Department to complete the

performance analysis of scientist at ICAR-CTCRI within three months of presentation of Report and take corrective action under intimation to the Committee.

Infrastructure at ICAR-CTCRI

15. The Committee note that the Institute has state-of-the-art laboratories for DNA Sequencing, Molecular Marker Study, Tissue Culture, Bioinformatics, Soil Fertility and Plant Nutrition, Soil Physics, Geoinformatics, Transgenics, Virus Diagnostics, Biopesticides, Food Processing and Starch Biochemistry. The laboratories are equipped with genetic analyser, gel documentation system, real time quantitative PCR, ELISA reader, thermal cycler (PCR), cryostat, graphite furnace AAS, leaf area meter, chlorophyll fluorescence meter, automated soil CO_2 flux system, automatic N digestion and distillation system, electroantennogram, HPLC, HPTLC, GLC, Fibre Analyser, Image Analyser, Tintometer, Refractometer, Food Extruder, Food Texture Analyser, DSC, Rheometer, FTIR, Rapid Viscoanalyser, Diode Array Spectrophotometer, FT-NIR Spectrometer and automatic weather station. The Committee were also informed that the Institute has established a full-fledged Local Area Network and a VPN connectivity is established for Global Access to the servers. Agricultural Knowledge Management Unit (AKMU) was established with 17 workstations with centralized facilities for printing, scanning etc. The Unit became one of the nodal points of National Knowledge Network of India (NKN) for effective sharing of scientific resources. The Institute has a modern library with more than 18,000 volumes, and current subscription of 42 journals besides re-prints and e-prints on tuber crops.

The Committee also observe that the Institute has requirement for advanced research equipments such as Agrobotics and Computer Simulation Laboratory, Ploidy Analyser , Oxygen Diffusion Rate Meter and accessories, Profile moisture meter, TDR based with accessories and Erdas Imagine & Arc GIS licenses which is essential for research works. The Committee are of view that necessary infrastructure and research equipments forms the basis of a robust research system. However, efforts should be made to explore possibilities to share research equipments with Institute located in nearby Districts. The Committee desire the Institute to explore possibilities for sharing of research equipments with other Institutes. Further, the Committee recommend the Department to make necessary financial allocation to the ICAR-CTCRI for provision of above mentioned research equipments if Institute is not able to access these equipments in other Research Institutes.

Use of Chemical Fertilizers and Pesticides for cultivation of Root and Tuber Crops

16. Integrated Pest and Nutrient Management is cardinal principle for safe and judicious use of pesticides and fertilizer in agriculture. The Committee note that ICAR-CTCRI has developed site specific nutrient management (SSNM) technology using computer programmes to calculate the exact quantity of fertilizers required for getting a particular yield for all major growing regions of the country. Fertilizer calculation charts, decision support system and mobile app were developed to help the farmers to calculate the quantity of different fertilizers. The Committee also note that ICAR-CTCRI collect soil samples from Root and Tuber Crops farmers and analyze samples and prepares Soil Health Card. Further, Institute has also developed Integrated Pest and Disease Management strategy for all important pests and diseases such as cassava mosaic disease, tuber rot of cassava, sweet potato weevil, collar rot of elephant foot yam etc. The Committee note that the Institute has trained 2653 farmers from 2012-2018 about Integrated pest and disease management of tropical tuber crops.

The Committee also note that the Institute has developed bio-pesticide and biofumigant from cassava leaf and tuber rind.viz. Menma, Nanma and Shreya. The formulation Menma is very effective against borer pests like pseudostems weevil and rhizome weevil in banana, red palm weevil in coconut etc. Sucking pests such as mealy bug, thrips, scale insects, mites etc. Nanma is very useful in horticultural crops. Waxy coating around mealy- bug gives protection from

insecticide application but Shreya can dissolve mealy substance and kill it. Biofumigants isolated from cassava leaves are effective against stored product pests. Large scale field trial covering over one lakh banana plants in different districts of Kerala under the RKVY project has established the efficacy of the bioformulation against pseudostem and rhizome weevils in banana.

The Committee appreciate the ICAR-CTCRI for success achieved in the field of Integrated Pest and Nutrient Management. However, the Committee desire the Institute to disseminate methods of site specific nutrient management (SSNM) technology and bio-pesticide and biofumigant from cassava among the farmers cultivating Root & Tuber crops in other parts of Country so that use of chemical fertilizer and pesticides can be further minimized. The Committee also desire the Institute to explore the market opportunities in other States so that return on investment on research could be optimized.

<u>Planning For the Future</u>

17. The Committee note that Cassava mosaic disease – variability, diagnostics, vector relation and management and Development of cassava starch based novel products and functional foods from other tuber crops are flagship project of ICAR-CTCRI which it intend to focus in future. Apart from these, the Institute has identified other priority areas of research such as Conservation and utilization of germplasm of tuber crops for sustaining production, Genetic improvement of tuber crops through conventional breeding and molecular approaches; Integrated crop, water and nutrient management for improving productivity of tropical tuber

crops; Studies on the impact of climate change and devising mitigation strategies for sustaining productivity of tuber crops; Development and refinement of integrated disease management and forecasting system for improved tuber crops production; Improving knowledge and skill of stakeholders for sustainable production of tuber crops etc. as thrust areas in future.

The Committee is also note that ICAR-CTCRI has made projection for fund to the tune of Rs.8.09 crore for the period of 2017-20 to achieve the target set for the future. The Committee, therefore, recommend the Department to make available requisite funds in coming fiscal to the Institute to achieve its aims.

New Delhi
August, 2018
Shravana, 1940 (Saka)

HUKMDEV NARAYAN YADAV
Chairperson
Standing Committee on Agriculture

APPENDIX-I

STANDING COMMITTEE ON AGRICULTURE
(2015-16)

MINUTES OF THE TWENTY SIXTH SITTING OF THE COMMITTEE

*****

The Committee sat on Thursday, the 30th June, 2016 from 1100 hours to 1245 hours in Committee Room 'E', Parliament House Annexe, New Delhi.

PRESENT

Shri Hukm Deo Narayan Yadav – Chairperson

MEMBERS

LOK SABHA

2. Shri Sanganna Karadi
3. Md. Badaruddoza Khan
4. Dr. Tapas Mandal
5. Shri Janardan Mishra
6. Shri Ajay Nishad
7. Shri Mukesh Rajput
8. Shri C.L. Ruala
9. Shri Arjun Charan Sethi
10. Shri Satyapal Singh (Sambhal)
11. Shri Jai Prakash Narayan Yadav

RAJYA SABHA

12. Saradar Sukhdev Singh Dhindsa
13. Shri Janardan Dwivedi
14. Shri Vinay Katiyar
15. Shri Mohd. Ali Khan
16. Shri Rajpal Singh Saini
17. Shri Ram Nath Thakur
18. Shri Shankarbhai N. Vegad
19. Shri Darshan Singh Yadav

SECRETARIAT

1. Shri U.B.S. Negi - Joint Secretary
2. Shri Arun K. Kaushik - Director
3. Shri Sumesh Kumar - Under Secretary

1

WITNESSES
MINISTRY OF AGRICULTURE & FARMERS WELFARE
(DEPARTMENT OF AGRICULTURAL RESEARCH AND EDUCATION)

S.No.	NAME OF THE OFFICER	DESIGNATION
1.	Shri Chhabilendra Roul	Addl. Secretary (DARE) & Secretary (ICAR)
2.	Shri Sunil Kumar Singh	Addl. Secretary (DARE) & FA
3.	Dr. N.K. Krishna Kumar	Dy. Director General (Horticulture Science)
4.	Dr. James George	Director (CTCRI)

2. At the outset, the Chairperson welcomed the Members of the Committee to the sitting convened for briefing on 'Central Tuber Crops Research Institute (CTCRI)'. Thereafter, the representatives of Ministry of Agriculture and Farmers Welfare (Department of Agricultural Research and Education) were ushered in. After welcoming the representatives of the Ministry of Agriculture and Farmers Welfare to the sitting, the Chairperson apprised them of the provisions of the Directions 55 (1) and 58 of the Directions by the Speaker, Lok Sabha regarding confidentiality of the proceedings.

3. After the witnesses introduced themselves, one of the representatives of the Department made a power point presentation and briefed the Committee on the Subject. Thereafter, the Chairperson and the Members of the Committee raised several issues/points as briefly mentioned below and sought clarification/information of the Department thereon:

I. Need to explore the possibility of utilising tuber crops as animal feed;

II. Need of R&D on wild varieties of tuber crops for their medicinal and other properties.

III. Need of R&D to explore possibilities of utilisation of tuber crops plant residue;

IV. Need to explore commercial viability of technology to use tuber crops as biodegradable plastic;

V. Need to explore use of leaves of Sweet Potato as animal feed;

VI. Steps being taken to enhance awareness about benefits of tuber crops;

VII. Impact of use of chemical fertilizers in tuber crops cultivation;

VIII. Need of R&D to develop varieties of Ratalu with enhanced usable portion;

IX. Reason for reduction in productivity of tuber crops due to organic farming;

X. Steps being taken by the Institute to explore growing of tuber crops in water logged areas;

XI. Steps being taken by the Institute to enhance nutritive value of tuber crops;

XII. Need of R&D to explore medicinal value of 'Suran' variety of tuber crops grown in Madhya Pradesh;

XIII. Need to collaborate with farmer engaged in farming of tuber crops; and

XIV. Need of R&D about impact of consumption of Dioscorea Wild Yam on fertility of Jarawa tribes of Andaman & Nicobar Islands.

4. The Representatives of the Department responded to most of the queries raised by the Members. The Chairperson then thanked the witnesses for sharing

valuable information with the Committee on the subject and directed them to send, in writing, the requisite information in points/items, which was not readily available with them to the Secretariat of the Committee at the earliest.

5. Thereafter, the Committee decided to select a new subject "Variance in Cost and Quality of Agricultural Tools and Implements being provided to the Farmers under Rashtriya Krishi Vikas Yojana (RKVY) and problems being faced by the farmers due to imported power tillers - A Review", for detailed examination and report.

6. A copy of verbatim record of the proceedings has been kept separately.

The Committee then adjourned.

APPENDIX-II

STANDING COMMITTEE ON AGRICULTURE
(2016-17)

MINUTES OF THE TWENTY SIXTH SITTING OF THE COMMITTEE

*****

The Committee sat on Friday, the 26th May, 2017 from 1500 hrs. to 1605 hrs. in the Committee Room "B", Ground Floor, Parliament House Annexe, New Delhi.

PRESENT

Shri Hukm Deo Narayan Yadav – Chairperson

MEMBERS

LOK SABHA

1. Prof. Ravindra Vishwanath Gaikwad
2. Shri Md. Badaruddoza Khan
3. Dr. Tapas Mandal
4. Shri Devji Mansingram Patel
5. Shri Mukesh Rajput
6. Shri C. L. Ruala
7. Shri Satya Pal Singh
8. Shri Dharmendra Yadav

RAJYA SABHA

9. Sardar Sukhdev Singh Dhindsa
10. Shri Janardan Dwivedi
11. Shri Meghraj Jain
12. Shri Vinay Katiyar
13. Shri Ram Nath Thakur
14. Shri R. Vaithilingam
15. Shri Shankarbhai N. Vegad
16. Shri Darshan Singh Yadav

SECRETARIAT

1.	Shri Arun K. Kaushik	–	Director
2.	Smt. Juby Amar	–	Additional Director
3.	Shri Sumesh Kumar	–	Under Secretary

LIST OF WITNESSES

MINISTRY OF AGRICULTURE AND FARMERS WELFARE (DEPARTMENT OF AGRICULTURAL RESEARCH AND EDUCATION)

S.No.	NAME OF THE OFFICER	DESIGNATION
1.	Dr. Anand Kumar Singh	Deputy Director General (HS), ICAR
2.	Dr. T. Jankiram	Assistant Director General (HS), ICAR
3.	Dr. Archana Mukherjee	Director, CTCRI

2. At the outset, the Chairperson welcomed the members to the sitting of the Committee and the representatives of the Ministry of Agriculture and Farmers Welfare (Department of Agricultural Research and Education) and apprised them of the provisions of the Direction 55 (1) of the Directions by the Speaker, Lok Sabha regarding confidentiality of the proceedings.

3. After the introduction, the Chairperson initiated the discussion which was taken forward by the representatives of the Department and the Members of the Standing Committee. The Committee raised several issues/points which have been briefly mentioned below and sought opinion of the Department on the same:

i). Achievements of ICAR-CTCRI;

ii). Research Initiatives taken by the ICAR-CTCRI for the benefits of farmers and entrepreneurs in the sectors of Root and Tuber Crops;

iii). Steps being taken by the Institute for development of machinery for food processing industries based on Root and Tuber crops;

iv). Need of research on neglected varieties of Root and Tuber crops;

v). Steps taken to fill vacancies of scientist and technical personnel in the Institute;

vi). Need to take steps for promoting cultivation of Root and Tuber crops in new States;

vii). Need to open centre of CTCRI in North East and Central India;

viii). Need to explore use of Root and Tuber Crops or fodder for animals; and

ix). Need to explore nutritional and medicinal uses of Root and Tuber Crops.

4. The Representatives of the Department responded to most of the queries raised by the Members. The Chairperson then thanked the witnesses for sharing valuable information with the Committee on the subject and directed them to send, in writing, the requisite information in points/items, which was not readily available with them to the Secretariat of the Committee at the earliest.

The Committee then adjourned.

(A copy of the verbatim proceedings of the Sitting has been kept separately).

APPENDIX-III

STANDING COMMITTEE ON AGRICULTURE

(2017-18)

MINUTES OF THE TWENTY SEVENTH SITTING OF THE COMMITTEE

*****

The Committee sat on Tuesday, the 31st July, 2018 from 1500 hrs. to 1635 hrs. in the Committee Room "B", Ground Floor, Parliament House Annexe, New Delhi.

PRESENT

Shri Hukm Deo Narayan Yadav – Chairperson

MEMBERS

LOK SABHA

2. Shri Sanjay Dhotre
3. Prof. Ravindra Vishwanath Gaikwad
4. Shri Nalin Kumar Kateel
5. Smt. Rakha Nikhil Khadse
6. Md Badaruddoza Khan
7. Shri C. Mahendran
8. Dr. Tapas Mandal
9. Shri Nityanand Rai
10. Shri Mukesh Rajput
11. Shri Virendra Singh
12. Shri Dharmendra Yadav
13. Shri Jai Prakash Narayan Yadav

RAJYA SABHA

14. Shri Rajmani Patel
15. Shri Kailash Soni
16. Shri Harnath Singh Yadav

SECRETARIAT

1.	Shri D.S. Malha	–	Joint Secretary
2.	Shri Arun K. Kaushik	–	Director
3.	Smt. Juby Amar	–	Additional Director
4.	Shri Sumesh Kumar	–	Under Secretary

*2. XXXXX XXXXX XXXXX XXXXX

*3. XXXXX XXXXX XXXXX XXXXX

[THE WITNESSES WITHDREW]

4. Thereafter, the Committee took up for consideration the following draft Reports:

*(i) XXXXX XXXXX XXXXX XXXXX

*(ii) XXXXX XXXXX XXXXX XXXXX

*(iii) XXXXX XXXXX XXXXX XXXXX

*(iv) XXXXX XXXXX XXXXX XXXXX

(v) Draft Report on the Subject "ICAR-Central Tuber Crops Research Institute - A Performance Review" of the Ministry of Agriculture and Farmers Welfare (Department of Agricultural Research and Education).

*(vi) XXXXX XXXXX XXXXX XXXXX

5. After some deliberations, the Committee adopted the draft Reports at para (i), (ii), (iii), (v) and (vi) without any modifications and Draft Report at para (iv) with minor modification and authorized the Chairperson to finalize and present these Reports to Parliament after factual verification of Subject report from the concerned Departments/Ministries.

*6. XXXXX XXXXX XXXXX XXXXX

The Committee then adjourned.

(A copy of the verbatim proceedings of the Sitting has been kept separately).

***Matter not related to this Report.**