CAPP-4

Format for Application for Agri-CRP Projects
Indian Agricultural Research Institute
New Delhi 110 012

1. Title of Platform: **Consortia Research Platform on Conservation Agriculture**

2. Title of the Platform Project: **Conservation agriculture for improving productivity & profitability and soil health**

3. Location
Instituteôs Name: Indian Agricultural Research Institute
Place: New Delhi
District: West Delhi
State: Delhi

4. Principal Investigator (PI)
Name: Dr T. K. Das (Cropping system productivity, economics, input-use efficiency, weed dynamics & management and GHGs emission in irrigated ecologies)
Designation: Principal Scientist
Date of Birth: 03.11.1964
Experience: 21 Years

5. i) Co-Principal Investigator (PI)
Name: Dr R. N. Padaria (Capacity building & farmers' field demonstrations of CA practices)
Designation: Principal Scientist
Date of Birth: 15.12.1964
Experience: 22Years
Number of Scheme handled: 13
Number of research publications: 30
Number of other Research Schemes (being carried out by PI): 1
Title of Scheme (S) Innovative extension models (Inhouse)
Name of the funding Agency: ICAR-IARI
Period from April 2014 to March 2019Grant: Rs. 5 Cr.

ii) Co-Principal Investigator (PI)
Name: Dr Rajbir Yadav [Breeding for CA-specific crop varieties (wheat, maize)]
Designation: Principal Scientist
Date of Birth: 08.02.1966
Experience: 22 (Years)
Number of Scheme handled: 3
Number of important research publications: 50

Number of other Research Schemes (being carried out by PI): 1
Title of Scheme (s)
Name of the funding Agency: ICAR-Network, Generation Challenge (Australia)
Period: from 2004 to 2014: Grant: Rs. 150 lakhs

iii) Co-Principal Investigator (PI)
Name: Dr. Ranjan Bhattacharyya (C-sequestration/ C-pools and soil health in CA-based systems)
Designation: Senior Scientist
Date of Birth: 28.06.1972
Experience: (Years) 13 Years
Number of Scheme handled: 14
Number of important research publications: 52
Number of other Research Schemes (being carried out by PI)
Title of Scheme (s) Nil
Name of the funding Agency:
Period from____ to_____ Grant: Rs._____

iv) Co-Principal Investigator (PI)
Name: Dr. M. C. Meena (Nutrient management protocols for CA-based systems)
Designation: Scientist (Sr. Scale)
Date of Birth: 25.09.1977
Experience: 8 (Years)
Number of Scheme handled: 5
Number of important research publications: 20
Number of other Research Schemes (being carried out by PI)
Title of Scheme (s) Nil
Name of the funding Agency: _____
Period from_____ to_____ Grant: Rs. _____

v) Co-Principal Investigator (PI)
Name: Dr. K. K. Bandyopadhyay (Soil physical environment in CA-based cropping systems)
Designation: Principal Scientist
Date of Birth: 01.03.1969
Experience: 16 (Years)
Number of Scheme handled: 15
Number of important research publications: 95
Number of other Research Schemes (being carried out by PI): Nil
Title of Scheme (s) _____
Name of the funding Agency: _____
Period from___ to___ Grant: Rs._____

6. i) *Collaborative Investigator (s) (separate set for each)
Name: Dr. B.S. Dwivedi
Designation: Head & Principal Scientist
Date of Birth: 04.11.1960
Experience: 29Years
Number of research publications: 91
Number of other Research Schemes (being carried out by PI): One
Title of Scheme (S) Restoration and improvement of soil health
Name of the funding Agency: ICAR-IARI
Period from 2014 to 2019 Grant: _____Rs.

ii) *Collaborative Investigator (s) (separate set for each)
Name: Dr. S. Sudhishri
Designation: Principal Scientist
Date of Birth: 28.06.1972
Experience: 20 Years
Number of research publications: 65
Number of other Research Schemes (being carried out by PI): Nil
Title of Scheme (S) _____
Name of the funding Agency: _____
Period from_____ to _____Grant: _____Rs.

iii) *Collaborative Investigator (s) (separate set for each)
Name: Dr. Arti Bhatia
Designation: Principal Scientist
Date of Birth: 22.09.1969
Experience: 18 Years
Number of research publications: 50
Number of other Research Schemes (being carried out by PI): Nil
Title of Scheme (S) ___
Name of the funding Agency: ____
Period from_____ to _____Grant: _____Rs.

iv) *Collaborative Investigator (s) (separate set for each)
Name: Dr. Geeta Singh
Designation: Principal Scientist
Date of Birth: 01.12.1963
Experience: 23Years
Number of research publications:32
Number of other Research Schemes (being carried out by PI):Nil
Title of Scheme (S) _____
Name of the funding Agency: _____
Period from_____to _____Grant: _____Rs.

v) *Collaborative Investigator (s) (separate set for each)
Name: Dr. D. K. Das
Designation: Senior Scientist
Date of Birth: 26.06.1964
Experience: 21Years
Number of research publications: 22
Number of other Research Schemes (being carried out by PI): 2
Title of Scheme (S); Wave-enabled weather-based DSS for forwarning and management of insect pests and diseases of mustard in Delhi NCR
Name of the funding Agency: DST
Period from 2011 to 2014 Grant: Rs. 35 lakhs.

vi) *Collaborative Investigator (s) (separate set for each)
Name: Dr. D. Chakraborty
Designation: Senior Scientist
Date of Birth: 2.11.1970
Experience: 13 Years
Number of research publications: 43
Number of other Research Schemes (being carried out by PI): Nil
Title of Scheme (S) _____
Name of the funding Agency: _____
Period from_____to _____Grant: _____Rs.

vii) *Collaborative Investigator (s) (separate set for each)
Name: Dr. Seema Sepat
Designation: Scientist
Date of Birth: 10.10.1982
Experience: 5Years
Number of research publications: 11
Number of other Research Schemes (being carried out by PI)
Title of Scheme (S) Nil
Name of the funding Agency:
Period from_____ to _____Grant: _____Rs.

viii) *Collaborative Investigator (s) (separate set for each)
Name: Dr R.S. Bana
Designation: Scientist
Date of Birth: 01.03.1984
Experience: 6 Years
Number of research publications: 26
Number of other Research Schemes (being carried out by PI)
Title of Scheme (S) Nil

Name of the funding Agency: ___
Period from_____ to ____Grant: _____Rs.

ix) *Collaborative Investigator (s) (separate set for each)
Name: Dr. Sujit Sarkar
Designation: Scientist
Date of Birth: 12.06.1985
Experience: 02Years
Number of research publications: 3
Number of other Research Schemes (being carried out by PI): Nil
Title of Scheme (S) _____
Name of the funding Agency: _____
Period from_____ to _____Grant: _____Rs.

x)*Collaborative Investigator (s) (separate set for each)
Name: Dr Sarvender Kumar
Designation: Scientist
Date of Birth: 31.12.1980
Experience: 3 Years
Number of research publications: 5
Number of other Research Schemes (being carried out by PI): Nil
Title of Scheme (S) _____
Name of the funding Agency: _____
Period from____ to ____Grant: _____Rs.

7**. *Objectives (in brief):**

i. Demonstration of CA-based production systems under irrigated cropping systems.
ii. Identification/development of CA-specific cultivars (wheat, maize) and on-station validation of CA-practices for sustainable intensification of cropping systems.
iii. Development of nutrient management protocols and quantification of the impact of CA practices on soil health, weed dynamics, input-use efficiency, carbon sequestration and greenhouse gas emissions.
iv. Knowledge sharing/management and capacity building for accelerated adoption of CA.

8. *Practical/Scientific Utility:

- A number of morpho-physiological genotypic traits would be identified.
- Cropping system based CA adaptable cereal genotypes would be identified.
- Residue management and quantification for a sustainable soil-environmental health.
- Water productivity/savings would be evaluated.
- Energy input-output and benefit-cost economics would be assessed for different CA systems.
- Carbon sequestration and global warming potential under different CA systems would be quantified.
- Efficient nutrient management protocols/strategies would be developed.
- Weed dynamics evaluated and management options recommended for different CA systems.
- Insect-pests & nematode dynamics and their management strategies under CA systems would be documented.

- Key microbiological properties would be evaluated and soil health indicators identified.

9. *Research work conducted

i) At sponsoring institutions:

Conventional transplanted rice (TPR)-conventional till wheat (CTW) cropping system under irrigated conditions has encountered a host of problems and reached to a fatigue in the IGPs of India. Modifications in the system either with a profitable alternative non-rice crop (e.g. cotton, pigeonpea, maize) during *kharif* season or CA-based rice-wheat system with emphasis on direct-seeded rice, rice-residue retention, zero-till wheat is highly essential. A study undertaken for last five years in three major non-rice cropping systems, *viz*., cotton-wheat, pigeonpea-wheat and maize-wheat with suitable conservation agriculture (CA) practices (namely, zero-till permanent narrow bed (70 cm), broad bed (140 cm) and flat bed with both season crop residue) revealed that cotton-wheat system under zero-till permanent broad, flat and narrow beds is superior to pigeonpea-wheat and maize-wheat systems in terms of system productivity, net returns, and water & energy productivity than in conventional-till (CT) flat bed (Das et al., 2014). Crop residue retention is superior to no residue treatment, irrespective of the beds. Significantly higher soil organic carbon (SOC) in the surface 0-5 cm layer was recorded under zero-till broad-bed with residue. This offers to be an important adaptation-led mitigation strategy to climate change. Similarly, a study carried out for five years towards replacing transplanted rice (TPR) with direct-seeded rice (DSR) through interventions of CA practices revealed that a system of ZT DSR with summer mungbean (SMB) residue retention - rice residue (RR) retention in ZTW ï wheat residue retention in ZT summer mungbean (SMB) results in comparable rice yield, but higher system productivity, net returns, B:C and system water productivity than that in TPR-CTW/ZTW system. This treatment results in improvement in SOC& total N in surface (0-5 cm) soil and a reduction in global warming potential (GWP) through reduction in methane emission from rice field (Bhatia et al., 2012). This could be a possible alternative to TPR-CTW and another adaptation-led mitigation strategy to climate change. Another conservation agriculture-based maize-wheat-mungbean cropping system adopted for three years after a three-year experiment on cotton-wheat system to study the long-term impact of different tillage and crop establishment techniques on the performance of this system. This revealed that system productivity, system partial factor productivity (NPK), net returns and B:C were significantly higher in ZT-F and ZT-B than in CT-F. Application of residues of wheat (in *kharif*) + maize (in *rabi*) resulted in higher grain yields of maize, wheat and mungbean, and, as a result, system productivity, system partial factor productivity (NPK), net returns and B:C were higher in this both season residue treatment. ZT bed and flat planting with residues of wheat (in *kharif*) + maize (in *rabi*) resulted in significantly lower bulk density and higher infiltration rate in soil compared to other treatments (Bhattacharya *et al.,* 2013; Das et al. 2013). In ZT-B or ZT-F bed with C/M + W residue retention, 290 and 283 kg total N are retained over a period of 4 years, i.e., around 70-75 kg total N/ha/year. Similarly, equivalent amount of CO_2 was retained/ sequestered in soil. Double cropping is mostly not feasible under rainfed conditions in the north-western plain zone due to inadequate soil moisture after *kharif* crop harvest. An attempt has also been made to evaluate nine different cropping systems with crop residue or *Leuceana* mulching under zero-till rainfed conditions for possible double cropping under rainfed conditions with CA interventions. Persistent use of conventional tillage (CT) practice with extensive tillage and burning of crop residues have decreased soil organic matter content and labile soil carbon pools (Bhattacharya *et al.,* 2013; Das et

al. 2013), deteriorated soil physical properties (Aggarwal *et al*., 1995, Mishra et al., 2015) as well as are capital- and energy-intensive, resulting in lower economic returns (Das et al., 2014). Contrarily, conservation agriculture has been reported to improve crop productivity, water-use efficiency and reduce global warming potential than conventional tillage practices, thus, enhances farm profitability (Bhatia et al., 2012; Das et al., 2014). Availability of new/modern machines for sowing of crops, placing fertilizers at right depths, and availability of effective herbicides in recent years offer opportunities for adoption of CA in different cropping systems. There is need to redefine CA in Indian context, and develop suitable CA technologies suited to varied agro-ecosystems of the country.

ii) In other institution of the country:

CA improves soil penetration ratio (SPR) and water stable aggregates (Gathala *et al*., 2011, Saharawat *et al*., 2009); reduces mechanical impedance; increases infiltration, reduces erosion and increases WUE (Azooz and Arshad, 1996), provides a conducive root environment through enhanced root-moisture interaction, and decreases soil temperatures. Overall CA has been reported to improve crop productivity, resource-use efficiency and reduce global warming potential than CT (Saharawat *et al*., 2011; Bhatia *et al*., 2014; Das *et al*., 2014), enhances numerous ecosystem services and farmers profitability (Lal *et al*., 2010, Gathala *et al.*, 2011). Conservation agriculture and conservation tillage practices improved soil aggregation (Bhattacharyya et al. 2012a,b), aggregate associated C and N (Bhattacharyya et al., 2010; Bhattacharyya et al., 2013), soil microbial dynamics and overall soil health (Kukal et al., 2013); crop productivity (Jat et al., 2013), resource use efficiency over business as usual, enhances farm profitability (Saharawat et al., 2012).

iii) Other countries:

Conservation agriculture improves soil health (Zachmann *et al.*, 1987; Gan *et al.*, 2007), results in greater stratification of soil nutrients and higher availability of nutrients (Jones and Chen, 2007), immobilizes nutrients by increased microbial biomass (Jansson and Persson, 1982), increases total soil organic carbon, C and N mineralization (Fuentes *et al.*, 2009), increases macro-aggregation and aggregate associated C (Blanco-Canqui *et al*., 2006), improves soil penetration ratio (SPR) and water-stable aggregates (Wright and Hons, 2005; Gathala *et al*., 2011, Saharawat *et al*., 2009); reduces mechanical impedance (Sadras and Calvino, 2001); increases infiltration, reduces erosion and increases water use efficiency (Azooz and Arshad, 1996), provides a conducive root environment through enhanced root-moisture interaction (Derpsch, 2008), and decreases soil temperatures (Shaver *et al.,* 2002).

10. Technical Programme:

Items of Investigation:

- Farmers-level demonstrations (2 croping systems x 2 districts x 2 villages x 3 farmers in each village) and trainings for enabling farmers towards adopting CA practices.
- Breeding (genotype x CA)wheat & maize; mapping population for molecular markers in CA based cereal (wheat, maize) systems; identification of morpho-physiological genotypic traits; identification of molecular tags for QTLs for yield traits.
- Crop & system productivity (both on-station & on-farm), water productivity, energy budgeting, economics, insect-pest and weed dynamics, nutrient management options & input-use efficiency in CA-based systems.
- Mean C input, C-sequestration, microbiological properties, soil physical and chemical health and nutrient dynamics, greenhouse gas emissions.

- Report writing, presenting data at national fora and publishing in peer reviewed journals.

Activity Chart and Time Schedule

Activity	**1st Year**		**2nd Year**
Objective 1			
• Selection of demonstration and experimental sites, hiring of human resources, homogenization of study site, procurement of Turbo-seeder, development of technical programme, preparation of data protocols	ã	ã	
• Demonstration of CA based production systems in 2 irrigated cropping systems in 2 districts and 3 villages	ã	ã	ã
Objective 2			
• Breeding (genotype x CA)-wheat and maize o Mapping population for molecular markers in CA based cereal (wheat, maize) systems; o Identification of morpho-physiological genotypic traits o Preliminary screening for molecular marker for CA adaptations	ã	ã	ã
• Component technology generation on crop management (after evaluating nutrient, water, energy use efficiencies and crop productivity)		ã	ã
Objective 3			
• Studies on crop & water productivity, energy budgeting, weed dynamics, input-use efficiency and benefit-cost economics of novel CA-based systems	ã	ã	ã
• Studies on mean C input, C-sequestration, microbiological properties, soil physico-chemical health and nutrient management protocols	ã	ã	ã
Objective 4			
• Farmers trainings towards adopting CA practices		ã	ã
• Report writing, presenting data at national forum, publishing in peer reviewed journals	ã	ã	ã

11. Facilities Available:

i) Equipments/instruments/ apparatus: (1) Gas Chromatography, AAS
(2) CHN Analyser, N analyser
(3) Spectrophometer, Flame photometer
(4) ICP Emission Spectrophotometer

ii) Area of experimental fields (hectares): 4.0 ha

iii) Laboratory : Separate laboratories for Agronomy, Soil Physics, Soil Chemistry and Soil Biology.

iv) Other facilities: (1) Weather Station available

12. Additional facilities required:

i) Equipment/Machinery/Apparatus: **Turbo Seeder (2); Bed Planter (2); Zero-till Drill (2); Multi-crop Planter (1);**

ii) Area of land for experimentation (hectares): Available
iii) Laboratory: Available
iv) Office facilities: Administrative support personnel (1 number)

13. Duration: Two years

14. Staff Requirements (Scientific, Technical etc.): Available
15. Estimation of Costs:
    i) Sr. Research Fellows: 6
    ii) Contractual/Skilled Labourers (20): As per requirement
16. Recurring and Non-recurring contingencies: Rs. 40 lakhs (details given below)

Recurring and Non-recurring contingencies	**Year I (2015-16)#**
Capital	
Equipment/ Machinery/ Apparatus/ Misc. items[@]	5.0
Revenue	
Contractual services (SRF 6 & other contractual services)	19.0
TA	2.0
Other recurring contingencies including institutional charges*	15.0
Total	**40.0**

***Institutional charges @10% of RC for lead institute and 5%of RC for cooperating institutes**
 # As per the new BE (2015-16). Original sanctioned total project budget is 63 crore.
[@]Computer/Air Conditioner/ Furniture as per absolute requirement of the budget.

17. Receipts anticipated: Total = Rs. 184.47 Lakhs

UNDERTAKING

18. Certified that:

i. The research work proposed in the Platform Project (**Conservation agriculture for improving productivity & profitability and soil health)** does not in any way duplicate the research work already done and being carried out elsewhere on the subject.

ii. The present scheme cannot be combined with any scheme financed by the Council, Central and State Governments, Universities or Private Institution of their own funds.

iii. Necessary financial provision for the platform project will be made in the Institution/ University/ State budget in anticipation of the sanction to the scheme by the council.

iv. We undertake to abide by the guidelines provided by the Council for the implementation of the Platform Project.

Principal Investigator **Signature**
Name

Certified that:

i. Project is in line with the approved mandate of the implanting institute.
ii. Platform Project Investigator/ Co-investigators are competent technically to undertake the project.
iii. Research work will not amount to duplication of efforts and In-house projects, handled by them will not suffer.
iv. Equipment and other infrastructure proposed under the project are either not available with the institute or the available facility cannot be extended to the project activities.
v. Basic facilities such as Telephone/ Fax/ photocopies/Generators etc. will be provided by the implementing agency. However, operational cost for these activities will be met from the institutional charges sanctioned under the scheme.
vi. The cost of equipment and other infrastructure requested for under the project is realistic and based on the prevailing market rates.
vii. Justifications and clear specifications for the equipment and other infrastructure asked for are reflected in the proposal.
viii. For collaborative projects with other institutions, the administrative/ financial/ technical issues related to implementation of the project shall be addressed between the two implementing agencies.
ix. The institutions has already furnished to the ICAR, full accounts and Utilization Certificates in respect of the grants received by it previously, as per the following details:

ICAR's amount	UC & Accounts furnished

Communication of Grant by the Institution and date of (Please indicate the Sanctioning Grant number and date of the communication with which ASAs, etc. are sent)

(1)_____ (2) _____ (3) _____
It is certified that the Institution has not received any grant from the ICAR previously.

Date: **Executive Authority of the Institution**