Consortia Research Platform

on

Conservation Agriculture

ICAR

Lead Centre

LCPC: Dr. A.K. Biswas
Dy-LCPC: Dr. R.S. Chaudhary

Indian Institute of Soil Science
(Indian Council of Agricultural Research)
Bhopal -462038

CONSORTIA RESEARCH PLATFORM ON CONSERVATION AGRICULTURE

CRP Structure as per Guidelines

PSC
(Chairman: DG, ICAR; Member Secretary: ADG (Coord.))

↑

PIC
(Chairman: DDG (NRM); Member-Secretary: ADG (SWM))

↑

Director

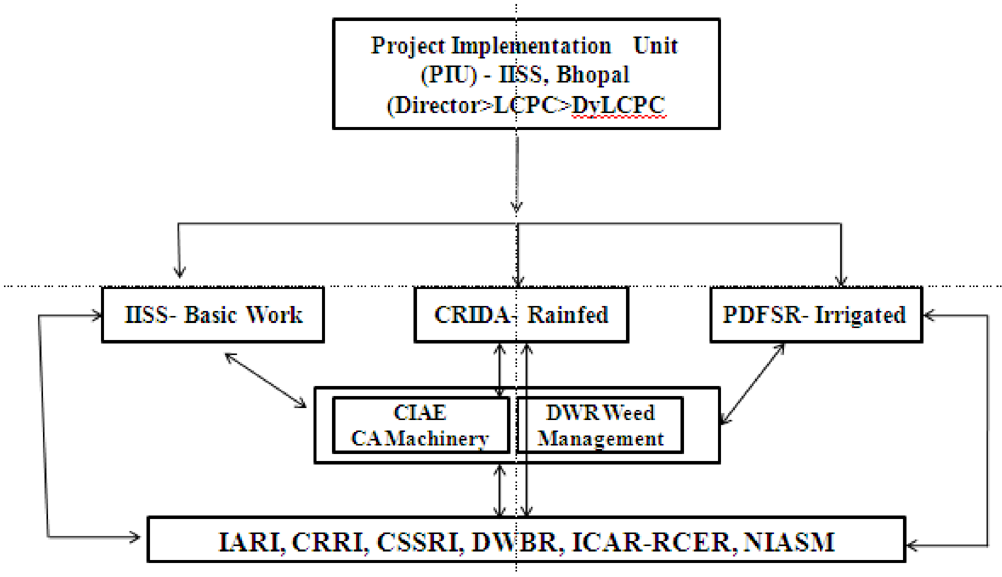
↑

Dy LCPC ⟷ **LCPC** ⟷ Dy LCPC

↑

PPI PPI PPI PPI PPI PPI PPI PPI

Proposed Structure of the CRP on CA



(Acronyms & Abbreviation: PSC= Platform Steering Committee; PIC= Platform Implementation Committee; LCPC= Lead Centre Platform Coordinator; Dy. LCPC= Deputy Lead Centre Platform Coordinator; PPI= Projects Principal Investigator)

Allocation of Budget for the FY 2015-16 as per BE (2015-16)

	Institutes/Unit	**Budget (Rs. in lakh)**
i.	Project Implementation Committee (PIC), KAB-II	5.0
ii.	Project Implementation Unit (PIU), IISS, Bhopal	15.0
iii.	ICAR-CRIDA, Hyderabad	45.0
iv.	ICAR-IIFSR, Modipuram	30.0
v.	ICAR-IISS, Bhopal	55.0
vi.	ICAR-IARI, New Delhi	40.0
vii.	ICAR- CSSRI, Karnal	25.0
viii.	ICAR-RCER, Patna	25.0
ix.	ICAR-CIAE, Bhopal	25.0
x.	ICAR- DWR, Jabalpur	25.0
xi.	ICAR-CRRI, Cuttack	20.0
xii.	ICAR-IIWBR, Karnal	20.0
xiii.	ICAR-NIASM, Baramati	20.0
	Total	**350.0**

Consolidated Budget for the FY 2015-16 as per BE (2015-16)

Heads	PIC	PIU	CRIDA	IIFSR	IISS	IARI	CIAE	DWR	RCER	CSSRI	CRRI	IIWBR	NIASM	Total
Capital														
Equipment$^{\$}$/ Machinery$^{\$}$/ Apparatus$^{\$}$/ Misc. items$^{\#}$	-	2.0	6.0	4.0	10.0	4.0	5.0	3.0	3.0	2.0	2.5	2.0	2.5	46.0
Revenue														
Contractual services (SRF + other contractual staff)	4.0 (1)	9.0 (2)	22.0 (6)	13.5 (5)	25.0 (8)	19.0 (6)	11.0 (3)	11.0 (3)	11.0 (3)	12.0 (3)	9.5 (2)	10.0 (2)	9.5 (2)	166.5 (46)$^{@}$
TA	1.0	3.0	2.0	1.5	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	18.5
Other recurring contingencies including institutional charges*	-	1.0	15.0	11.0	18.0	15.0	10.0	10.0	10.0	10.0	7.0	7.0	7.0	119
Total	**5.0**	**15.0**	**45.0**	**30.0**	**55.0**	**40.0**	**25.0**	**25.0**	**25.0**	**25.0**	**20.0**	**20.0**	**20.0**	**350.0**

*Institutional charges @10% of RC for lead institute and 5%of RC for cooperating institutes

$^{\#}$ Computer/Air conditioner/ Furniture as per absolute requirement of the project

$^{@}$ The figures in brackets indicate the number of SRFs to be recruited by each centre/unit

$^{\$}$ Equipment/ Machinery/Apparatus as per the list given in individual project

CAP PROJECTS

<u>CAP Consortia Project-I</u>

Format for Application for Agri-CRP Projects

Title of Platform: Consortium Research Platform (CRP) on Conservation Agriculture (CA)

Title of the Platform Project: Development, adaptation and refinement of location specific CA practices for enhancing productivity and profitability of rainfed eco-systems

THEME AREA:STRATEGIC AND APPLIED RESEARCH

Partners: (Details of investigators etc are available in annexure I)

Lead Institute: ICAR- Central Research Institute for Dryland Agriculture, Hyderabad

Collaborating Institute(s)

a. Indian Institute of Soil Science, Bhopal
b. Central Rice Research Institute, Cuttack
c. Directorate of Weed Research, Jabalpur
d. Central Institute of Agricultural Engineering, Bhopal
e. National Institute for Abiotic Stress Management, Baramati

Objectives:

- Adapt and mainstream available best bet location specific CA practices for enhanced productivity and profitability in rainfed and irrigated eco-systems.
- Development and validation of location specific CA technologies for sustainable intensification of cropping systems across agro-ecologies.
- Capacity building, knowledge management, institutional arrangement and enabling policies for accelerated adoption of Conservation Agriculture for rainfed crops and cropping systems

Practical/Scientific Utility:

It is expected that the Indian population will reach 1.6 billion by 2050 and the food grain demand is expected to reach 385 mt which calls for significant enhancement in productivity from rainfed systems in the years to come. Declining resource productivity, unabated land degradation, declining organic carbon status, variable rainfall and climate change are some of the constraints impacting the productivity of rainfed agriculture. Conservation agriculture is an emerging approach for sustainable agricultural production without excessively disturbing the soil, while protecting it from the processes that contribute to soil degradation like erosion, compaction, aggregate breakdown, loss of organic carbon, leaching of nutrients etc. Conservation agricultural systems are gaining increased attention worldwide as an effective option to enhance productivity and profitability in a sustainable way without compromising on resource quality and have potential to address the emerging issues of climate change. Reducing the tillage intensity, residue retention and crop rotation are important components of conservation agriculture. Since, the CA practices are dependent on resource endowments of the location and on the prevalent crops and cropping systems, site specific research is essential for the development of CA practices. Besides the influence of various conservation tillage practices on water and nutrient availability, root growth pattern of crops, carbon sequestration potential is required to be studied in detail for successful development and scaling up of conservation agricultural practices in the country.

Research work conducted

At sponsoring institutions:

Research on development of reduced tillage systems was initiated at various centers of the All India Coordinated Research Project for Dryland Agriculture during 1999 and found that reducing tillage intensity adversely influences the crop yields but the differences got reduced in subsequent years. Due to less biomass productivity and reduced availability of biomass under rainfed conditions and competing uses of crop residues, the scope of using crop residues for conservation agriculture is limited in dryland ecosystems. However, experiments conducted at CRIDA, Hyderabad, has shown that in dryland ecosystems, where only a single crop is grown in a year, it is possible to raise a second crop with residual soil moisture by retaining crop residues. There is a need for comprehensive studies to develop crop specific CA practices which can retain residues and can contribute to cropping intensification and productivity under rainfed conditions.

In other institution of the country:

Unlike, in the rest of the world, in India spread of CA technologies is taking place mostly in the irrigated regions of the Indo-Gangetic plains where rice-wheat cropping system dominates. CA practices were also developed for irrigated rice fallows where maize is commonly grown after paddy. CA systems have not been extensively tried or promoted in other major agro-ecoregions like rainfed semi-arid tropics, the arid regions or the mountain agro-ecosystems. Experience at IISS, Bhopal showed that reduced tillage in soybean-wheat system is a suitable option for successfully growing soybean and wheat crops with saving of energy and labour and improvement of soil carbon content and soil physical properties in Vertisols under sub-humid regions. Considering the severe problems of land degradation due to excess runoff induced soil erosion, rainfed areas particularly in arid and semi-arid regions require the practice of CA more than the irrigated areas in order to ensure a sustainable production.

Other countries:

CA systems, comprising minimum mechanical soil disturbance, organic mulch cover, and crop species diversification, in conjunction with other good practices of crop and production management, are now practiced globally on about 125 M ha in all continents and all agricultural ecologies, including in the various temperate environments. While in 1973/74 CA systems covered only 2.8 M ha worldwide, the area had grown in 1999 to 45 M ha, and by 2003 to 72 M ha. In the last 11 years CA systems have expanded at an average rate of more than 7 M ha per year showing the increased interest of farmers and national governments in this alternate production method. Adoption has been intense in North and South America as well as in Australia and New Zealand, and more recently in Asia and Africa where the awareness and adoption of CA is on the increase. Globally much of the area under CA systems is under rainfed systems and in temperate regions.

Technical Programme:

<table>
<tr><th>Components/Activities</th><th>Cropping System (Area)</th><th>Collaborating Institute</th><th>Output</th></tr>
<tr><td rowspan="4">1. Need assessment and strategic entry points for different production systems/ ecologies.

2. Synthesis and documentation of the CA based best management practises (BMPs)

3. To screen and identify suitable varieties through on-farm and on-station experiment (Wheat and Rice).

4. Participatory adaptation and out-scaling of CA based BMPs.</td><td>A. Rainfed

Rice-fallow (12 mha)</td><td>CRIDA-AICRPDA

CRRI</td><td rowspan="4">• Spread/adoption of CA under different production systems/ ecologies.

• CA based best management practises (BMPs)

• Participatory adaptation and out-scaling of CA based BMPs.</td></tr>
<tr><td>Soybean-Wheat* /Soybean-Chickpea (2.23 mha)</td><td>IISS

CIAE

DWR</td></tr>
<tr><td>Pearlmillet/Sorghum/clusterbean-wheat/ mustard/chickpea* (5.7 mha)</td><td>CRIDA-AICRPDA

NIASM</td></tr>
<tr><td>Maize-wheat* (1.8 mha)</td><td>CRIDA-AICRPDA</td></tr>
</table>

Items of Investigation: The items of investigation are as follows:

(i) Development of residue management practices for the selected rainfed crops and systems without compromising the fodder availability
(ii) Development of reduced tillage practices for various rainfed production systems
(iii) Exploring the feasibility of cropping intensification with CA practices
(iv) To assess the performance of proven CA practices under farmers' fields and fine tune these practices for large scale adoption.

Duration: 2 years

Staff Requirements (Scientific, Technical etc.): Details of institute-wise staff requirement is given in **annexure I**

Budget

a. **Recurring and Non-recurring contingencies:** Details of institute wise budget requirement is given in **annexure I**

The following are the deliverables from the project

- Identification of best bet location specific CA practices for various rainfed production systems
- Developed component technologies of CA for rainfed crops and systems
- Enhanced capacity of AICRPDA centers on technology development and also refinement of CA practices and mechanisation

UNDERTAKING

Certified that:

i. The research work proposed in the **Platform Project on Conservation Agriculture** 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** 24/6/15

Name: Dr. Ch. Srinivasarao

DIRECTOR
Central Research Institute
for Dryland Agriculture
P.O. Saidabad, Hyderabad-500659

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 me 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**

<u>CAP Consortia Project-II</u>

Format for Application for Agri-CRP Projects

Title of Platform: Consortium Research Platform (CRP) on Conservation Agriculture (CA)

Title of the Platform Project: Development, Adaptation and refinement of location specific CA practices for enhancing productivity and profitability of irrigated eco-systems

THEME AREA:STRATEGIC AND APPLIED RESEARCH

Partners: (Details of investigators etc are available in annexure I)

Lead Institute: ICAR- Indian Institute of Farming System Research, Modipuram

Collaborating Institute(s)

a) Indian Agricultural Research Institute, New Delhi
b) Central Soil Salinity Research Institute, Karnal
c) ICAR Research Complex for Eastern Region, Patna
d) Directorate of Wheat and Barley Research, Karnal
e) National Institute for Abiotic Stress Management, Baramati
f) Central Rice Research Institute, Cuttack

Objectives:

- Adapt and mainstream available best bet location specific CA practices for enhanced productivity and profitability in irrigated eco-systems.
- Development and validation of location specific CA technologies for sustainable intensification of cropping systems in irrigated ecologies.
- Capacity building, knowledge management, institutional arrangement and enabling policies for accelerated adoption of Conservation Agriculture for irrigated crops and cropping systems

Conservation agriculture strives to develop a balanced co-existence between rural and urban societies, based on increased urban awareness of the environmental benefits and services provided by the rural sector. It works with the international and national market place to develop financial mechanisms to ensure that environmental benefits provided by CA are recognized by society at large, and benefits accrued to CA practitioners. A recent example is the marketing of carbon credits under the Kyoto Accord, but this is only the beginning. Many other opportunities for environmental payments will develop in the future, including the potential for farm products produced under a new "conservation label". The rapid adoption of conservation technologies by large as well as small farmers in many areas of the world, often without government support, is clear evidence of the economic, environmental and social benefits that accrue from these practices. The principles of CA and the activities to be supported are described as follows:

- *Maintaining permanent soil cover and promoting minimal mechanical disturbance of soil through zero tillage systems, to ensure sufficient living and/or residual biomass to enhance soil and water conservation and control soil erosion.* In turn, this improves soil aggregation, improves soil biological activity and soil biodiversity, improves water quality, and increases soil carbon sequestration. Also, it enhances water infiltration, improves soil water use efficiency, and provides increased insurance against drought. Permanent soil cover is maintained during crop growth phases as well as during fallow periods, using cover crops and maintaining residues on the surface;
- *Promoting a healthy, living soil through crop rotations, cover crops, and the use of integrated pest management technologies.* These practices reduce requirements for pesticides and herbicides, control off-site pollution, and enhance biodiversity. The objective is to complement natural soil biodiversity and to create a healthy soil microenvironment that is naturally aerated, better able to receive, hold and supply plant available water, provides enhanced nutrient cycling, and better able to decompose and mitigate pollutants. Crop rotations and associations can be in the form of crop sequences, relay cropping, and mixed crops;
- *Promoting the application of fertilizers, pesticides, herbicides, and fungicides in balance with crop requirements.* This principle is based on feeding the soil rather than fertilizing the crop. The strategy is to reduce chemical pollution of the environment, improve water quality, and maintain the natural ecological integrity of the soil, while optimizing crop productivity and the economic returns;
- *Promoting precision placement of crop inputs to reduce input costs, optimize efficiency of operations, and prevent environmental damage.* This principle is based on treating the problems at the field location where they occur, rather than blanket treatment of the field, as with conventional systems. The benefits are increased economic and field operation efficiencies, improved environmental protection, and reduced (optimized) input costs. Precision is exercised at many levels: seed, fertilizer and spray placement; permanent wheel placement to stop random compaction; individual weed killing with spot-spraying rather than field spraying, etc. Global positioning systems are sometimes used to enhance precision, but farmer sensibility in problem diagnosis and precise placement of treatments is the principal basis. In small scale farming systems and horticultural systems, it also includes differential plantings on hills and ridges to optimize soil moisture and sunshine conditions;
- *Promoting legume fallows (including herbaceous and tree fallows where suitable), as well as promoting composting and the use of manures and other organic soil amendments.* This improves soil structure and biodiversity, and reduces the need for inorganic fertilizers;
- *Promoting agroforestry for fiber, fruit and medicinal purposes.* Agroforestry (trees on farms) provides many opportunities for value added production, particularly in tropical regions, but these technologies are also used as living contour hedges for erosion control, to conserve and enhance biodiversity, and to promote soil carbon sequestration.

FAO also defines CA with the following quantifying parameters

1. Minimum soil disturbance: the disturbed area must be less than 15 cm wide or 25 per cent of the cropped area (whichever is lower); no periodic tillage disturbs a great area than the aforementioned limit.

2. Soil cover: three categories are distinguished; between 30-60 per cent, 61-90 per cent and 91+ per cent ground cover, measured immediately after the planting operation; ground cover less than 30 per cent will not be considered conservation agriculture.

3. Crop rotation: the rotation should involve at least three different crops.

   Minimum tillage is necessary but it has to be combined with at least two complementary practices which are soil cover and diversified crop rotations. Only the combination of these techniques with their synergistic effect can lead to a sustainable, resource saving CA model

Tillage management practices with minimal soil disturbance and incorporation of crop residues decrease soil carbon losses through enhanced decomposition and reduced erosion. Systems that retain crop residues tend to increase soil carbon because these residues are the precursors of soil organic matter. For example, conservation tillage which leaves at least 30% of ground covered by crop residue mulch during seedbed preparation, increases soil organic carbon content when land is converted from conventional (plough-based) use.

Reduced tillage is another conservation tillage achieved by minimum disturbance of the soil in areas where seeds will be planted, either in rows or planting holes or small basins. Reduced tillage evolved in attempt to solve some disadvantages of NT systems, and improve root growth and penetration and water infiltration while maintaining surface mulch and slow down decomposition of organic residues. Reduce tillage can be achieved through:

Ripping is the most popularly advocated conservation tillage technology in tropical soils. Ripping is achieved by using a ripper that breaks clogs along the planting rows, leaving the spacing between rows undisturbed. The ripped area also acts as micro-catchment to collect rainfall water and increase infiltration. Ripping can be done by using tractors or oxen.

Small Planting basin is reduced tillage practices where the farm is cultivated in small fixed/permanent basins with 30-cm long and 20-cm deep, using narrow, deep and strong hand-hoes. The basins are cultivated at 70 cm spacing along the planting rows and 90 cm apart between rows to form rows of small basins. Seeding and fertilizer application is done in each basin. For maize 8, to 10 seeds are planted in a basin, while 10 to 20 seeds of beans are planted per basin. The basins are the only spot where soil is disturbed, hence helps to conserve soil and moisture. The basins also act as in situ rainwater harvesting and store water in the soil profile.

Increased nutrient uptake and N use efficiency across a wide range of rice growing environments with diverse climatic conditions were related to the effects of improved N management and balanced nutrition, an important impact of conservation agriculture. A major challenge is to simplify the approach for wider scale dissemination without sacrificing components that are crucial to its success. The underlying principles of SSNM need to be carefully identified and evaluated for each macronutrient. Approaches to further dissemination must be related to prevailing site-specific conditions.

Research Work Conducted

At sponsoring institutions:

- ✓ Identification of bio-intensive, complementary cropping systems for high productivity and efficient resource use
- ✓ Resource conservation and sustaining high productivity through cropping system management and land configuration
- ✓ Long Term influence of Resource Conservation Technologies and crop Residue Management Practices on Crop Productivity, water requirement and soil health in Rice-Wheat cropping system.
- ✓ Long Term influence of Resource Conservation Technologies on Crop Productivity, weed management, water use and soil health in Rice-Wheat cropping system.
- ✓ Long Term influence of Resource Conservation Technologies on Crop Residue Management practices on crop productivity and soil health in Rice-Wheat cropping system
- ✓ Development of low-cost multi tillage, multi-crop planter for round grain cereals, legumes and pulses.
- ✓ Resource conservation modules for high yield realization for different cropping systems
- ✓ Studies on improvement of soil organic carbon pool in rice-wheat system under resource conservation technology
- ✓ Conservation agriculture based weed management practices in rice-wheat cropping system

In other Institution of the country (India)

Conservation Agriculture is a concept for resource saving agricultural crop production to achieve sustained production and conserving the environment. Function of conservation agriculture is based on three key principles, viz. effective resource conservation, input optimization and optimum productivity of the farming system (Nagarajan et al., 2013). Certainly, the advancement in conservation agriculture is possible through genetic improvement in crops and varieties, which are suitable for better adaptation to different farming system environments. Besides, improved varieties and technologies can be assumed to improve productivity with an optimized input level. In the case of rice, resource conservation is possible with proper technological intervention. Water is the one of the most important factor, which governs the productivity of rice. In the concept of conservation agriculture, rice growing systems such as aerobic rice, direct seeded rice, system of rice cultivation and alternate wetting and drying could be used to conserve water. Several problems come to exist in rice growing environment under limited water such as pest, disease and weeds, which may reduce productivity.

Conservation agriculture helps in sequestering atmospheric carbon in soil-plant system through change in agricultural operations and management practices. Conservation tillage along with efficient management of inputs, viz. irrigation, fertilizer and pesticides facilitates carbon sequestration in soil-plant system. Land use change and conventional agricultural practices are major contributors to global annual emission of CO_2. Conservation agriculture and recommended management practices (RMPs) collectively are helpful to offset part of the emissions due to unscientific agricultural practices.

Based on average benefits of all conservation tillage systems, the carbon sequestration potential of adopting a conservation tillage system is about 0.15 t/ha (Lal 1997, b). Adoption of reduced tillage may also save fossil fuels at the rate of about 8 KgC/ha/year.

Zero tillage, strip till drill, bed planter and rotary till drill saved 60-85 per cent resources in rice – wheat system (Singh, 2012). Zero tillage is conservation tillage achieved by no soil disturbance. Hence planting is done by no-till planter capable of placing seeds at appropriate depth in the soil and ensures adequate seed-soil contact required for germination. The advantage of NT is that it ensures surface soil cover by leaving residue on the surface, conserve soil moisture, and increase SOM in the top soil. However, NT in compacted soil hinders root development after seed germination especially during first years of no till, and reduced infiltration at early stages of NT. Weed pressure is also a problem in case the surface mulching is low in NT system. In the zero tillage or NT practices weed control depends solely on herbicides. The grain yields of rice were not significant with tillage. Zero-till wheat (Sah et al. 2013), however, produced significantly higher grain yield (2777 kg ha^{-1}) than permanent bed planting (2438 kgha-1) and conventional tillage (2499 kgha-1). It is not only on the part of saving energy but zero tillage helps in increasing cropping intensity thus improving carbon sink. As a successful example ICAR Research Complex for NEH Region, Meghalaya (ICAR report) introduced vegetable garden pea after rice using zero tillage technology in Nongthymmai village where farmers leave rice field fallow during rabi season mainly owing to lack of irrigation facilities.Efficient nutrient management of macronutrients increased yields of rice and wheat crops by 12 and 17% and profitability by 14 and 13%, respectively, in Northwest India (Khurana et al., 2008). Results suggest that further increases in yield can only be expected when farmers exploit the synergy that occurs when all aspects of crop, nutrient, and pest management are improved simultaneously.

Other countries

Historically, invention of cultivation implements such as mouldboard in the 11th century in Europe, followed by agricultural mechanization using tractors with multiple implements by early 1900 enable intensive cultivation in many agricultural soils in Europe and America. However, between 1931 and 1939, a dust bowl era took away precious top soil, which was made vulnerable by ploughing, was witnessed in the southern plain of US resulting in farm degradation and crop failure (Huggins and Reganold, 2008). Thus, the need to reduce intensive cultivation and ensure soil cover was realized as early as in 1940's.The important practices of conservation of soil and water and improving rain/irrigation water have been summarized.

Conservation tillage is an important instrument that achieve minimum soil disturbance and leave organic residue on the surface of the soil to ensure at least 30% of surface soil cover (FAO, 1993). Conservation agriculture (CA) is a combination of wide range of tillage and cropping practices/technologies that aims at ensuring minimum soil disturbance, adequate soil cover, and mix or rotation of crops so as to reduce soil physical and chemical degradation (IIR and ACT, 2005). A combination of practices such as conservation tillage (reduced/minimum or zero tillage), mulching, intercropping, crop rotation are core in CA. Conservation agriculture hold great promise to break vicious cycle of poverty due low productivity and food insecurity caused by land degradation that makes the society vulnerable and hence poor. The entry point to break the cycle is through CA's positive impact on preventing/reducing land degradation to form a sustainable and viable production system that will improve livelihood of many rural communities in Africa. The CA core technologies/practices include:

The agricultural soil is usually disturbed by tilling or cultivating so as to loosen up the soil to enable easy root penetration and water infiltration for adequate crop growth. Other advantages of soil disturbance is discouraging weeds growth and reduce weed competition with crops at early stages of crop development. However, too much soil disturbance and inappropriate tillage methods has led to excessive removal of soil surface cover, destruction of soil structure and compaction, rapid losses of SOM and susceptibility to water and wind erosion during early stages of before full canopy cover.

Residue management is key to maintaining soil C in annual crops. Early estimates (Graham et al. 2007) suggested that, on average, about 55% of the stover produced by the U.S. corn crop could be harvested without risk of erosion were no-till management widely adopted. Erosion, however, is not the sole arbiter of soil C levels—recent evidence (Wilhelm et al. 2007) suggests that only about a third of this amount can be harvested if soil C stocks are to be maintained. Removing even this amount, however, is likely to be insufficient to sequester additional C, so the fossil fuel offset credit of harvested residue must be carefully compared to the lost soil sequestration benefit, particularly if the prior system was accumulating soil C via no-till or set-aside management. Furthermore, the need to replace nutrients removed in residues, through increasing fertilizer additions, is an additional consideration.

Conservation tillage and no-tillage practices could provide higher C sequestration. It was found that a change from conventional tillage to no tillage could sequester from 0.43 to 0.71 Mg C ha−1 year−1 In an experiment conducted in Saskatchewan by Malhi and Lemke (2007), N_2O emissions were significantly lower from no-tillage (155 g N ha−1) than the conventional tillage (398 g N ha−1) treatments in the third year of the study. Rochette et al. (2008) summarized the effect of no tillage on N_2O emission and concluded that the net impact of the no-tillage on N_2O emission to be highly dependent on local environment (i.e. climate, soil type). In addition, the lower farm operation from no-tillage practices could further improve the net GHG. Although, in long term, the C sequestration return diminishes, CO_2 emissions are directly reduced since tillage fuel consumption is the greatest proportion of farming activity (Johnson et al. 2007) and Singh (2012) also reported a reduction of around 70 kg CO^2 emission by zero tillage over conventional sowing.

Integrating perennial trees/shrubs plants in agricultural lands both crop production and grazing has been documented to improve soil cover, and ensure green cover during off season. In so doing trees/shrubs in agricultural land helps to curb land degradation and conserve biodiversity to create a resilient land use that adapt and mitigate climate change (Kitalyi et al., 2011). This technology when integrated in crop land has to be done in such a way that light competition or shading effect between trees and crops is avoided. Thus, careful selection of trees with low shading effect and planting at the border of the farms preferably on the south-north borders is recommended. Trees can also be planted in areas of the farms that are highly vulnerable to soil degradation such as on steep slopes, soil bunds of terraces, and near water sources. Alley cropping can also be done, where trees are planted in alleys between crop fields.

Fertilizer trees capable of fixing atmospheric nitrogen and with multipurpose use such as Sesbaniasesban, Crotalaria grahamiana and Tephrosiavogelii are recommended and have been successful used in Kenya and Tanzania (Kitalyi et al., 2011). The World Agroforestry Center has developed four fertilizer trees options to improve soil fertility in the crop land. These fertilizer tree options includes fertilizer trees during fallow in rotations with cereal crops, intercropping fertilizer trees as coppiced fallow and cereals, intercropping shrubs in annual allay with cereals, and harvesting Gliricidia or Tithonia trees/shrubs leaves and apply them in crop land as mulch, green manure or compost (biomass transfer).

Technical Programme:

Components/Activities	**Cropping System (Area)**	**Collaborating Institute**	**Output**
1. Need assessment and strategic entry points for different production system in irrigated ecologies. 2. Synthesis and documentation of the CA based best management practises (BMPs) 3. To screen and identify suitable varieties through on-farm and on-station experiment . 4. Participatory adaptation and out-scaling of CA based BMPs.	**B. Irrigated** Rice-Wheat (10 mha)	IARI, CSSRI IIFSR ICAR RC for ER, DWBR DWR	• Spread/adoption of CA under different production systems under irrigated ecologies. • CA based best management practises (BMPs) • Participatory adaptation and out-scaling of CA based BMPs.
	Maize-Wheat (1.8 mha)	IARI, ICAR RC for ER DWBR IIFSR	
	Wheat-Sugarcane (0.97mha)	IIFSR NIASM	
	Rice-Rice/pulse (5.9mha)	CRRI, IIFSR	

Items of Investigation: The items of investigation are as follows:

i. Development of residue management practices for the selected irrigated crops and systems.
ii. Development of reduced tillage practices for various irrigated production systems

iii. Exploring the feasibility of cropping intensification with CA practices
iv. To assess the performance of proven CA practices under farmers' fields and fine tune these practices for large scale adoption.

Duration: 2 years

Staff Requirements (Scientific, Technical etc.): Details of institute wise staff requirement is given in annexure I

Budget

b. **Recurring and Non-recurring contingencies:** Details of institute wise budget requirement is given in annexure I

The following are the deliverables from the project

- Identification of best bet location specific CA practices for various rainfed production systems
- Developed component technologies of CA for rainfed crops and systems
- Information on the impact of CA on soil health, input use efficiency, carbon sequestration and greenhouse gas emissions
- Enhanced capacity of AICRPDA centers on technology development and also refinement of CA practices and mechanisation
- Development / modification of machinery for zero till sowing

UNDERTAKING

Certified that:

i. The research work proposed in the **Platform Project on Conservation Agriculture** 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: 29.06.2015

Name: Mahendra Pal Singh Arya

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 me 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:

29/6/2015
Executive Authority of the Institution
DIRECTOR
ICAR-Indian Institute of Farming Systems Research
Modipuram, Meerut-250110 (U.P.)

<u>CAP Consortia Project - III</u>

Format for Application for Agri-CRP Projects

Title of Platform: Consortium Research Platform (CRP) on Conservation Agriculture (CA)

Title of the Platform Project: Development and refinement of component technologies of conservation agriculture (CA) and quantifying impact of CA practices on soil and environment.

THEME AREA: BASIC AND STRATEGIC RESEARCH

Partners: (Details of investigators etc are available in annexure I)

Lead Institute: ICAR- Indian Institute of Soil Science, Bhopal

Sub-leading institute(s)

a) Central Institute for Agricultural Engineering, Bhopal (**CA Machinery**)
b) Directorate of Weed Research, Jabalpur (**Weed Management**)
c) Indian Institute of Soil Science, Bhopal (**Water, nutrient and energy management**)

Collaborating Institute(S): IARI, CRIDA, CRRI, IIFSR, ICAR-RCER, NIASM

Objectives:

CA Machinery

- Adaptation/ development and validation of location specific CA machinery for different cropping systems for improving crop productivity and profitability
- Capacity building and knowledge management for accelerated adoption of conservation agriculture machinery.

Weed Management

- Study of weed dynamics and biology of major weeds in diversified cropping systems under conservation agriculture
- Development of efficient weed management technologies involving cultural, mechanical and chemical methods including new herbicide molecules, mixtures and rotations
- Monitoring of herbicide resistance in weeds, herbicide residues and soil health under long-term conservation agriculture systems

Water, Nutrient and Energy Management

- Identifying best tillage, water and nutrient management practice under CA
- To quantify changes in soil quality parameters, nutrient dynamics, carbon sequestration and green house gas emission under conservation agriculture

- Budgeting Nutrient, water & energy under CA

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.
- Wheat residue incorporation or retention coupled with application of 28 kg N ha-1 through fertilizer or organic manures is more beneficial than burning in terms of enhanced crop productivity and soil fertility.
- Soil incorporation of wheat residue plus N supplementation through FYM at the rate of 28 kg N ha-1 (approx. 4 t FYM ha-1) along with 25 kg P ha-1 for rainfed soybean and 68 kg N + 30 kg P ha-1 for irrigated (1+ 2 irrigations) wheat was more effective and profitable
- Wheat residue incorporation resulted in 20–22% higher yields in soybean and 15-25% in wheat as compared to residue burning.
- Nutrient dynamics (N, P, K, S, and micronutrients) under long term fertilizer applications
- Soil test based nutrient application for different crops and soils

Research work conducted

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 – 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.

i) 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).

ii) 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).

The overall objective of CA is to enhance the productivity and sustainability of farming systems as well as maintaining the soil health. Hence, the investigation should be focused, among other things, to the individual and interactive effects of conservation tillage practices, residue management, crop rotations, nutrient and water inputs on nutrient use efficiencies. Also, nutrient management practices in CA systems cannot be reduced to simple physical input-output model. While there is much new work that needs to be done to formulate nutrient management strategies in CA systems, all such strategies would need to ensure that soil health becomes the means of meeting crop nutrient needs in an optimum and cost-effective way within the prevailing ecological and socio-economic conditions.

Little work has been done up to now on nutrient dynamics especially nitrogen and phosphate and their interaction in conservation agriculture as practiced by smallholders in the tropics. Hence, this work aims at understanding how conservation agriculture affects the fluxes and dynamics of N and P in the presence of legumes, and at identifying with farmers strategies that will allow using these resources in the most sustainable way. This information will contribute to the development of tools to evaluate the relevance of conservation agriculture for smallholders.

Technical Programme:

Components/Activities	Cropping System (Area)	Collaborating Institute	Output
1. Fine-tuning the existing CA and developing new CA machinery 2. Identify existing long term CA trials in different ecologies and production systems for assessing the impacts 3. Nutrient dynamics, soil health, weed dynamics, 4. Nutrient, water & energy budgeting 5. Quantify GHG emission and GWP 6. Carbon sequestration under CA systems 7. Simulation models and strategies for climate change mitigation through CA.	**A. Rainfed** Rice-fallow (12 mha) Soy-Wheat / Soy-Chickpea Pearlmillet/Sorghum/clusterbean-wheat/mustard/chickpea **B. Irrigated** Rice-Wheat (10 mha) Maize-Wheat Wheat-Sugarcane Rice-Rice/pulse (5.9mha)	IISS, IARI, CRIDA CIAE CRRI DWR, NIASM	• Enhanced soil health, improved water and carbon footprints. • Improved input use efficiency, crop productivity and profitability under diverse ecologies • Understanding g crop-forage-livestock interactions under CA • Calibrated and validated suitable simulation models under Indian climate conditions

Items of Investigation:

The items of investigation for CA machinery:

- Identify promising CA machineries, fine-tuning the existing CA machinery and developing new CA machinery
- Validation and refinement of developed machinery/equipment
- Identify training needs on CA machinery system for project staff and stakeholders.
- Developing protocols for data collection, analysis and interpretation for CA machinery system.

The items of investigation for Weed management

- Appraisal of weed dynamics (density and diversity) and monitoring of weed flora shift in different cropping systems under CA
- Development of IWM modules for CA
- Screening and evaluation of new herbicide molecules, herbicide combinations /rotations
- Monitoring of herbicide resistance in weeds

The items of investigation for Water, Nutrient and Energy Management

- Developing nutrient and water management practices under CA
- Nutrient, water, and energy budgeting under different systems of CA
- Soil carbon storage and budgeting, green house gas emissions, soil health

Duration: 2 years

Staff Requirements (Scientific, Technical etc.): Details of institute-wise staff requirement is given in annexure I

Budget

Recurring and Non-recurring contingencies: Details of institute-wise budget requirement is given in annexure I

UNDERTAKING

Certified that:

i. The research work proposed in the **Platform Project on Conservation Agriculture** 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: Dr. K.M. Hati

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 me 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.
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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: 16/7/15

Executive Authority of the Institution

Dr. Ashok K. Patra
Director
Indian Institute of Soil Science (I.C.A.R.)
Nabi Bagh, Berasia Road, BHOPAL-462 038 (M.P.)

CAPP-1

Format for Application for Agri-CRP Projects

1. **Title of Platform**: Consortium Research Platform (CRP) on Conservation Agriculture (CA)

2. **Title of the Platform Project**: Development and validation of CA practices for rainfed production systems of India

3. **Location**
   Institute's Name: ICAR- Central Research Institute for Dryland Agriculture
   Place: Hyderabad
   District: Ranga Reddy
   State: Telangana

4. **Principal Investigator (PI)**
   Name: Dr Ch Srinivasa rao
   Designation: Director
   Date of Birth: 04-10-1965
   Experience: (Years): 22 years

5. **Co-Principal Investigator (Co-PI)**
   Name: Dr K.L.Sharma
   Designation: Principal Scientist
   Date of Birth: 5-1-1959
   Experience: (Years): 25 years
   Number of Scheme handled: 9
   Number of important research publications: 70
   Number of other Research Schemes (being carried out by PI):
   Title of Scheme (s): Conservation tillage farming strategies and crop residue management for soil health improvement and higher crop productivity in Sorghum-Blackgram in rainfed Alfisol
   Name of the funding Agency: CRIDA
   Period from 2013 to 2020 Grant: Rs.

6. *__Collaborative Investigator (s) (separate set for each)__
   Name: G. Pratibha
   Designation: Principal Scientist
   Date of Birth: 24-8-1965
   Experience: 20 Years
   Number of research publications: 45
   Number of other Research Schemes (being carried out by PI): 1

Title of Scheme (S): Crop residue management for enhancing soil quality, crop productivity and mitigation of climate change
Name of the funding Agency: DST, New Delhi
Period from 2012 to 2015 Grant: Rs. 56 Lakhs

i. Collaborative Investigator (s) (separate set for each)

Name: Dr JVNS Prasad
Designation: Principal Scientist
Date of Birth: 28-04-1969
Experience: 19 Years
Number of research publications: 49
Number of other Research Schemes (being carried out by PI):1
Title of Scheme (S): Development of green house gas emission coefficients for climate resilient technologies
Name of the funding Agency: NICRA
Period from 2015 to 2019: Grant: Rs. Lakhs

ii. **Collaborative Investigator (s) (separate set for each)**

Name: Dr G.R.Chary
Designation: Principal Scientist
Date of Birth: 6-6-1964
Experience: 25Years
Number of research publications: 45
Number of other Research Schemes (being carried out by PI):1
Title of Scheme (S) Adaptation strategies through cropping systems at selected soil bench marked sites
Name of the funding Agency: NICRA
Period from 2012 to 2017 Grant: Rs.

ii. Collaborative Investigator (s) (separate set for each)

Name: Dr Sumantha Kundu
Designation: Scientist
Date of Birth: 26-11-1979
Experience: 5Years
Number of research publications: 30
Number of other Research Schemes (being carried out by PI):1
Title of Scheme (S) Conservation agriculture for productivity enhancement and mitigating GHG emissions in Maize-Horsegram system in Alfisols of Semi Arid Tropics
Name of the funding Agency: NICRA
Period from 2012 to 2017 Grant: Rs.

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

The objectives for the rainfed production system are

- Adapt and mainstream available best bet location specific CA practices for enhanced productivity and profitability in rainfed and irrigated eco-systems.
- Development and validation of location specific CA technologies for sustainable intensification of cropping systems across agro-ecologies.
- Quantify impact of CA on soil health, pest dynamics, input use efficiency, carbon sequestration and greenhouse gas emissions
- Capacity building, knowledge management, institutional arrangement and enabling policies for accelerated adoption of Conservation Agriculture for rainfed crops and cropping systems

8. ***Practical/Scientific Utility**:

It is expected that the Indian population will reach 1.6 billion by 2050 and the food grain demand is expected to reach 385 mt which calls for significant enhancement in productivity from rainfed systems in the years to come. Declining resource productivity, unabated land degradation, declining organic carbon status, variable rainfall and climate change are some of the constraints impacting the productivity of rainfed agriculture. Conservation agriculture is an emerging approach for sustainable agricultural production without excessively disturbing the soil, while protecting it from the processes that contribute to soil degradation like erosion, compaction, aggregate breakdown, loss of organic carbon, leaching of nutrients etc. Conservation agricultural systems are gaining increased attention worldwide as an effective option to enhance productivity and profitability in a sustainable way without compromising on resource quality and have potential to address the emerging issues of climate change. Reducing the tillage intensity, residue retention and crop rotation are important components of conservation agriculture. Since, the CA practices are dependent on resource endowments of the location and on the prevalent crops and cropping systems, site specific research is essential for the development of CA practices. Besides the influence of various conservation tillage practices on water and nutrient availability, root growth pattern of crops, carbon sequestration potential is required to be studied in detail for successful development and scaling up of conservation agricultural practices in the country.

9. ***Research work conducted**

i. **At sponsoring institutions**:

Research on development of reduced tillage systems was initiated at various centers of the All India Coordinated Research Project for Dryland Agriculture during 1999 and found that reducing tillage intensity adversely influences the crop yields but the differences got reduced in subsequent years. Due to less biomass productivity and reduced availability of biomass under rainfed conditions and competing uses of crop residues, the scope of using crop residues for conservation agriculture is limited in dryland ecosystems. However, experiments conducted at CRIDA, Hyderabad, has shown that in dryland ecosystems, where only a single crop is grown in a year, it is possible to raise a second crop with residual soil moisture by retaining crop residues. There is a need for comprehensive studies to develop crop specific CA practices which can retain residues and can contribute to cropping intensification and productivity under rainfed conditions.

ii. **In other institution of the country**:

Unlike, in the rest of the world, in India spread of CA technologies is taking place mostly in the irrigated regions of the Indo-Gangetic plains where rice-wheat cropping system dominates. CA practices were also developed for irrigated rice fallows where maize is commonly grown after paddy. CA systems have not been extensively tried or promoted in other major agro-ecoregions like rainfed semi-arid tropics, the arid regions or the mountain agro-ecosystems. Experience at IISS, Bhopal showed that reduced tillage in soybean-wheat system is a suitable option for successfully growing soybean and wheat crops with saving of energy and labour and improvement of soil carbon content and soil physical properties in Vertisols under sub-humid regions. Considering the severe problems of land degradation due to excess runoff induced soil erosion, rainfed areas particularly in arid and semi-arid regions require the practice of CA more than the irrigated areas in order to ensure a sustainable production.

iii. **Other countries**:

CA systems, comprising minimum mechanical soil disturbance, organic mulch cover, and crop species diversification, in conjunction with other good practices of crop and production management, are now practiced globally on about 125 M ha in all continents and all agricultural ecologies, including in the various temperate environments. While in 1973/74 CA systems covered only 2.8 M ha worldwide, the area had grown in 1999 to 45 M ha, and by 2003 to 72 M ha. In the last 11 years CA systems have expanded at an average rate of more than 7 M ha per year showing the increased interest of farmers and national governments in this alternate production method. Adoption has been intense in North and South America as well as in Australia and New Zealand, and more recently in Asia and Africa where the awareness and adoption of CA is on the increase. Globally much of the area under CA systems is under rainfed systems and in temperate regions.

10. **Technical Programme**: Items of Investigation:

The items of investigation are as follows:

i. Development of residue management practices for the selected rainfed crops and systems without compromising the fodder availability
ii. Development of reduced tillage practices for various rainfed production systems
iii. Exploring the feasibility of cropping intensification with CA practices
iv. Development of appropriate machinery for simultaneous sowing, fertilizer application and herbicide application
v. To determine the influence of CA practices on soil carbon buildup, soil physical, chemical and biological properties in various rainfed production systems of the country
vi. To assess the performance of proven CA practices under farmers' fields and fine tune these practices for large scale adoption.

The technical programme will be implemented 4 AICRPDA centers representing rainfed sorghum, finger millet, soybean, and rainfed rice systems which are the predominant rainfed systems of the country distributed in significant area.

Apart from the above the KVKs representing Tumkur (Karnataka), Nalgonda (Telangana), Baramati (Maharashtra), Sonitpur (Assam) and one selected district from Gujarat will be involved in the project to adapt and to mainstream available best bet location specific CA practices for enhanced productivity and profitability in rainfed systems in these districts.

The ongoing long term experiments at CRIDA on sorghum-pulse, castor-pigeonpea, maize-horsegram will be continued and used for intensive data collection and to assess the soil health, pest dynamics, input use efficiency, carbon sequestration and greenhouse gas emissions and also for capacity building on rainfed systems.

11. **Facilities Available**:

Equipments/instruments/ apparatus:

(1) Total carbon analyser
(2) Nitrogen analyser
(3) Gas chromatograph for quantification of green house gases
(4) Soil respiration unit
(5) AAS
(6) Core samplers for measuring bulk density and root biomass
(7) Leaf area and root area analyser
(8) Infrared thermometer for quantification of canopy temperature

Area of experimental fields (hectares):
Laboratory: At CRIDA a well established and fully functional soil physical laboratory which can assess the soil physical properties, and a well established chemistry laboratory

for assessing the soil chemical and biological properties and soil enzymes exists. In addition to the above, a central laboratory is in place which has the state of the art equipment for quantification of carbon in plants, soils, water samples and green house gases from soils. These facilities will be used for the CRP on conservation agriculture.

Other facilities:

(1) Two large experimental farms for conducting field experiments with established farm machinery fabrication unit for development/ modification of farm machinery
(2) Facilities for measuring the runoff from various experimental plots with various levels of tillage
(3) CRIDA has various research centers representing predominant rainfed crops and systems of the country which operate in network mode. These network centers will be used for technology development and validation on CA practices which in turn will be released as proven technologies by the concerned state governments.
(4) In addition to the above technology demonstrations for climate resilient practices are being taken up in 100 climatically vulnerable districts of the country. Some of these districts will be used to mainstream available best bet location specific CA practices for enhanced productivity and profitability in rainfed eco-systems

12. **Additional facilities required**:
    Equipment & apparatus:
    (1) ______________________________ (50 Chrs)
    (2)______________________________ (50 Chrs)
    (3) ______________________________ (50 Chrs)

    Area of land for Experimentation (hectares):
    Laboratory: --
    Office facilities: ----

13. **Duration**: 2 years

14. Staff Requirements (Scientific, Technical etc.)

Designation of Post: NIL: Number of Post: NA: Scale of Pay: NA: Qualification Prescribed: NA

15. Estimation of Costs:

i) Sr. Research Fellows: 6
ii) Other contractual services: As per requirement

16. Recurring and Non-recurring contingencies: Rs. 45 lakhs (details given below)

Recurring and Non-recurring contingencies	Year-I (2015-16)#
Capital	
Equipment/ Machinery/ Apparatus/ Misc. items@	6.0
Revenue	
Contractual service (SRF 6 & other contractual services)	22.0
TA	2.0
Other recurring contingencies including institutional charges*	15.0
Total	**45.0**

***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

The following are the deliverables from the project

- Identification of best bet location specific CA practices for various rainfed production systems
- Developed component technologies of CA for rainfed crops and systems
- Information on the impact of CA on soil health, input use efficiency, carbon sequestration and greenhouse gas emissions
- Enhanced capacity of AICRPDA centers on technology development and also refinement of CA practices and mechanisation
- Development / modification of machinery for zero till sowing

UNDERTAKING

18. **Certified that**:

i. The research work proposed in the **Platform Project on Conservation Agriculture** 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 CH.SRINIVASA RAO

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 me will not suffer.
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(1)__________________________(2)____________________(3)

It is certified that the Institution has not received any grant from the ICAR previously.

Date: 24/6/15

Executive Authority of the Institution

DIRECTOR
Central Research Institute
for Dryland Agriculture
P.O. Saidabad, Hyderabad-500659

CAPP-2

Format for Application for
Agri-CRP Projects

1. Title of Platform: Agr-CRP

2. Title of the Platform Project: Agri-CRP on Conservation Agriculture.

3. Location
   Institute's Name: ICAR- Indian Institute of Farming Systems Research
   Place: Modipuram Meerut
   District: Meerut 250 110
   State: Uttar Pradesh

4. Principal Investigator (PI)
   Name: Dr. Mahendra Pal Singh Arya
   Designation: Principal Scientist (Agronomy)
   Date of Birth: 18 Dec. 1954
   Experience: (Years): 35 years

5. Co-Principal Investigator (PI)
   Name: Dr. Mohammad Shamim
   Designation: Scientist (Agricultural Meteorology)
   Date of Birth: 10th, November, 1975
   Experience: (Years): Five Years
   Number of Scheme handled: Two
   Number of important research publications: Eleven

6. *Collaborative Investigator (s) (separate set for each):Not Applicable
   Name:
   Designation:
   Date of Birth:
   Experience:
   Number of Scheme handled:
   Number of important research publications:
   Number of other Research Schemes (being carried out by PI):
   Title of Scheme (s)
   Name of the funding Agency:
   Period from toGrant: Around Rs

7. *Objectives (in brief)
   - To enhance nutrient use efficiency through cropping /farming systems approach
   - To improve water conservation by irrigation management practices.
   - To enhance energy conservation through land configuration and planting techniques
   - To develop Decision Support System (DSS) under small and marginal farms

*Practical/Scientific Utility:

Conservation agriculture (CA) is a concept of resource saving agricultural crop production that strives to achieve acceptable profit together with high and sustained production level while concurrently conserving the environment (FAO).It is based on enhancing natural biological process above and below the ground. Conservation agriculture is characterized by three principals namely: (i) continuous minimum mechanical soil disturbance; (ii) permanent organic soil cover; (iii) diversified crop rotations in the case of annual crops and plant associations in case of perennial crops. (Detailed Information in Annexure A).

9*Research work conducted: Annexure B

i. At sponsoring institutions
ii. In other institution of the country
iii. Other countries: Annexure IV

10. Technical Programme

Items of Investigation

- Standardization of irrigation schedule.
- Identification and evaluation of different cropping /farming systems.
- Studies on planting methods and land configuration.
- Development of Decision Support Systems and its validation

11. Facilities Available:

Equipments/instruments/ apparatus:

1. Farm Machineries e.g. Rice transplanter, combine, Roto till drill etc.
2. CHNS Analyser
3. GCMS
4. Leaf Area Meter
5. SPAD
6. Temperature and Humidity Probe
7. CO_2 probe
8. Photosynthesis systems
9. Spectro-radiometer
10. Petty equipment

Area of experimental fields (hectares) Two Research Farm
Laboratory: Well-equipped Soil and Plant Physiology&Agromet-Lab
Other facilities: Irrigation Facility, Farm Machinaries, Already developed IFS model, Conference halls etc.

12. Additional facilities required:

Equipment & apparatus:
(1) Water meters for measuring the irrigation water
(2) Laser land leveler

(3) Zero till drill machine
(4) Conoweeder
(5) Tensio meter
(6) Hot air oven
(7) Digital weighing balance
(8) Petty implements and tools
Area of land for Experimentation (hectares): One Hectare

13. Duration: Two Years
*Detailed information with regard to Sr. No. 6, 7, 8 and 9 may be furnished separately as supplementary annexure.

14. Staff Requirements (Scientific, Technical etc.)
15. Estimation of Costs:
iii) Sr. Research Fellows: 5
iv) Other contractual services: As per requirement

16. Recurring and Non-recurring contingencies: Rs. 30 lakhs (details given below)

Recurring and Non-recurring contingencies	Year-I (2015-16)#
Capital	
Equipment/ Machinery	4.0
Revenue	
Contractual service (SRF 5 & other contractual services)	13.5
TA	1.5
Other recurring contingencies including institutional charges*	11.0
Total	**30.0**

***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.

Others

i. Receipts anticipated :Nil

UNDERTAKING

ii. Certified that:

i. The research work proposed in the Platform Project (Agri-CRP on Conservation Agriculture) 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:** 29.06.2015

Name: Mahendra Pal Singh Arya

Principal Investigator **Signature**

Name: Dr. Mahendra Pal Singh Arya

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 me 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
Rs. 6000000	-

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: 29/6/2015

Executive Authority of the Institution

DIRECTOR
ICAR-Indian Institute of Farming Systems Research
Modipuram, Meerut-250110 (U.P.)

Annexure A

Conservation Agriculture

Conservation agriculture strives to develop a balanced co-existence between rural and urban societies, based on increased urban awareness of the environmental benefits and services provided by the rural sector. It works with the international and national market place to develop financial mechanisms to ensure that environmental benefits provided by CA are recognized by society at large, and benefits accrued to CA practitioners. A recent example is the marketing of carbon credits under the Kyoto Accord, but this is only the beginning. Many other opportunities for environmental payments will develop in the future, including the potential for farm products produced under a new "conservation label". The rapid adoption of conservation technologies by large as well as small farmers in many areas of the world, often without government support, is clear evidence of the economic, environmental and social benefits that accrue from these practices. The principles of CA and the activities to be supported are described as follows:

- *Maintaining permanent soil cover and promoting minimal mechanical disturbance of soil through zero tillage systems, to ensure sufficient living and/or residual biomass to enhance soil and water conservation and control soil erosion.* In turn, this improves soil aggregation, improves soil biological activity and soil biodiversity, improves water quality, and increases soil carbon sequestration. Also, it enhances water infiltration, improves soil water use efficiency, and provides increased insurance against drought. Permanent soil cover is maintained during crop growth phases as well as during fallow periods, using cover crops and maintaining residues on the surface;
- *Promoting a healthy, living soil through crop rotations, cover crops, and the use of integrated pest management technologies.* These practices reduce requirements for pesticides and herbicides, control off-site pollution, and enhance biodiversity. The objective is to complement natural soil biodiversity and to create a healthy soil microenvironment that is naturally aerated, better able to receive, hold and supply plant available water, provides enhanced nutrient cycling, and better able to decompose and mitigate pollutants. Crop rotations and associations can be in the form of crop sequences, relay cropping, and mixed crops;
- *Promoting the application of fertilizers, pesticides, herbicides, and fungicides in balance with crop requirements.* This principle is based on feeding the soil rather than fertilizing the crop. The strategy is to reduce chemical pollution of the environment, improve water quality, and maintain the natural ecological integrity of the soil, while optimizing crop productivity and the economic returns;
- *Promoting precision placement of crop inputs to reduce input costs, optimize efficiency of operations, and prevent environmental damage.* This principle is based on treating the problems at the field location where they occur, rather than blanket treatment of the field, as with conventional systems. The benefits are increased economic and field operation efficiencies, improved environmental protection, and reduced (optimized) input costs. Precision is exercised at many levels: seed, fertilizer and spray placement; permanent wheel placement to stop random compaction; individual weed killing with spot-spraying rather than field spraying, etc. Global positioning systems are sometimes used to enhance precision, but farmer sensibility in problem diagnosis and precise placement of treatments is the principal basis. In small scale farming systems and horticultural systems, it also includes differential plantings on hills and ridges to optimize soil moisture and sunshine conditions;
- *Promoting legume fallows (including herbaceous and tree fallows where suitable), as well as promoting composting and the use of manures and other organic soil amendments.* This improves soil structure and biodiversity, and reduces the need for inorganic fertilizers;
- *Promoting agroforestry for fiber, fruit and medicinal purposes.* Agroforestry (trees on farms) provides many opportunities for value added production, particularly in tropical regions, but these technologies are also used as living contour hedges for erosion control, to conserve and enhance biodiversity, and to promote soil carbon sequestration.

FAO also defines CA with the following quantifying parameters

1. Minimum soil disturbance: the disturbed area must be less than 15 cm wide or 25 per cent of the cropped area (whichever is lower); no periodic tillage disturbs a great area than the aforementioned limit.

2. Soil cover: three categories are distinguished; between 30-60 per cent, 61-90 per cent and 91+ per cent ground cover, measured immediately after the planting operation; ground cover less than 30 per cent will not be considered conservation agriculture.

3. Crop rotation: the rotation should involve at least three different crops.

4. Minimum tillage is necessary but it has to be combined with at least two complementary practices which are soil cover and diversified crop rotations. Only the combination of these techniques with their synergistic effect can lead to a sustainable, resource saving CA model

Tillage management practices with minimal soil disturbance and incorporation of crop residues decrease soil carbon losses through enhanced decomposition and reduced erosion. Systems that retain crop residues tend to increase soil carbon because these residues are the precursors of soil organic matter. For example, conservation tillage which leaves at least 30% of ground covered by crop residue mulch during seedbed preparation, increases soil organic carbon content when land is converted from conventional (plough-based) use.

Reduced tillage is another conservation tillage achieved by minimum disturbance of the soil in areas where seeds will be planted, either in rows or planting holes or small basins. Reduced tillage evolved in attempt to solve some disadvantages of NT systems, and improve root growth and penetration and water infiltration while maintaining surface mulch and slow down decomposition of organic residues. Reduce tillage can be achieved through:

Ripping is the most popularly advocated conservation tillage technology in tropical soils. Ripping is achieved by using a ripper that breaks clogs along the planting rows, leaving the spacing between rows undisturbed. The ripped area also acts as micro-catchment to collect rainfall water and increase infiltration. Ripping can be done by using tractors or oxen.

Small Planting basin is reduced tillage practices where the farm is cultivated in small fixed/permanent basins with 30-cm long and 20-cm deep, using narrow, deep and strong hand-hoes. The basins are cultivated at 70 cm spacing along the planting rows and 90 cm apart between rows to form rows of small basins. Seeding and fertilizer application is done in each basin. For maize 8, to 10 seeds are planted in a basin, while 10 to 20 seeds of beans are planted per basin. The basins are the only spot where soil is disturbed, hence helps to conserve soil and moisture. The basins also act as in situ rainwater harvesting and store water in the soil profile.

Increased nutrient uptake and N use efficiency across a wide range of rice growing environments with diverse climatic conditions were related to the effects of improved N management and balanced nutrition, an important impact of conservation agriculture. A major challenge is to simplify the approach for wider scale dissemination without sacrificing components that are crucial to its success. The underlying principles of SSNM need to be carefully identified and evaluated for each macronutrient. Approaches to further dissemination must be related to prevailing site-specific conditions.

Annexure B

Research Work Conducted

i. *At sponsoring institutions:*

- ✓ Identification of bio-intensive, complementary cropping systems for high productivity and efficient resource use
- ✓ Resource conservation and sustaining high productivity through cropping system management and land configuration
- ✓ Long Term influence of Resource Conservation Technologies and crop Residue Management Practices on Crop Productivity, water requirement and soil health in Rice-Wheat cropping system.
- ✓ Long Term influence of Resource Conservation Technologies on Crop Productivity, weed management, water use and soil health in Rice-Wheat cropping system.
- ✓ Long Term influence of Resource Conservation Technologies on Crop Residue Management practices on crop productivity and soil health in Rice-Wheat cropping system
- ✓ Development of low-cost multi tillage, multi-crop planter for round grain cereals, legumes and pulses.
- ✓ Resource conservation modules for high yield realization for different cropping systems
- ✓ Studies on improvement of soil organic carbon pool in rice-wheat system under resource conservation technology
- ✓ Conservation agriculture based weed management practices in rice-wheat cropping system

II. *In other Institution of the country (India)*

Conservation Agriculture is a concept for resource saving agricultural crop production to achieve sustained production and conserving the environment. Function of conservation agriculture is based on three key principles, viz. effective resource conservation, input optimization and optimum productivity of the farming system (Nagarajan et al., 2013). Certainly, the advancement in conservation agriculture is possible through genetic improvement in crops and varieties, which are suitable for better adaptation to different farming system environments. Besides, improved varieties and technologies can be assumed to improve productivity with an optimized input level. In the case of rice, resource conservation is possible with proper technological intervention. Water is the one of the most important factor, which governs the productivity of rice. In the concept of conservation agriculture, rice growing systems such as aerobic rice, direct seeded rice, system of rice cultivation and alternate wetting and drying could be used to conserve water. Several problems come to exist in rice growing environment under limited water such as pest, disease and weeds, which may reduce productivity.

Conservation agriculture helps in sequestering atmospheric carbon in soil-plant system through change in agricultural operations and management practices. Conservation tillage along with efficient management of inputs, viz. irrigation, fertilizer and pesticides facilitates carbon sequestration in soil-plant system. Land use change and conventional agricultural practices are major contributors to global annual emission of CO_2. Conservation agriculture and recommended management practices (RMPs) collectively are helpful to offset part of the emissions due to unscientific agricultural practices.

Based on average benefits of all conservation tillage systems, the carbon sequestration potential of adopting a conservation tillage system is about 0.15 t/ha (Lal 1997, b). Adoption of reduced tillage may also save fossil fuels at the rate of about 8 KgC/ha/year.

Zero tillage, strip till drill, bed planter and rotary till drill saved 60-85 per cent resources in rice – wheat system (Singh, 2012). Zero tillage is conservation tillage achieved by no soil disturbance. Hence planting is done by no-till planter capable of placing seeds at appropriate depth in the soil and ensures adequate seed-soil contact required for germination. The advantage of NT is that it ensures surface soil cover by leaving residue on the surface, conserve soil moisture, and increase SOM in the top soil. However, NT in compacted soil hinders root development after seed germination especially during first years of no till, and reduced infiltration at early stages of NT. Weed pressure is also a problem in case the surface mulching is low in NT system. In the zero tillage or NT practices weed control depends solely on herbicides. The grain yields of rice were not significant with tillage. Zero-till wheat (Sah et al. 2013), however, produced significantly higher grain yield (2777 kg ha^{-1}) than permanent bed planting (2438 kgha-1) and conventional tillage (2499 kgha-1). It is not only on the part of saving energy but zero tillage helps in increasing cropping intensity thus improving carbon sink. As a successful example ICAR Research Complex for NEH Region, Meghalaya (ICAR report) introduced vegetable garden pea after rice using zero tillage technology in Nongthymmai village where farmers leave rice field fallow during rabi season mainly owing to lack of irrigation facilities.Efficient nutrient management of macronutrients increased yields of rice and wheat crops by 12 and 17% and profitability by 14 and 13%, respectively, in Northwest India (Khurana et al., 2008). Results suggest that further increases in yield can only be expected when farmers exploit the synergy that occurs when all aspects of crop, nutrient, and pest management are improved simultaneously.

III. **Other countries**

Historically, invention of cultivation implements such as mouldboard in the 11th century in Europe, followed by agricultural mechanization using tractors with multiple implements by early 1900 enable intensive cultivation in many agricultural soils in Europe and America. However, between 1931 and 1939, a dust bowl era took away precious top soil, which was made vulnerable by ploughing, was witnessed in the southern plain of US resulting in farm degradation and crop failure (Huggins and Reganold, 2008). Thus, the need to reduce intensive cultivation and ensure soil cover was realized as early as in 1940's.The important practices of conservation of soil and water and improving rain/irrigation water have been summarized.

Conservation tillage is an important instrument that achieve minimum soil disturbance and leave organic residue on the surface of the soil to ensure at least 30% of surface soil cover (FAO, 1993). Conservation agriculture (CA) is a combination of wide range of tillage and cropping practices/technologies that aims at ensuring minimum soil disturbance, adequate soil cover, and mix or rotation of crops so as to reduce soil physical and chemical degradation (IIR and ACT, 2005). A combination of practices such as conservation tillage (reduced/minimum or zero tillage), mulching, intercropping, crop rotation are core in CA. Conservation agriculture hold great promise to break vicious cycle of poverty due low productivity and food insecurity caused by land degradation that makes the society vulnerable and hence poor. The entry point to break the cycle is through CA's positive impact on preventing/reducing land degradation to form a sustainable and viable production system that will improve livelihood of many rural communities in Africa. The CA core technologies/practices include:

The agricultural soil is usually disturbed by tilling or cultivating so as to loosen up the soil to enable easy root penetration and water infiltration for adequate crop growth. Other advantages of soil disturbance is discouraging weeds growth and reduce weed competition with crops at early stages of crop development. However, too much soil disturbance and inappropriate tillage methods has led to excessive removal of soil surface cover, destruction of soil structure and compaction, rapid losses of SOM and susceptibility to water and wind erosion during early stages of before full canopy cover.

Residue management is key to maintaining soil C in annual crops. Early estimates (Graham et al. 2007) suggested that, on average, about 55% of the stover produced by the U.S. corn crop could be harvested without risk of erosion were no-till management widely adopted. Erosion, however, is not the sole arbiter of soil C levels—recent evidence (Wilhelm et al. 2007) suggests that only about a third of this amount can be harvested if soil C stocks are to be maintained. Removing even this amount, however, is likely to be insufficient to sequester additional C, so the fossil fuel offset credit of harvested residue must be carefully compared to the lost soil sequestration benefit, particularly if the prior system was accumulating soil C via no-till or set-aside management. Furthermore, the need to replace nutrients removed in residues, through increasing fertilizer additions, is an additional consideration.

Conservation tillage and no-tillage practices could provide higher C sequestration. It was found that a change from conventional tillage to no tillage could sequester from 0.43 to 0.71 Mg C ha−1 year−1 In an experiment conducted in Saskatchewan by Malhi and Lemke (2007), N_2O emissions were significantly lower from no-tillage (155 g N ha−1) than the conventional tillage (398 g N ha−1) treatments in the third year of the study. Rochette et al. (2008) summarized the effect of no tillage on N_2O emission and concluded that the net impact of the no-tillage on N_2O emission to be highly dependent on local environment (i.e. climate, soil type). In addition, the lower farm operation from no-tillage practices could further improve the net GHG. Although, in long term, the C sequestration return diminishes, CO_2 emissions are directly reduced since tillage fuel consumption is the greatest proportion of farming activity (Johnson et al. 2007) and Singh (2012) also reported a reduction of around 70 kg CO^2 emission by zero tillage over conventional sowing.

Integrating perennial trees/shrubs plants in agricultural lands both crop production and grazing has been documented to improve soil cover, and ensure green cover during off season. In so doing trees/shrubs in agricultural land helps to curb land degradation and conserve biodiversity to create a resilient land use that adapt and mitigate climate change (Kitalyi et al., 2011). This technology when integrated in crop land has to be done in such a way that light competition or shading effect between trees and crops is avoided. Thus, careful selection of trees with low shading effect and planting at the border of the farms preferably on the south-north borders is recommended. Trees can also be planted in areas of the farms that are highly vulnerable to soil degradation such as on steep slopes, soil bunds of terraces, and near water sources. Alley cropping can also be done, where trees are planted in alleys between crop fields.

Fertilizer trees capable of fixing atmospheric nitrogen and with multipurpose use such as Sesbaniasesban, Crotalaria grahamiana and Tephrosiavogelii are recommended and have been successful used in Kenya and Tanzania (Kitalyi et al., 2011). The World Agroforestry Center has developed four fertilizer trees options to improve soil fertility in the crop land. These fertilizer tree options includes fertilizer trees during fallow in rotations with cereal crops, intercropping fertilizer trees as coppiced fallow and cereals, intercropping shrubs in annual allay with cereals, and harvesting Gliricidia or Tithonia trees/shrubs leaves and apply them in crop land as mulch, green manure or compost (biomass transfer).

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CAPP-3

Format for Application for Agri-CRP Projects

1. **Title of Platform**: Consortium Research Platform (CRP) on Conservation Agriculture (CA)

2. **Title of the Platform Project**: Development, refinement and validation of conservation agriculture (CA) in Vertisols of central India and quantifying impact of CA practices on soil and environment.

3. Location

Institute's Name:	ICAR- Indian Institute of Soil Science
Place:	Bhopal
District:	Bhopal
State:	Madhya Pradesh

4. Project Principal Investigator: Dr. K.M.Hati

5. Co-Project Principal Investigators: Drs. A.K. Viswakarma, J. Somasundaram, Sanjay Srivastava & Pramod Jha

7. Objectives (in brief):

- To identify best tillage, water and nutrient management practice under CA
- To quantify changes in soil quality parameters, nutrient dynamics, carbon sequestration and green house gas emissions under conservation agriculture
- Budgeting nutrient, water & energy use under CA

The objectives will be fulfilled through the subprojects give below:

Sub-project-1: Demonstration of Best-Bet Conservation Agriculture Practices on Farmers'Fields in Vertisols of Central India.

Objectives:

1. To evaluate conservation agriculture practices for crop productivity and profitability in farmer's field.
2. To identify the best conservation agriculture practices.
3. To create awareness about conservation agriculture practices among farming community.

Co-PPI : Dr. A.K. Viswakarma

Collaborative Investigator (CI): Drs. RH Wanjari , R.K. Singh, KC Shinogi & AK Tripathi

Sub-project-2: Fine-tuning of Conservation Agricultural Practices for Vertisols of Central India

Objectives:

1. To identify and evaluate potential cropping systems and conservation tillage practices best suited for the Vertisols of central India
2. To formulate suitable weed management options for major cropping systems
3. Refinement and validation of component technologies of conservation agriculture.

Co-PPI : Dr. J Somasundaram
CI : Drs. K Ramesh, S. Ramana, B.P. Meena & Abhay Sirale

Sub-project-3: Development of Water and Nutrient Management Practices in Conservation Agriculture for Vertisols of Central India.

Objectives:

1. Studying root behavior and nutrient dynamics at different moisture regimes under CA
2. Quantifying water & nutrient use efficiencies, nutrient, water & energy budget under CA
3. Identifying the best water and nutrient management practices under CA

Co- PPI : Dr. S. Srivastava
CI : Drs. K.V. Ramana Rao, I Rashmi & N. K. Sinha

Sub-project-4: Impact of Conservation Agricultural Practices on Soil Health, Carbon Sequestration and Green House Gas Emissions in Different Production Systems

Objectives:

1. To quantify the changes in soil quality parameters (physical, chemical and biological) under CA
2. To study soil organic carbon dynamics, stabilization and stratification under CA
3. To quantify green house gases emissions under CA

Co-PPI : Dr. Pramod Jha
CI : Drs. B.L. Lakaria, M. Mohanty, J.K. Thakur & Kola Bharati

8. Practical/Scientific Utility:

- Residue management and quantification for a sustainable soil environment management.
- Potential cropping systems and conservation tillage practices best suited to the agro-ecological settings.
- 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 for CA would be developed.
- Weed dynamics would be evaluated and management options would be recommended for different CA systems.
- Key microbiological properties would be evaluated and soil health indicators would be identified.
- Development of optimum nutrient management practices under conservation agriculture suitable to different water management practices and soil moisture regimes.
- A resilient agriculture practice bringing substantial economic (low cost of agrochemicals and high productivity), environmental (reduced soil degradation, greenhouse gas emission and N leaching) as well as social benefits.
- Improved soil health for sustainable farming system.

9. Research work conducted

i. At sponsoring institutions:

A long-term tillage experiment on soybean-wheat system conducted at IISS, Bhopal showed that productivity of soybean and wheat did not differ significantly in conservation tillage systems compared to conventional tillage system indicating a sustainable benefit of no tillage system. Root length density of soybean at top 15 cm depth was higher in NT and RT than in MB and CT. An improvement in selected soil physical properties like soil water storage, bulk density, aggregate stability, penetration resistance and saturated hydraulic conductivity (Ks) were recorded in NT and RT than CT. Soil organic carbon (SOC) and also the aggregate associated carbon content at 0-15 cm depth were significantly higher in NT, and RT where wheat residues were left after harvest than that in CT system after ten years of cropping. It is concluded that no tillage and reduced tillage systems with management of residues and recommended rate of N for soybean-wheat system would be a suitable practice for sustainable production of soybean-wheat cropping system in Vertisols of central India (Hati et al., 2014). Another experiment conducted at the institute showed that the wheat residue incorporation or retention coupled with application of 28 kg N ha^{-1} through fertilizer or organic manures is more beneficial than burning in terms of enhanced crop productivity and soil fertility. Wheat residue incorporation resulted in 20–22% higher yields in soybean and 15-25% in wheat as compared to residue burning. Soil incorporation of wheat residue plus N supplementation through FYM at the rate of 28 kg N ha-1 (approx. 4 t FYM ha-1) along with 25 kg P ha-1 for rainfed soybean and 68 kg N + 30 kg P ha-1 for irrigated (1+ 2 irrigations) wheat was more effective and profitable. Soil carbon saturation and stabilization/measurement of green house gas emissions/soil quality and health monitoring were also studied.

ii. In other institution of the country:

Unlike, in the rest of the world, in India spread of CA technologies is taking place in the irrigated regions in the Indo-Gangetic plains where rice-wheat cropping system dominates. CA systems have not been extensively tried or promoted in other major agro-ecoregions like rainfed semi-arid tropics, the arid regions or the mountain agro-ecosystems. Considering the severe problems of land degradation due to runoff induced soil erosion, rainfed areas particularly in arid and semi-arid regions require the practice of CA more than the irrigated areas in order to ensure a sustainable production (Venkateswarlu et al., 2009). In India, efforts to adopt and promote resource conservation technologies have been underway for more than a decade, but it is only in the past 6-8 years that technologies are finding acceptance by the farmers particularly in the Indo-Gangetic plains under the aegis of Rice-Wheat Consortium (Abrol and Sangar, 2006). 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). 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 – 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 an improvement in the 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). Persistent use of conventional tillage (CT) practice with extensive tillage and burning of crop residues had 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).

CA improves soil penetration ratio (SPR) and water stable aggregates; reduces mechanical impedance; increases infiltration, reduces erosion and increases WUE, provides a conducive root environment through enhanced root-moisture interaction, and decreases soil temperatures (Gathala *et al*., 2011, Saharawat *et al*., 2009). 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). Conservation agriculture and conservation tillage practices improved soil aggregation, aggregate associated C and N

(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).

The overall objective of CA is to enhance the productivity and sustainability of farming systems as well as maintaining the soil health. Hence, the investigation should be focused, among other things, to the individual and interactive effects of conservation tillage practices, residue management, crop rotations, nutrient and water inputs on nutrient use efficiencies. Also, nutrient management practices in CA systems cannot be reduced to simple physical input-output model. While there is much new work that needs to be done to formulate nutrient management strategies in CA systems, all such strategies would need to ensure that soil health becomes the means of meeting crop nutrient needs in an optimum and cost-effective way within the prevailing ecological and socio-economic conditions.

10. Technical Programme:

Field experiments will be conducted both in farmers field and institute farm to evaluate cropping systems, conservation tillage practices, nutrient and weed management options under conservation agriculture most suitable for the Vertisols of the central India.

Items of Investigation:

(i) Assessment of the performance of proven CA practices under farmers' fields and fine tune these practices for large scale adoption.
(ii) Estimation of the influence of CA practices on crop productivity and soil properties under different cropping systems.
(iii) Crop growth parameters like biomass, LAI will be recorded at periodic intervals
(iv) Monitoring of the soil hydro-thermal regimes
(v) Quantification of residue addition in the component systems
(vi) Dynamics of the soil physical, chemical and biological properties under tillage and crop rotation regimes

(vii) Weed dynamics, weed shift and weed seed stratification
(viii) Yield and yield attributing parameters of the component crops
(ix) Energy budgeting, system productivity and profitability
(x) Soil fertility parameters during crop growth and after harvest of each crop
(xi) Nutrient and water uptake studies
(xii) Root characteristics and physiological parameters
(xiii) Nutrient, water, and energy budgeting under different systems of CA
(xiv) Biomass removal under different treatments
(xv) Computation of soil test based nutrient recommendations
(xvi) Development of customized formulation of nutrients
(xvii) Soil carbon storage and budgeting, green house gas emissions, soil quality

11. Facilities Available:

Equipments/instruments/ apparatus:

The institute laboratories are well equipped with ICP, GC, NIR, Spectrophotometer, N Distillation System, pH, EC meter, TOC analyzer, BOD, Environmental Shaker, Media Distributor, Centrifuge, **Wet Sieve Apparatus, Infiltrometer, Pressure Plate Apparatus, Penetrometer, Moisture meter** and other basic facilities. The institute Central Lab has Atomic Absorption Spectrophotometer, Flow Injection Auto Analyzer, UV- Visible Spectrophotometer and CHNS Analyzer.

Area of experimental fields (hectares):

The Institute developed its campus and experimental farm on a consolidated block of 50-hectare. Out of which 33 hectare of land is under cultivation with different field crops like soybean, wheat, mustard, chickpea, lentil, etc and horticultural crops like mango, guava, aonla, pomegranate etc. The farm has 4 water harvesting ponds which supply water for rabi season crops. Besides this 10 hectares agricultural field will be selected in progressive farmer's field and participatory research will be conducted on those farmers field.

Laboratory: Four fully equipped laboratories, one referral lab and one central lab is available in the institute

Other facilities: (1) Training hostel
(2) Subject matter specialist
(3) Administrative and technical man power

12. Additional facilities required:
Equipment & apparatus:

1) Turbo Happy Seeder – 3 nos.
2) Strip till seed drill - one

3) Sprayers - 4 Nos
4) Inclined Plate Planter with Herbicide Application Unit
5) Drip irrigation including overhead: one
6) Pump set: 3 HP: one
7) Microsprinkler: one
8) Storage tanks : 30000 L total capacity
9) Ventury fertigation: One

Area of land for Experimentation (hectares):
Laboratory: Already available
Office facilities: Already available

13. Duration: 2 years

14. Staff Requirements (Scientific, Technical etc.):

Designation of Post: NIL: Number of Post: NA: Scale of Pay: NA: Qualification Prescribed: NA
Designation of Post: Senior Research fellow (SRF)
Number of Post: 8

15. Estimation of Costs (2015-16):

Jr. Research Fellow:	NIL
Sr. Research Fellows:	Rs. 19.6 lakhs for eight SRFs
Research Associate:	NIL
Other Contractual Staff:	Rs. 5.4 lakhs

16. Recurring and Non-recurring contingencies: Rs. 55 lakhs (Details given below)

Recurring and Non-recurring contingencies	**Year-I (2015-16)#**
Capital	
Equipment/ Machinery/Apparatus/ Misc. items@	10.0
Revenue	
Contractual service (SRF 8 & other contractual services)	25.0
TA	2.0
Other recurring contingencies including institutional charges*	18.0
Total	**55.0**

***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 project

17. Receipts anticipated: Produce obtained from the experimental fields

UNDERTAKING

18. Certified that:

v. The research work proposed in the **Platform Project on Conservation Agriculture** does not in any way duplicate the research work already done and being carried out elsewhere on the subject.

vi. 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.

vii. 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.

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

Principal Investigator

KMHati

Signature

Name: Dr. K.M. Hati

Certified that:

x. Project is in line with the approved mandate of the implanting institute.

xi. Platform Project Investigator/ Co-investigators are competent technically to undertake the project.

xii. Research work will not amount to duplication of efforts and In-house projects, handled by me will not suffer.

xiii. 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.

xiv. 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.

xv. The cost of equipment and other infrastructure requested for under the project is realistic and based on the prevailing market rates.

xvi. Justifications and clear specifications for the equipment and other infrastructure asked for are reflected in the proposal.

xvii. 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.

xviii. 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: 10/7/15

Executive Authority of the Institution

Dr. Ashok K. Patra
Director
Indian Institute of Soil Science (I.C.A.R.)
Nabi Bagh, Berasia Road, BHOPAL-462 038 (M.P.)

CAPP-4

Format for Application for Agri-CRP Projects

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
Institute's 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

iii) 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 – 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.

iv) 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).

v) 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	√	√	
• Demonstration of CA based production systems in 2 irrigated cropping systems in 2 districts and 3 villages	√	√	√
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	√	√	√
• Component technology generation on crop management (after evaluating nutrient, water, energy use efficiencies and crop productivity)		√	√
Objective 3			
• Studies on crop & water productivity, energy budgeting, weed dynamics, input-use efficiency and benefit-cost economics of novel CA-based systems	√	√	√
• Studies on mean C input, C-sequestration, microbiological properties, soil physico-chemical health and nutrient management protocols	√	√	√

Objective 4			
• Farmers trainings towards adopting CA practices		√	√
• Report writing, presenting data at national forum, publishing in peer reviewed journals	√	√	√

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:

x. Project is in line with the approved mandate of the implanting institute.

xi. Platform Project Investigator/ Co-investigators are competent technically to undertake the project.

xii. Research work will not amount to duplication of efforts and In-house projects, handled by them will not suffer.

xiii. 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.

xiv. 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.

xv. The cost of equipment and other infrastructure requested for under the project is realistic and based on the prevailing market rates.

xvi. Justifications and clear specifications for the equipment and other infrastructure asked for are reflected in the proposal.

xvii. 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.

xviii. 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: 7. 7. 2015

Executive Authority of the Institution

Joint Director (Research)
Indian Agricultural Research Institute
New Delhi-110012

CAPP-5

Format for Application for Agri-CRP Projects

1) Title of Platform: **Consortium Research Platform (CRP) on Conservation Agriculture (CA)**

2) Title of the Platform Project: Adoption/development agriculture machinery for conservation agriculture

3) Location
Institute's Name: ICAR- Central Institute of Agricultural Engineering
Place: Nabibagh, Berasia Road
District: Bhopal
State: Madhya Pradesh

4) Principal Investigator (PI)
Name: Dr. R. C. Singh
Designation: Principal Scientist (FM&P) and Head, Agricultural Energy and Power Division
Date of Birth: 10/11/1956
Experience: (Years): 25 years

5) Co-Principal Investigator (PI)
Name: Dushyant Singh
Designation: Senior Scientist (Mech. Engg.)
Date of Birth: 28 July 1970
Experience: (Years) 15 Years
Number of Scheme handled: projects 18 Nos.
Number of important research publications: 22
Number of other Research Schemes (being carried out by PI): PI -1 Co-PI -1
Title of Scheme (s) PI, AICRP on Energy in Agriculture and Agro-based Industries (EAAI)
Name of the funding Agency: ICAR)
Period 2011 to continue Grant:

6) *Collaborative Investigator (s) (separate set for each)
Name: K. P. Saha
Designation: Senior Scientist (Agril. Economics)
Date of Birth: October 01, 1973
Experience: 16 (Sixteen) Years
Number of research publications: 18 Nos.
Number of other Research Schemes (being carried out by PI)
Title of Scheme (S) ________Nil____ (30 Chrs)
Name of the funding Agency: ____ (30 Chrs)
Period from________________ to _______________________Grant: __________Rs.

7) *Objectives (in brief):

- Adaptation/ development and validation of location specific CA machinery for different cropping systems.
- Capacity building and knowledge management for accelerated adoption of conservation agriculture machinery.

8) *Practical/Scientific Utility:

As conservation technologies are useful for breakthrough for sustaining productivity, natural resource conservation, energy productivity with economic growth of the farmers. These practices enhanced the productivity and improve the soil health at lower input cost by reducing the use of seed and fertilizer by 20-30% and saving in use of chemicals by 20-30% with timeliness in operation, reduction in compaction of soil, fuel usage, and energy demand by 20-40 %, production cost and GHG emission. They are also helpful in improvement in water productivity by saving in irrigation water by 30-40 %, soil drainage and avoiding the sponge effect created by normal cultivation. It is estimated that total saving in cultivation cost is Rs. 1500-2000 per ha in CA as compared to conventional agriculture. Most of the equipments and technologies required for conservation agriculture are available and the need is only to develop a few new or fine tune the existing machine as per requirement and their promotion for specific situations and cropping systems such as an improvement upon zero-tillage can come if crops are grown on ridge-and-furrow planting configuration: farmers shift to a permanent bed system, i.e., zero/minimum-tilled crops on bed condition and package of equipment and technology for seeding/planting under crop residues (mulching and incorporated condition). Studied carried out by various researchers at different places for various crops has indicated that use of conservation agricultural machines like laser guided land leveler, no till drill, permanent bed former cum seeder/planter, rotary slit drill and happy seeder has enhanced the soil health, water and energy productivity, profitability with sustained productivity of crops.

9) *Research work conducted

iv. At sponsoring institutions:

- Adaptation/development of zero till drill for sowing in heavy residue condition
- Adaptation of no till planter cum herbicide applicator
- Adaptation/development of bed shaper cum no till seed cum fertilizer drill
- Adaptation/development of stubble saver for mulching of crop residue.
- Operational demonstration of conservation agricultural machinery
-

v. In other institution of the country:

- Fine tuning of location specific existing CA machinery based on cropping system.

vi. Other countries: NA

vii. Technical Programme:

Items of Investigation:

- Identify promising CA machineries from existing experiments.
- Fine-tuning the existing CA machinery and developing need based CA machinery
- Validation and refinement of developed machinery/equipment if required.

- Identify training needs and conduct the training on CA machinery system for project staffs and stakeholders.
- Centre of excellence on CA machinery system for training.

10) Facilities Available:

Equipments/instruments/apparatus:

- TD Rotary slit no till drill
- TD No till drill
- TD Variable depth fertilizer applicator
- TD Rotary broad bed former cum seeder/planter
- TD Planter cum pre-emergence herbicide strip applicator
- TD Aero blast sprayer
- TD Vertical conveyer reaper
- TD Straw reaper with trailer
- Animal drawn single row no till drill
- Bio-char production system

Laboratory:

(1) Seeding planting laboratory.
(2) Plant protection laboratory.
(3) Soil-bin testing facilities
(4) Tillage: soil engineering properties
5) Farm machinery testing centre
(6) Farm power testing laboratory

Other facilities:

- Workshop and Prototype Production Centre
- TOC analyzer

11) Additional facilities required:

Equipment & apparatus:

(1) CA Machineries and tractor
(2) Sensors and video Camera

Office facilities: Information technology, computers, printer and furniture

12) Duration: 2 years

*Detailed information with regard to Sr. No. 6, 7, 8 and 9 may be furnished separately as supplementary annexure.

13) Estimation of Costs:

v) Sr. Research Fellows: 3 Nos.
vi) JRF (Sr. Mechanic) 2 Nos.
vii) Office /computer assistant 1 No
i) Other contractual services: As per requirement

14) **Recurring and Non-recurring contingencies: Rs. 25 lakhs (details given below)**

Recurring and Non-recurring contingencies	Year-I (2015-16)#
Capital	
Equipment/ Machinery	5.0
Revenue	
Contractual service (SRF 3 & other contractual services)	11.0
TA	1.0
Other recurring contingencies (Miscellaneous) including Institutional charges*	8.0
Total	**25.0**

***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.

15) **Receipts anticipated**

Need based CA machinery

- Location specific CA machinery for different cropping systems
- Zero till drill cum pre-emergence herbicide applicator.
- Bed shaper cum planter with herbicide applicator.
- Awareness among stake holders about CA machinery

Centre of excellence on CA machinery system.

UNDERTAKING

10) Certified that:

v. The research work proposed in the Platform Project (**Platform Project on Conservation Agriculture**) does not in any way duplicate the research work already done and being carried out elsewhere on the subject.

vi. 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.

vii. 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.

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

Principal Investigator
Name , Dr. R. C. SINGH

Signature [signature] 27.6.2015

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 me 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: NA

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: 27/06/15

Executive Authority of the Institution

DIRECTOR
Central Institute of Agricultural Engineering
(I.C.A.R.)
Nabi Bagh, Berasia Road,
BHOPAL-462038 (M.P.)

CAPP-6

Format for Application for
Agri-CRP Projects

1) **Title of Platform:** ICAR Agri-Consortia Research Platform (Agri-CRP)

2) **Title of the Platform Project:** Development of integrated weed management techniques for conservation agriculture systems

3) **Location**
Institute's Name: ICAR - Directorate of Weed Research
Place: Jabalpur
District: Jabalpur
State: Madhya Pradesh

4) **Principal Investigator (PI)**
Name: Dr. A.R. Sharma____ (30 Chrs)
Designation: Director____ (30 Chrs)
Date of Birth: 13 April, 1960____ (30 Chrs)
Experience: (Years): 28 years____ (30 Chrs)
Number of Scheme handled: None
Number of important research publications: More than 150__________________ (30 Chrs each)
Number of other Research Schemes (being carried out by PI)
Title of Scheme (s): None ____ (30 Chrs)
Name of the funding Agency: Not applicable__________________________________ (30 Chrs)
Period from_______/__________________ to__________ Grant: Rs. Nil____________

5) **Co-Principal Investigator (PI)**
Name: Dr. Raghwendra Singh____ (30 Chrs)
Designation: Senior Scientist (Agronomy) __________________________________ (30 Chrs)
Date of Birth: 22.11.1975 (30 Chrs)
Experience: (Years) 15 Yrs
Number of Scheme handled: 2
Number of important research publications: 15 (30 Chrs each)
Number of other Research Schemes
Title of Scheme (s): ____ (30 Chrs)
Name of the funding Agency: ____ (30 Chrs)
Period from_________________________ to__________ Grant: Rs. ________________

6) ***Collaborative Investigator - 1**

Name: Mr. Dibakar Ghosh
Designation: Scientist (Agronomy)
Date of Birth: 25.01.1985
Experience: 3 ½ Years
Number of research publications: Nil
Number of other Research Schemes:
Title of Scheme (S) ____ (30 Chrs)
Name of the funding Agency: ____ (30 Chrs)
Period from_______________ to ______________________Grant: __________Rs.

Collaborative Investigator – 2

Name: Dr. (Mrs.) C. Sarathambal____ (30 Chrs)
Designation: Scientist (Microbiology) ___________________________________ (30 Chrs)
Date of Birth: 13-07-1983
Experience: 6 Years
Number of research publications: 15
Number of other Research Schemes:
Title of Scheme (S) ____ (30 Chrs)
Name of the funding Agency: ____ (30 Chrs)
Period from_______________ to ______________________Grant: __________Rs.

Collaborative Investigator – 3

Name: Dr. P.P. Choudhury
Designation: Senior Scientist (Residue Chemistry)
Date of Birth: 14.11.1963
Experience: 13 Years
Number of research publications: 22
Number of other Research Schemes: Nil
Title of Scheme (S) ____ (30 Chrs)
Name of the funding Agency: ____ (30 Chrs)
Period from_______________ to ______________________Grant: __________Rs.

Collaborative Investigator – 4

Name: Mr. Subhash Chander Singariya
Designation: Scientist (Economic Botany
Date of Birth: 14.08.1985
Experience: 1Year
Number of research publications: 3
Number of other Research Schemes: Nil
Title of Scheme (S) ____
Name of the funding Agency: ____)
Period from_______________ to ______________________Grant: __________Rs.

Collaborative Investigator – 5
Name: Dr. (Mrs.) Yogita Gharde____ (30 Chrs)
Designation: Scientist (Agricultural Statistics)______________________________ (30 Chrs)
Date of Birth: 04.01.1981
Experience: 4 ½ Years
Number of research publications: 8 Nos
Number of other Research Schemes:
Title of Scheme (S) ____ (30 Chrs)
Name of the funding Agency: ____ (30 Chrs)
Period from_______________ to ______________________Grant: __________Rs.

Collaborative Investigator – 6
Name: Dr. P.K. Singh____ (30 Chrs)
Designation: Principal Scientist (Agricultural Extension)___________________ (30 Chrs)
Date of Birth: 31.12.1964
Experience: 25 Years
Number of research publications: More than 60
Number of other Research Schemes:
(i)Title of Scheme (S) Socio-economic survey of maize growers in Karnataka and Bihar with special reference to weed management (30 Chrs)
Name of the funding Agency: Monsanto India (P)Limited (30 Chrs)
Period from 2006 to 2008 Grant: □ 10.0 Lakh.

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

- Study of weed dynamics and biology of major weeds in diversified cropping systems under conservation agriculture
- Development of efficient weed management technologies involving cultural, mechanical and chemical methods including new herbicide molecules, mixtures and rotations
- Monitoring of herbicide resistance in weeds, herbicide residues and soil health under long-term conservation agriculture systems
- Transfer of technology to the farmers

8) ***Practical/Scientific Utility:____(300** Chrs)

Conservation agriculture is a system designed to achieve agricultural sustainability by improving the biological functions of the agro-ecosystem with limited mechanical practices and judicious use of chemical inputs (FAO, 2010). It involves minimum soil disturbance, providing a soil cover through crop residues or other cover crops, diversification of species and sensible crop rotations. The conventional agricultural systems involve intensive tillage and these results in gradual decline in soil organic matter through accelerated oxidation and burning of crop residues. When the crop residues are retained on soil surface in combination with zero tillage, several changes occur that lead to improved soil quality and overall resource enhancement. Therefore, the conservation agriculture technologies lead to sustainable improvement in the efficient use of water and nutrients by improving nutrient balances and availability, infiltration and retention by soils reducing water losses, and improving the quality and availability of ground and surface water.

Weed control in agricultural crops was primarily achieved through mechanical cultivation of the soil. Since 1940s and 1950s, an increasing number of effective herbicide options, paired with tillage operations, have allowed farmers to significantly increase crop yields while reducing labour demands. Tillage influences weed infestation, and thus interactions between tillage and weed control practices are commonly observed in crop production. In response to continued soil depletion and other environmental impacts from agricultural production, conservation agriculture has been promoted as a means of maintaining high crop productivity and increasing economic potential while preserving natural resources and limiting future environmental damage. To achieve goals proposed with conservation agriculture, innovative weed control strategies including chemical methods are and will continue to be an essential component in the development of sustainable agricultural practices. An understanding of the fundamental components of conservation agriculture is imperative in order to appreciate the necessity for weed control strategies in these practices as well as the difficulties associated with their development. Therefore, it is necessary to identify the key components of conservation systems and the evaluation of herbicides within these practices, and secondly, the strategy for utilization of high residue cereal cover crop in conjunction with chemical weed control methods to address the changes in weed control requirements.

Despite both environmental and production advantages offered through conservation systems, adoption rates have previously lagged in many countries due to several factors including weed control issues. Although weed control in tilled systems is no small task, conservation agriculture systems have presented an even greater challenge to achieve the same results. Many weed species within agricultural settings are able to flourish when intense tillage operations are minimized. Therefore, conservation systems have been characterized by greater weed densities than conventionally-tilled agricultural productions. The shift from conventional tillage practices, where the soil is turned prior to planting, to conservation agriculture practices, where tillage is reduced to a minimum, can be particularly difficult with respect to weed control. Weed shift and herbicide-resistant weeds are already becoming more common on zero-till farms in some countries. Therefore, the continued adoption of zero-tillage based farming system is highly dependent on the development of new herbicide formulations and integrated weed management options.

Conservation agriculture systems are necessary to preserve agricultural productivity and meet future global food demands. To implement these systems, adequate weed control is crucial in their success. Herbicide use has been a valuable asset when adopting conservation practices; however, prudent use of chemical weed control is essential to fulfilling the goals of conservation agriculture, reducing detrimental environmental impact, and reducing herbicide resistance development. Further development and testing of alternative weed management practices that can be utilized along with herbicide applications must be pursued in order for conservation practices to remain successful. Hence, launching of a platform on conservation Agriculture by the ICAR is the most timely and innovative step for sustainability of Indian agriculture. Since weed management will be the key issue in conservation agriculture systems, it is proposed to initiate under this platform a project on "Development of integrated weed management techniques for conservation agriculture systems".

9) *Research work conducted

At sponsoring institutions:

A flagship programme on "Weed management under long-term conservation agriculture systems" has been launched at the Directorate since 2012. Following experiments have been conducted under this programme, which are continuing:

i. Weed management in rice-based cropping systems under conservation agriculture
ii. Weed management in maize-based cropping systems under conservation agriculture
iii. Weed management in soybean-based cropping systems under conservation agriculture

- Weed management in cotton-based cropping systems under conservation agriculture
- In other institutions of the country: At 17 centres of AICRP on Weed Management____(100 Chrs)
- Other countries: None____(100 Chrs)

10) Technical Programme: (100 Chrs)

Experiments will be conducted in the field, laboratory and greenhouse on different aspects including tillage, residue management, cover cropping, weed control and other production factors in diversified cropping systems. Detailed investigations will be made on crop performance, weed dynamics and soil health.

Major activities will be as follows:

- Appraisal of weed dynamics (density and diversity) and monitoring of weed flora shift in rice- and soybean- based cropping systems
- Assessment of growth behavior of prominent weeds and crops in rice- and soybean- based cropping systems
- Assessment of weed seed bank
- Evaluation of different mechanized seeding equipments on weed growth
- Estimation of yield and yield attributing characters of crops
- Development of IWM modules employing different methods
- Screening and evaluation of new herbicide molecules, herbicide combinations /rotations
- Studies on persistence and degradation of herbicides in soil environment.

- Monitoring of herbicide resistance in weeds
- Assessing herbicide residues in food chain
- Estimation of carbon sequestration
- Assessment of soil physico-chemical and biological properties
- The outcome (technologies emerged) will be demonstrated at the farmers field in large scale

11) Facilities Available:

- Laser levelller
- Happy Seeder
- CO_2 analyzer
- Nitrogen Auto Analyser
- LC-MS/MS

11) **Additional facilities required: Renovation of the laboratories of soil / plant analysis,** microbiology, and herbicide residues

12) Equipment & apparatus:

- CNS analyzer
- Soil CO_2 flux chamber
- Tractor, power sprayer and power weeder
- Seeding equipments, viz. happy seed drill, easy seed drill, zero-till drill, double disc planter and laser leveler etc. (One each)
- HPLC and its accessories and consumables for and GC, viz. Columns, solid phase extraction kits, etc
- Multi channel soil temperature measurement system
- Misc. equipments and accessories, viz. tensiometers, infiltrometer, penetrometer, RF stable access tubes for use with AquaPro moisture meter etc.

13) Duration: 3 years ____

14) Staff Requirements (Scientific, Technical etc.)

15) Designation of Post: Research Associates / Research Fellows________________

Number of Post: 5 (Agronomy / Weed Science – 2, Microbiology – 1, Soil Science / Organic Chemistry -1, Agricultural Economics / Extension – 1) ____________________

Scale of Pay: As per norms of the ICAR_____________________________________

Qualification Prescribed: M.Sc. or Ph.D. in the relevant subject_____________

16) Estimation of Costs:

viii) Sr. Research Fellows: 3

ix) Other contractual services: As per requirement

17) Recurring and Non-recurring contingencies: Rs.25.0 Lakhs

Recurring and Non-recurring contingencies	Year-I (2015-16)#
Capital	
Equipment/ Machinery/ Apparatus/ Misc. items[@]	3.0
Revenue	
Contractual service (SRF 3 & other contractual services)	11.0
TA	1.0
Other recurring contingencies including institutional charges*	10.0
Total	**25.0**

***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.

18) Receipts anticipated : □290.0 Lakhs

UNDERTAKING

19) Certified that:

- The research work proposed in the Platform Project (**Development of integrated weed management techniques for conservation agriculture systems**) does not in any way duplicate the research work already done and being carried out elsewhere on the subject.
- 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.
- 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.
- We undertake to abide by the guidelines provided by the Council for the implementation of the Platform Project.

Principal Investigator

Signature

Name: Dr. A. R. Sharma

Dr. Raghwendra Singh (Co-PI) ~~(on leave)~~

Mr. Dibakar Ghosh (CI) (on study leave)

Dr. (Mrs.) C. Sarathambal (CI)

Dr. P. P. Choudhury (CI)

Mr. Subhash Chander Singariya (CI)

Dr. (Mrs.) Yogita Gharde (CI)

Dr. P.K. Singh (CI)

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 me 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: 7/7/2015

Executive Authority of the Institution

<u>**CAPP-7**</u>

Format for Application for
Agri-CRP Projects

12) Title of Platform: **Consortium Research Platform (CRP) on Conservation Agricultural (CA)**

13) Title of the Platform Project: **Evaluation of Conservation Agricultural (CA) practices under Rice-fallow system of Eastern Region**

14) Location (Bihar, Jharkhand and Chhattisgarh)
    Institute's Name: ICAR Research Complex for Eastern Region
    Place: Patna
    District: Patna
    State: Bihar

15) Principal Investigator (PI)
    Name: Dr. J. S. Mishra
    Designation: Principal Scientist and Head, Division of Crop Research
    Date of Birth: 31-03-1967
    Experience: 25 years
    Number of Scheme handled: 03
    Number of important research publications: 90
    Number of other Research Schemes (being carried out by PI):02
    Title of Scheme (s)
    i. Cereal Systems Initiative for South Asia (CSISA)
    Name of the funding Agency: Bill & Melinda Gates Foundation/CIMMYT
    Period from: January 2013 to September; 2015 Grant: Rs. 33.00 lakhs
    ii. Improved Rice Rainfed-based Agricultural System (IRRAS)
    Name of the funding Agency: IRRI
    Period from April 2012 to September 2015; Grant: Rs. 27.00 Lakhs

5a. Co-Principal Investigator (Co-PI)
    Name: Dr. M. Idris
    Designation: Principal Scientist (Entomology)
    Date of Birth: 01-07-1958
    Experience: 28 Years
    Number of Scheme handled: 03
    Number of important research publications: 40
    Number of other Research Schemes (being carried out by Co-PI)
    Title of Scheme (s) Integrated Farming System
    Name of the funding Agency: ICAR
    Period from 2011 to 2015 Grant: Rs. 82.72 lakhs

5b. Co-Principal Investigator (Co-PI)
Name: Dr. S.K. Singh
Designation: Principal Scientist (Agronomy)
Date of Birth: 01-01-1958
Experience: (34 Years)
Number of Scheme handled: 10
Number of important research publications:40
Number of other Research Schemes (being carried out by Co-PI): 01
Title of Scheme (s) Sustainable and Resilient Farming System Intensification (SRFSI) in the Eastern Gangetic plains.
Name of the funding Agency: CIMMYT)
Period from 2014 to 2018 Grant: Rs. 1.80 Crores

6 A) *Collaborative Investigator (s) (separate set for each)

Name: Dr. BAL KRISHNA JHA
Designation: Senior Scientist (Horticulture)
Date of Birth: 15th June 1967
Experience: 17 Years
Number of research publications: 27 research papers in national and international journal, technical bulletins, book chapters and popular articles.
Number of other Research Schemes (being carried out by PI)
(1) Title of Scheme (S): Sustainable livelihood improvement through need based integrated farming system model in disadvantaged district of Bihar
(2) Name of the funding Agency: NAIP
Period from 2008 to 2013

(II) Title of Scheme (S): Standardization of planting geometry and growth stage based fertigation pattern for commercial cultivation of selected vegetables using drip irrigation system
Name of the funding Agency: NABARD
Period from 2012 to 2015, Grant: 21.0 lakhs

B) *Collaborative Investigator (s) (separate set for each)
Name: Dr. SUSHANTA KUMAR NAIK
Designation: Senior Scientist (Soil Science)
Date of Birth: 30th June 1975
Experience: 12 Years
Number of research publications: 47 research articles, 03 technical bulletins, 03 extension folders, 08 popular articles
Number of other Research Schemes (being carried out by PI)

Title of Scheme (S) Acid soil management by use of basic slag
Name of the funding Agency: Tata Steel, Jamshedpur
Period from August 2014 to August 2016 Grant: Rs 12.55 lakhs.

C) *Collaborative Investigator (s) (separate set for each)

Name: Dr. Santosh S. Mali
Designation: Scientist (SWCE)
Date of Birth: 4-03-1981
Experience: 08 Years
Number of research publications: 12 research papers in national and international journal, technical bulletins, book chapters and popular articles.

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

i. To develop, demonstrate and validate CA-based crop management technologies for improving the productivity of rice-fallows in rainfed ecosystems of eastern regions.

8 ***Practical/Scientific Utility**:

Soil and water are the two major limiting factors responsible for low productivity of crops in rice-fallows. Resource conservation technologies (RCTs) could be an appropriate approach to address the problems in rice-fallows. After harvesting of rice crop low moisture content in soil followed by fast decline in water table with the advancement of *rabi* season results in mid-and-terminal drought at flowering and reproductive stages adversely affects the productivity of crops in rice-fallows. Therefore, if crop residues are retained on the soil surface in combination with suitable planting techniques, it may alleviate terminal drought stress by conserving soil moisture and bring overall improvement in resource management. Zero tillage with minimum disturbance of soil and management of crop residues could lead to favourable effect on soil properties that further enhance the overall resource enhancement and productivity capacity in rice-fallows. This will also reduce cost of cultivation, and improved input-use efficiency making cultivation in rice-fallows more remunerative. Fodder (green/dry) scarcity for livestocks during *rabi* season is also an important issue in rice-fallows. Improving cropping intensity of rice-fallows may in-turn, help in meeting out the fodder requirement during lean period. The simple technologies like seed priming, spraying of 2% urea and micronutrients, etc., at vegetative stsges can substantially increase the productivity to remunerative levels for the resource-poor farmers in this difficult environment. Further, it is suggested that the RCTs can act as a catalyst for the introduction of further technologies that will permit reliable and profitable cultivation of post-rainy-season crops and thus improve the livelihoods of the rural population.

9 *Research work conducted

i. At sponsoring institutions:

In direct-seeded rice- fallow systems, different *rabi* crops were evaluated. Results revealed that linseed and mustard were found promising with 1-2 supplemental irrigations in Jharkhand. Under assured irrigation system, winter and summer vegetables like tomato, potato and brinjal (in winter); and cowpea, bottle gourd, okra, etc were found promising and remunerative in Ranchi district of Jharkhand. In north Bihar under low lying areas, surface seeding of wheat in transplanted rice is a common practice.

ii. In other institution of the country:

In rice-fallows, linseed was found more productive and remunerative at RAU, Pusa, Bihar (Thakur *et al*. 1997). At CRRI Cuttack, Rao *et al*. (1982) evaluated various *rabi* crops grown on residual moisture after harvest of rice on upland rainfed soil and found that safflower was the most remunerative followed by blackgram, lentil, mustard and niger. Kar *et al*. (2007) also found safflower as the most remunerative crop in rice-fallows in Orisa. Mulching with paddy straw and water hyacinth were found to increase the productivity of groundnut sown after rice (Chandra and Choubey, 2003). At IIPR, Kanpur, no-till drill for small farmers, having low purchasing power, was developed for line sowing in rice-fallow. This helped in more moisture retention as least soil disturbance occurred. By use of this no-till drill, the seeding was done timely at a reduced cost.

iii. Other countries

In north-western Bangladesh, chickpea is a promising post-wet-season crop to follow rainfed rice in the High Barind Tract. Yields in farmers' fields, however, remain low (<1 t ha^{-1}) primarily due to poor crop establishment, late sowing, and terminal drought and heat stress. Thirty trials were conducted entirely on residual soil moisture in farmers' fields. Seed priming (soacking of seeds overnight) significantly increased the seed yield by 47%. The priming response was attributed mainly to rapid seedling establishment, with higher plant stand and earlier crop maturity allowing escape from end-of-season stresses. Priming also reduced the incidence of stem and root diseases, and increased nodulation by native rhizobia.

10 Technical Programme:

Items of Investigation

i. Selection of appropriate rice varieties and management practices for successful introduction of *Rabi* crops.
ii. Construction of water harvesting reservoirs and farm ponds to provide life-saving irrigation.
iii. Mechanization of field operations.
iv. Scaling-up crop management practices like, tillage and plant population management, early maturing crop varieties, application of nutrients and weed

management, water management, mulching, relay cropping, foliar spray of nutrients, seed treatment, seed priming, inoculation with *Rhizobium*, insect-pest management, etc.

11 Facilities Available:

Equipments/instruments/ apparatus: (1) Nitrogen analyzer
(2) Flame photometer
(3) Atomic Absorption Spectrophotometer
(4) Muffle furnace
(5) Hot air oven
(6) pH meter
(7) EC meter
(8) Millipore water purification system
(9) Rotary shaker
(10) Hot plate

Area of experimental fields (hectares):

(a) **Bihar** (Patna, Vaishali and Gaya districts)
Farmer's field: 1.5 ha

(b) Jharkhand
Farmer's field at Jharkhand: 2.4 ha
ICAR-RCER, RC, Ranchi farm: 0.1 ha

(c) Chhattisgarh
Farmer's field at Chhattisgarh: 2.4 ha
Laboratory: Yes
Other facilities: (1) Tractor, cultivator, seed drill, disc harrow, disc plough.

12 Additional facilities required*:*

Equipment & apparatus:
(1) Soil moisture meter (1.0 lakh)
(2) Soil penetrometer (0.75 lakh)
(3) UV-VIS Spectrophotometer (5.0 lakhs)
(4) Wet sieving apparatus (0.80 lakh)
(5) Zero-Till seed-cum-fertilizer drill (02) (1.00 lakh)
(6) Happy/Turbo seeder (02) (2.50 lakh)
(7) Rotavator (02) (2.20 lakh)
(8) Plot seeder (02) (2.50 lakh)

13 **Duration**: 2 years (2015-16 to 2016-17)

*Detailed information with regard to Sr. No. 6, 7, 8 and 9 may be furnished separately as supplementary annexure.

19. Estimation of Costs:

x) Sr. Research Fellows: 3

xi) Field Assistant: 2

i) Other contractual services: As per requirement

14 Recurring and Non-recurring contingencies: Rs. 25 lakhs (details given below)

Recurring and Non-recurring contingencies	Year-I (2015-16)#
Capital	
Equipment/ Machinery/ Apparatus/ Misc. items@	3.0
Revenue	
Contractual service (SRF 3 & other contractual services)	11.0
TA	1.0
Other recurring contingencies including institutional charges*	10.0
Total	**25.0**

***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.

15 Receipts anticipated : NIL

UNDERTAKING

16 Certified that:

i. The research work proposed in the Platform Project (**Evaluation of Conservation Agricultural (CA) practices under Rice-fallow system of Eastern Region**) 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

Name: Dr. JS Mishra

Signature

24/06/15

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 me 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: 24/06/15

Executive Authority of the Institution

DIRECTOR / निदेशक
ICAR Research Complex For Eastern Region
पूर्वी क्षेत्र के लिए भा. कृ. अनु. प. का अनुसंधान परिसर
ICAR Parisar, P. O. - Bihar Veterinary College
आई.सी.ए.आर. परिसर, पो. बिहार वेटनरी कॉलेज
Patna-800014(Bihar) पटना - 800014 (बिहार)

Supplementary annexure

1 A) *Collaborative Investigator (s) (separate set for each)

Name: Dr. BAL KRISHNA JHA

Designation: Senior Scientist (Horticulture)

Date of Birth: 15th June 1967

Experience: 17 Years

Number of research publications: 27 research papers in national and international journal, technical bulletins, book chapters and popular articles.

Number of other Research Schemes (being carried out by PI)

(3) Title of Scheme (S): Sustainable livelihood improvement through need based integrated farming system model in disadvantaged district of Bihar

(4) Name of the funding Agency: NAIP

Period from 2008 to 2013

(II) Title of Scheme (S): Standardization of planting geometry and growth stage based fertigation pattern for commercial cultivation of selected vegetables using drip irrigation system

Name of the funding Agency: NABARD

Period from 2012 to 2015, Grant: 21.0 lakhs

B) *Collaborative Investigator (s) (separate set for each)

Name: Dr. SUSHANTA KUMAR NAIK

Designation: Senior Scientist (Soil Science)

Date of Birth: 30th June 1975

Experience: 12 Years

Number of research publications: 47 research articles, 03 technical bulletins, 03 extension folders, 08 popular articles

Number of other Research Schemes (being carried out by PI)

Title of Scheme (S) Acid soil management by use of basic slag

Name of the funding Agency: Tata Steel, Jamshedpur

Period from August 2014 to August 2016 Grant: Rs 12.55 lakhs.

C) *Collaborative Investigator (s) (separate set for each)

Name: Dr. Santosh S. Mali

Designation: Scientist (SWCE)

Date of Birth: 4-03-1981

Experience: 08 Years

Number of research publications: 12 research papers in national and international journal, technical bulletins, book chapters and popular articles.

2 ***Objectives** (in brief):

ii. To develop, demonstrate and validate CA-based crop management technologies for improving the productivity of rice-fallows in rainfed ecosystems of eastern regions.

3 ***Practical/Scientific Utility**:

Soil and water are the two major limiting factors responsible for low productivity of crops in rice-fallows. Resource conservation technologies (RCTs) could be an appropriate approach to address the problems in rice-fallows. After harvesting of rice crop low moisture content in soil followed by fast decline in water table with the advancement of *rabi* season results in mid-and-terminal drought at flowering and reproductive stages adversely affects the productivity of crops in rice-fallows. Therefore, if crop residues are retained on the soil surface in combination with suitable planting techniques, it may alleviate terminal drought stress by conserving soil moisture and bring overall improvement in resource management. Zero tillage with minimum disturbance of soil and management of crop residues could lead to favourable effect on soil properties that further enhance the overall resource enhancement and productivity capacity in rice-fallows. This will also reduce cost of cultivation, and improved input-use efficiency making cultivation in rice-fallows more remunerative. Fodder (green/dry) scarcity for livestocks during *rabi* season is also an important issue in rice-fallows. Improving cropping intensity of rice-fallows may in-turn, help in meeting out the fodder requirement during lean period. The simple technologies like seed priming, spraying of 2% urea and micronutrients, etc., at vegetative stsges can substantially increase the productivity to remunerative levels for the resource-poor farmers in this difficult environment. Further, it is suggested that the RCTs can act as a catalyst for the introduction of further technologies that will permit reliable and profitable cultivation of post-rainy-season crops and thus improve the livelihoods of the rural population.

4 ***Research work conducted**

iv. At sponsoring institutions:

In direct-seeded rice- fallow systems, different *rabi* crops were evaluated. Results revealed that linseed and mustard were found promising with 1-2 supplemental irrigations in Jharkhand. Under assured irrigation system, winter and summer vegetables like tomato, potato and brinjal (in winter); and cowpea, bottle gourd, okra, etc were found promising and remunerative in Ranchi district of Jharkhand. In north Bihar under low lying areas, surface seeding of wheat in transplanted rice is a common practice.

v. In other institution of the country:

In rice-fallows, linseed was found more productive and remunerative at RAU, Pusa, Bihar (Thakur *et al*. 1997). At CRRI Cuttack, Rao *et al*. (1982) evaluated various *rabi* crops grown on residual moisture after harvest of rice on upland rainfed soil and found that safflower was the most remunerative followed by blackgram, lentil, mustard and niger. Kar *et al*. (2007) also found safflower as the most remunerative crop in rice-fallows in Orisa. Mulching with paddy straw and water hyacinth were found to increase the productivity of groundnut sown after rice (Chandra and Choubey, 2003). At IIPR, Kanpur, no-till drill for small farmers, having low purchasing power, was developed for line sowing in rice-fallow. This helped in more moisture retention as least soil disturbance occurred. By use of this no-till drill, the seeding was done timely at a reduced cost.

vi. Other countries

In north-western Bangladesh, chickpea is a promising post-wet-season crop to follow rainfed rice in the High Barind Tract. Yields in farmers' fields, however, remain low (<1 t ha^{-1}) primarily due to poor crop establishment, late sowing, and terminal drought and heat stress. Thirty trials were conducted entirely on residual soil moisture in farmers' fields. Seed priming (soacking of seeds overnight) significantly increased the seed yield by 47%. The priming response was attributed mainly to rapid seedling establishment, with higher plant stand and earlier crop maturity allowing escape from end-of-season stresses. Priming also reduced the incidence of stem and root diseases, and increased nodulation by native rhizobia.

CAPP-8

Format for Application for Agri-CRP Projects

1.	**Title of Platform**	:	CRP on Conservation Agriculture
2.	**Title of the Platform Project**	:	Productive Utilization of Salt Affected Soils through Conservation Agriculture
3.	**Location**	:	
	Institute's Name	:	ICAR-Central Soil Salinity Research Institute
	Place	:	Karnal
	District	:	Karnal
	State	:	Haryana
4.	**Principal Investigator (PI)**	:	
	Name	:	Dr. Ranbir Singh
	Designation	:	Principal Scientist
	Date of Birth	:	04.03.1959
	Experience	:	26 years
	No. of Research scheme handled	:	Externally funded:6; Institute funded: 12
	No. of important research publications	:	50
5.	**Co-Principal Investigator (Co-PI)**	:	
(i)	Name	:	Dr. Arvind Kumar Rai
	Designation	:	Principal Scientist
	Date of Birth	:	21.01.1967
	Experience	:	15 years
(ii)	Name	:	Dr. Parvender Sheoran
	Designation	:	Senior Scientist
	Date of Birth	:	09.02.1976
	Experience	:	11 years
(iii)	Name	:	Dr. Satyendra Kumar
	Designation	:	Principal Scientist
	Date of Birth	:	29.09.1972
	Experience	:	17 years
(iv)	Name	:	Dr. D.K. Sharma
	Designation	:	Principal Scientist and Director, CSSRI, Karnal
	Date of Birth	:	15.01.1955
	Experience	:	35 years

6. Collaborative Investigator(s) : None

7. Objectives:

1. To sustain the productivity of cropping systems through efficient use of water, nutrient and energy in salt affected soils.
2. To evaluate the impact of resource conservation options on the physical, chemical and biological health and quality of salt affected soils.
3. To study salt dynamics and resource budgeting in varying resource conservation options.
4. To evaluate the economic feasibility of various resource conservation options.

8. Practical/Scientific utility:

1. Farmers' participatory evaluation and popularization of CA based production technologies in the salt affected areas.
2. Efficient tillage and residue management practices for reduced production costs, improved reclamation process and soil health, enhanced input (fertilizer, water and energy) use efficiency and insurance for timeliness of the field operations.
3. Remunerative crop diversification option for reducing the agricultural water requirement in western IGP.
4. CA practices for best utilization of saline water irrigation to enhance crop yields and reduce the risk of root zone soil salinization.
5. Best CA practices will help in ensuring the overall improvement in productivity, resource use efficiency and livelihood security in salt affected soils.

9. Research work conducted:

At CSSRI, Karnal:

Direct seeded rice is a promising option for sustainable rice production in reclaimed alkali soil of India. In long-term field experiment conducted at CSSRI Karnal, direct seeded rice (DSR) with wheat crop residue incorporation technique was evaluated the best option for sustainable rice production under limited water resources. Whereas, conventional rice transplanting (TPR) with wheat residue incorporation and dhaincha green manuring were found to be the best CA option in rice with sufficient water availability.

Yield of direct seeded basmati rice (CSR 30) was at par with TPR and saved 35% irrigation water. Water productivity of basmati CSR 30 rice variety was more in DSR compared to transplanted rice. The maximum water saving was in DSR with sesbania co-culture as a brown manuring (39.4% in CSR30). About 42% savings in diesel cost in reduced tillage and 86% in zero tillage when grown as DSR was observed. Corresponding values for labour savings were 24 and 30%, respectively. DSR technique saved 29% electricity in pumping of water (Singh *et al.*, 2012 and 2013). Crop residue incorporation in transplanted plots yielded 3.51% more grain yields in comparison to conventional transplanted plots. Basmati CSR 30 yielded better than Pusa 44 rice variety both in DSR and TPR methods in reclaimed alkali soil.

Mini sprinkler irrigation system saved electricity charges (37.85%) in comparison to conventional wheat sowing in rice–wheat cropping system (Singh *et al.,* 2014). Nitrogen use efficiency (NUE) was found to be as high as 68.4 kg grain/kg applied N in wheat through mini sprinkler system. Nitrogen fertilizer through mini sprinkler irrigation almost saved 50% of recommended N with 100% rice crop mulch.

In India:

The Indo-Gangetic plain (IGP) is of great importance for food security of India as well for South Asia. The major challenges for rice-wheat cropping are to sustain its productivity even with less water, labour and chemicals. Intensive tillage and residue burning has led to depletion of soil organic carbon resulting in decreased soil fertility and reduced factor productivity (Yadav, 1998; Singh *et al.,* 1999). Continued intensification of input-use since the green revolution, has provided lower marginal returns (Ladha et al., 2000). A decline in land productivity has been observed over the past few years in the Northern and North Western IGP despite the application of optimum levels of inputs under assured irrigation (Paroda, 1997). Inappropriate use of applied inputs and over exploitation of natural resources, like land and water led to degradation in the form of salinization, water-table depletion, physical and chemical deterioration of the soil, etc. (Byerlee, 1992 and Murgai et al., 2001).

Conservation agriculture can be seen as a new way forward for conserving resources and enhancing productivity to achieve the goals of sustainable agriculture, which demands a strong knowledge base and a combination of institutional and technological innovations (Abrol and Sangar, 2006). In India, efforts to develop and spread conservation agriculture have been made through the combined efforts of several State Agricultural Universities, ICAR institutes and the Rice-Wheat Consortium for the Indo-Gangetic Plains. The focus of developing and promoting conservation technologies has been on zero-till seed-cum fertilizer drill for sowing of wheat in rice-wheat system. Other interventions include raised-bed planting systems, laser equipment aided land leveling, residue management practices, alternatives to the rice-wheat system etc. In addition, raised-bed planting and laser land leveling are also being increasingly adopted by the farmers of the north-western region.

Adoption and spread of ZT wheat has been a success story in North-western parts of India due to reduction in cost of production (Malik et al., 2005 and RWC-CIMMYT, 2005) and enhancement of soil quality, i.e. soil physical, chemical and biological conditions (Jat et al., 2009; Gathala et al., 2011). Saharawat et al. (2012) also reported the enhancement, in the long term C sequestration and build-up in soil organic matter constitute a practical strategy to mitigate Green House Gas emissions and impart greater resilience to production systems to climate change related aberrations due to ZT. Experiences from several locations in the Indo-Gangetic plains showed that with zero tillage technology farmers were able to save on land preparation costs by about Rs. 2,500 ($41.7) per ha and reduce diesel consumption by 50 – 60 litres per ha (Sharma et al., 2005).

Improved agricultural practices such as direct seeding or conservation tillage have the potential to sequester more carbon (C) in soil than conventional practices. In recent years, due to continuous energy crisis and increasing fertilizer prices, green manuring has been considered as a sound practice for enriching soil fertility. Application of green manure along with chemical fertilizers resulted higher organic carbon status and reduced the gap between potential and actual yield to a large extent (Kumar and Prasad, 2008; Prasad *et al*., 1995, Bhandari *et al*., 1992, Hundal *et al*., 1992, Singh *et al*., 1999., and Singh *et al*., 1991).

Other countries:

Conservation agriculture is highly debated, with respect to both its effects on crop yields (Giller et al. 2009, R, Brouder and Gomez-Macpherson, 2014) and its applicability in different farming contexts (Stevenson et al. 2014). Pittelkow et al (2015) carried out the global meta-analysis using 5,463 paired yield observations from 610 studies to compare no-till, the original and central concept of conservation agriculture, with conventional tillage practices across 48 crops and 63 countries. Global data showed that no-till reduces yields, yet this response is variable and under certain conditions no-till can produce equivalent or greater yields than conventional tillage. Importantly, when no-till is combined with the other two conservation agriculture principles of residue retention and crop rotation, its negative impacts are minimized. Conservation agriculture (CA) practices offer the potential to increase wheat and maize productivity (Sayre and Hobbes, 2004), reduce production cost, increase soil organic carbon (Lal et al., 2007), and decrease soil salinity (Pang et al., 2009) compared to conventional production systems. Such advantages have been shown in a wide range of agro-ecological areas such as with wheat in Mediterranean conditions (Vita et al., 2007) or with maize in the sub-humid tropical highlands (Fisher et al., 2002).

Research findings demonstrated that conservation agriculture (CA) practices, i.e., reduced tillage, residue retention and appropriate rotation, can influence the location and accumulation of salts by reducing evaporation and upward salt transport in the soil (Brady and Well, 2008). Among the CA practices, raised bed planting is gaining importance for row-spaced crops in many parts of the world (Sayre, 2007). Raised beds are reportedly saving 25–30% irrigation water, increasing water use efficiency (Sayre and Hobbs, 2004; Hassan et al., 2005; Malik et al., 2005; Choudhary et al., 2008; Ahmad et al., 2009) and providing better opportunities to leach salts from the furrows (Bakker et al., 2010). However, under saline conditions, increased salt accumulation on top of the beds has been reported by Choudhary et al. (2008) due to the upward movement of salts through capillary rise in response to evaporation gradients. Also surface mulching with crop residues has been identified as a promising management option to combat soil salinity, as it can decrease soil water evaporation, increase infiltration and regulate soil water and salt movement (Tian and Lei, 1994; Pang and Xu, 1998; Li and Zhang, 1999; Pang, 1999; Li et al., 2000; Huang et al., 2001; Deng et al., 2003; Qiao et al., 2006).

10. Technical Programme:

(A) Technology demonstrations:

Title: Farmer's participatory evaluation of CA production technologies in rice/maize based cropping system under saline/sodic soils of Haryana.

A total of 6 demonstrations (4 in rice-wheat and 2 in maize-wheat system) will be carried out in farmers' participatory mode in collaboration with respective district KVKs to evaluate, validate and refine (if required) the technological interventions. The details are as under:

Cropping system	Soil type	Water quality	No. of demons.	Area (ha)	Location
Rice-wheat	Sodic/saline	Saline/Sodic/ Fresh	4	1.6	Karnal, Kaithal, Panipat
Maize-wheat	Sodic	Fresh	2	0.8	Kurukshetra, Karnal
Total			**6**	**2.4**	

Treatments:

Rice-wheat system	Maize-wheat system
• Conventional –Prevailing farmers practices-burning of residue • TPR with wheat residue incorporation(1/3 part)-ZT wheat with rice straw mulch • Rice transplanting after sesbania green manuring-ZT wheat with rice residue mulch • Direct seeded rice with wheat residue incorporation-ZT wheat with rice residue mulch with sprinkler irrigation method	• Conventional (TPR–Wheat) • Conventional maize-wheat cultivation • Maize-wheat in ZT on permanent raised bed • Maize in ZT with wheat residue (1/3) on raised bed-Wheat on fresh raised bed

Items of Investigation:

- Agronomic (crop yield and input use efficiency) and physiological parameters
- Monitoring changes in soil physico-chemical properties
- Economic analysis

(A) Basic and strategic research on conservation agriculture in salt affected soils

For productive utilization of saline, waterlogged-saline and sodic soils, resource conservation technologies of conservation agriculture needs to be identified development and validation of CA. In view of the above, to address the problem of soil health, crop productivity and resource requirements under different sets of soil and water quality, crop residue and tillage management and efficient irrigation water management needs to be evaluating in relation to tillage, residue incorporation/mulch and planting techniques in saline, waterlogged-saline and sodic soils .

The following projects have been formulated keeping the problems in mind how to make productive utilization of salt affected soils through conservation agriculture are proposed with the research objectives.

Expt. 1: Evaluation of resource conservation technology in rice–wheat cropping system in partially reclaimed sodic soil

Treatments:

Sym.	Rice	Wheat
T_1	Conventional rice transplanting	Conventional wheat sowing
T_2	Conventional rice transplanting after wheat residue incorporation	Wheat sowing after rice residue incorporation
T_3	Direct seeded rice (DSR)	Wheat in reduced tillage
T_4	DSR after wheat residue incorporation	Wheat in reduced tillage after rice residue incorporation
T_5	DSR in zero tillage	Wheat in zero tillage
T_6	Direct seeded rice in zero tillage with wheat residue retention	Wheat in zero tillage with rice residue retention
T_7	DSR without wheat residue in reduced tillage with surface irrigation	Wheat in Zero tillage with rice residue with surface irrigation
T_8	DSR without wheat residue in reduced tillage with drip irrigation	Wheat in Zero tillage with rice residue with drip irrigation
T_9	DSR without wheat residue in reduced tillage with sprinkler irrigation	Wheat in Zero tillage with rice residue retention and sprinkler irrigation system
T_{10}	DSR with wheat residue incorporation in reduced tillage with sprinkler irrigation	Wheat in Zero tillage with rice residue retention and sprinkler irrigation

Total area : 12000 m^2 (1.2 ha)
Replications : 4
Experimental Design : Strip plot /RBD
Crop sequence : Rice – Wheat
Irrigation : Fresh water

Expt. 2: Evaluation of resource conservation technology in sorghum –wheat cropping system in saline soil and water.

Treatments:

(A) Tillage levels:
- ZT (Zero Tillage) –ZT (with 1/3 residue retention in wheat crop)
- R T (Reduced Tillage) –ZT (with 1/3 residue retention in wheat crop)
- CT (Conventional tillage) -CT

(B) Irrigation and residue management:
- 100% water requirement in rabi season + no mulch (T_1)
- 80 % WR + no mulch (T_2)
- 60% WR + no mulch (T_3)
- T_1 + Rice straw mulch (5 t/ha)
- T_2 + Rice straw mulch (5 t/ha)
- T_3 + Rice straw mulch (5 t/ha)

- CT-CT + 100% WR pre and first post sown irrigation with good quality followed by three irrigation with saline water

Total area : 3500 m^2 (0.35 ha)
Replications : 3
Experimental Design : Strip plot /RBD
Crop sequence : Sorghum –Wheat

Items of investigation:

- Soil physical, chemical and microbial studies
- Soil moisture and weed dynamics
- Monitoring root zone salinity
- Agronomic parameters (growth and input use efficiency)
- Carbon sequestration, Nutrient dynamics, fractionation under different CA systems
- Identifying soil health indicators in CA systems
- Energy and water budgeting
- Input-output cost analysis

(11) Facilities available :

Equipments/instruments/apparatus : Soil, plant and water analysis laboratory, Spectrophotometer, AAS, ICPOES

Area of experimental fields (ha) : CSSRI Farm: 1.2 ha; Nain Fam, Panipat: 0.4 ha Farmers' Fields: 2.4 ha

Other facilities : Net house/farm mechanization/Irrigation facilities etc.

(12) Additional facilities required (Implements/Equipments/others) : Turbo/Zero till seed drill, Maize/Bed planter, Sprinkler/drip irrigation, Oven, Refrigerator, Soil solution access tubes, Table top shaker, N- Analyser , Data storage and Calculation

(13) Duration : 2 years (Likely to be continued upto 5 years)

(14) Staff requirements :

Designation of the post	No. of posts	Scale of Pay	Qualification prescribes
Senior Research Fellow	3	Rs.16000/= +HRA per month (@ 10%) First Two year and Third year Rs.18000/= +HRA	**Essential:** • **M.Sc (Agri.)** in Soil science/ environmental science/agronomy/Allied discipline. • Computer knowledge **Desirable:** At least 2 year research (lab/field) experience.
Lab. Cum Field Assistant	2	Rs.10000/= per month	**Essential:** • **10+2** qualification. • Computer knowledge **Desirable:** Lab/field wok experience.

(15) **Estimation of Costs:**

i) Sr. Research Fellows: 3

ii) Other contractual services: As per requirement

Recurring and Non-recurring contingencies: Rs. 25 lakhs (details given below)

Recurring and Non-recurring contingencies	Year-I (2015-16)#
Capital	
Equipment/ Machinery	2.0
Revenue	
Contractual service (SRF 3 & other contractual services)	12.0
TA	1.0
Other recurring contingencies including institutional charges*	10.0
Total	**25.0**

***Institutional charges @ 10% of RC for lead institute and 5% of RC for cooperating institutes**

 # As per the new RE (2015-16). Original sanctioned total project budget is 63 crore.

(16) Receipt anticipated : The experimental crop produce will be deposited in the farm store.

UNDERTAKING

Certified that:

- The research work proposed in the Platform Project **(CRP on CA)** does not in any way duplicate the research work already done and being carried out elsewhere on the subject.
- 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.
- 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.
- We undertake to abide by the guidelines provided by the Council for the implementation of the Platform Project.

(Dr. Ranbir Singh)
Principal Investigator

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 me 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: N.A.

ICAR's amount	UC & Accounts furnished
N.A.	N.A.

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

(1)____________________ (2) ____________ (3)

It is certified that the Institution has not received any grant from the ICAR previously.

23/6/15

Date :

Executive Authority of the Institution

निदेशक/Director
भा.कृ.अनु.प.-केन्द्रीय मृदा लवणता अनुसंधान संस्थान
ICAR- Central Soil Salinity Research Institute
करनाल–132001/ Karnal-132001

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CAPP-9

Format for Application for Agri-CRP Projects

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

2. Title of the Platform Project: **Conservation agriculture for enhancing the productivity of rice based cropping system in eastern India**

3. Location
   Institute's Name: Central Rice Research Institute
   Place: Bidyadharpur
   District: Cuttack
   State: Odisha

4. Principal Investigator (PI)
   Name: Dr. A.K.Nayak
   Designation: Head, Crop Production Division
   Date of Birth: 18/04/1969
   Experience: (Years): more than 15 Years
   Number of important research publications: 70 Nos.

   Co-Principal Investigator (Co-PI)
   Name: Dr. P.Bhattacharyya
   Designation: Principal Scientist
   Date of Birth: 16/06/1973
   Experience: (Years): 12 years
   Number of important research publications: 50 Nos.

   Co-Principal Investigator (Co-PI)
   Name: Dr. Rahul Tripathi
   Designation: Scientist
   Date of Birth: 15/07/1983
   Experience: (Years): 6 years
   Number of important research publications: 30 Nos.

   Co-Principal Investigator (PI)
   Name: B. Lal
   Designation: Scientist, Agronomy, crop production Division
   Date of Birth: 11/05/1983
   Experience: (Years): 4 years
   Number of important research publications: 18

   Co-Principal Investigator (PI)
   Name: Bipin Bihari Panda

Designation: Senior Scientist
Date of Birth: 04.05.1973
Experience: 11Years
Number of research publications: 33

Co-Principal Investigator (Co-PI)
Name: Dr. Mohammad Shahid
Designation: Scientist
Date of Birth: 13/08/1980
Experience: (Years): 5 years
Number of important research publications: 30 Nos.

Co-Principal Investigator (PI)
Name:Sushmita Munda
Designation:Scientist
Date of Birth:27.02.1983
Experience: (Years)Four years of serving ICAR
Number of Scheme handled:NA
Number of important research publications: 5

Co-Principal Investigator (PI)
Name: Dr. Sanjoy Saha
Designation: Principal Scientist
Date of Birth: February 02, 1966
Experience: 25 Years
Number of research publications: Research articles : 95; Popular articles : 15

Co-Principal Investigator (Co-PI)
Name: Dr. S.K. Mishra
Designation: Principal Scientist
Date of Birth: 06/06/1968
Experience: (Years): 15 years 10 months
Number of important research publications: 40 Nos.

Co-Principal Investigator (Co-PI)
Name: Dr. S.D,Mohapatra
Designation: Senior Scientist
Date of Birth: 10/08/1973
Experience: (Years): 14 years
Number of important research publications: 10

Co-Principal Investigator (Co-PI)
Name: Dr. Prabhat Guru
Designation: Scientist
Date of Birth: -

Experience: (Years): 4 months
Number of important research publications: -

5. *Collaborative Investigator (s) (separate set for each)
   Name: ______________________________ (30 Chrs)
   Designation: ______________________________ (30 Chrs)
   Date of Birth: ______________________________
   Experience: ____________________Years
   Number of research publications:
   Number of other Research Schemes (being carried out by PI)
   Title of Scheme (S) ______________________________ (30 Chrs)
   Name of the funding Agency: ______________________________ (30 Chrs)
   Period from____________ to ______________Grant: ________Rs.

6. *Objectives (in brief):

i. Adapt and mainstream available best bet location specific CA practices for enhanced productivity and profitability in rainfed and irrigated eco-systems
ii. Development and validation of location specific CA technologies for sustainable intensification of cropping systems across agro-ecologies
iii. Quantify impact of CA on soil health, pest dynamics, input use efficiency, carbon sequestration and greenhouse gas emissions
iv. Capacity building, knowledge management, institutional arrangement and enabling policies for accelerated adoption of Conservation Agriculture

7. Practical/Scientific Utility: During the green revolution era, production increase resulted from expansion in area and productivity of rice and wheat. Now, with little addition in available land, future demand has to be met mainly though increases in yield per unit area. The productivity and sustainability of the rice production systems are threatened because of combination of factors such as inefficient use of inputs (fertilizer, water, labor); increasing scarcity of resources, especially water and labor; changes in climate; changes in land use driven by a shortage of water and labor; socioeconomic changes (urbanization, labor migration, changing attitude of people to shun away from farm work) and concern about farm-related pollution. These factors causing yield to stagnate over the past two decades. The challenges are to produce more food at less cost and to improve water productivity and increase nutrient use efficiency. Conservation agriculture (CA) helps to mitigate the effects of climate change with regard to the emission of greenhouse gases. With the increasing soil organic matter, soils under conservation agriculture can retain carbon and store it safely for long periods of time. There is wide scope in conserving soil organic carbon and reducing green house gas emission to the atmosphere with implementation of proper CA system in rice and rice based cropping system. Efficient CA systems are needed to conserve energy and water resources, reduce green house gas emissions, and improve the quality of life for farm families.

8. *Research work conducted :

In the United States, Australia and Europe, rice is planted into either a dry-seeded or water-seeded system (Gianessi et al., 2002; Ntanos, 2001; Pratley et al., 2004). Direct seeding in saturated soil has been widely adopted in southern Brazil, Chile, Venezuela, Cuba, some Caribbean countries, and in certain areas of Colombia (Fischer and Antigua, 1996). In Asia, dry seeding is extensively practiced in rainfed lowlands, uplands, and flood-prone areas, while wet seeding remains a common practice in irrigated areas (Azmi et al., 2005; de Dios et al., 2005).

Experiments in Northwest India using DSR into non-puddled soils found 35–57% water savings (Sharma et al., 2002; Singh et al., 2002). Several challenges confront the wide-scale adoption of CA/RCT by farmers, such as high weed infestation is the major bottleneck in DSR especially in dry field conditions (Harada et al., 1996; Rao et al., 2007). The severity of rice blast increases under water limited conditions (Bonman, 1992; Mackill and Bonman, 1992). Root-knot nematodes have also been observed when switching from flooded to water conservation rice production systems (Prot et al., 1994). The number of sterile spikelets increased, as well as abortive, opaque and chalky kernels in DSR compared with TPR (Farooq et al., 2007, 2009).

9. Technical Programme:

Items of Investigation:

Objectives	Activities	Y-1	Y-2
Obj.1 Adapt and mainstream available best bet location specific CA practices for enhanced productivity and profitability in rainfed and irrigated eco-systems.	1. Synthesis and documentation of the CA based best management practices (BMPs)	√	√
	2. Participatory adaptation and up-scaling of CA based BMPs in two locations.	√	√
Obj.2 Development and validation of location specific CA technologies for sustainable intensification of cropping systems across agro-ecologies	1.Refinement and development of site specific CA technologies	√	√
	2. On station validation of developed CA technologies	√	√
Obj.3 Quantify impact of CA on soil health, pest dynamics, input use efficiency, carbon sequestration and greenhouse gas emissions. (On- station exp)	1.The nutrients flow and nutrient budgeting from the resources mobilized within and outside the system	√	√
	2.Estimation of carbon sequestration and greenhouse gases (GHG) emissions and Carbon budgeting	√	√

	3.Monitoring the changes of soil physical, chemical and biological properties under different treatments	√	√
	4. Quantification of yield, yield attributing characters and cost benefit ratio in rice based cropping systems.	√	√
Obj.4 Capacity building, knowledge management, institutional arrangement and enabling policies for accelerated adoption of Conservation Agriculture	1.Organizing farmers training programmes.	√	√

10. Facilities Available:
    Equipments/instruments/ apparatus: (1) Gas Chromatograph,
    (2) CHN analyser
    (3) AAS, ICP

    Area of experimental fields (hectares)
    Laboratory:
    Other facilities: (1) Experimental farm of CRRI (104 acre)
    (2)Soil physics, chemistry and biology laboratory. (50 Chrs)

11. Additional facilities required:

    Equipment & apparatus:
    (1)Zero till ferti seed drill
    (2) seed cum fertilizer drill
    (3) Zero till multicrop planter
    (4) Mechanical transplanter

12. Duration: July, 2015- March, 2017 (Two years)

    *Detailed information with regard to Sr. No. 6, 7, 8 and 9 may be furnished separately as supplementary annexure.

13. Staff Requirements (Scientific, Technical etc.)

    Designation of Post: ______________________________ (50 Chrs)
    Number of Post: ______________________________ (50 Chrs)
    Scale of Pay: ______________________________
    Qualification Prescribed: ______________________________ (50 Chrs)

14. Estimation of Costs:

i. Sr. Research Fellows : 2Nos
ii. Other contractual services : As per requirement

Others

15. Recurring and Non-recurring contingencies: Rs. 20 lakhs (details given below)

Recurring and Non-recurring contingencies	Year-I (2015-16)#
Capital	
Equipment/ Machinery/ Apparatus/ Misc. items[@]	2.5
Revenue	
Contractual service (SRF 2 & other contractual services)	9.5
TA	1.0
Other recurring contingencies including institutional charges*	7.0
Total	**20.0**

***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.

16. Receipts anticipated : 25 Lakhs per year as informed

UNDERTAKING

17. Certified that:

i. The research work proposed in the Platform Project (Consortium Research Project on Coservation Agriculture) 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 9/6/15

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 me 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** 22/06/15

CAPP-10

Format for Application for
Agri-CRP Projects

1. **Title of Platform:** Consortia research platform on conservation agriculture

2. **Title of the Platform Project:** "Conservation agriculture for enhancing the productivity and profitability of wheat based system"

3. **Location**
   Institute's Name: ICAR-Indian Institute of Wheat and Barley Research
   Place: : Karnal
   District: : Karnal
   State: : Haryana

4. **Principal Investigator (PI)**
   Name: Dr R. S Chhokar
   Designation: PS (Agronomy)
   Date of Birth: 17-11-1969
   Experience: (Years): 17 years
   Number of Scheme handled: More than 30 contract research projects on herbicide evaluation
   Number of important research publications: 50
   Number of other Research Schemes (being carried out by PI)
   Title of Scheme (S): Evaluation of herbicides
   Name of the funding Agency: Various herbicide Development Agencies
   Period from: 1999 to 2015 Grant: > Rs. 100 Lakhs

5. **Co-Principal Investigator (Co-PI)**
   Name: Dr R. K. Sharma
   Designation: PS & PI (Resource Management)
   Date of Birth: 20-03-1958
   Experience: (Years): 31 Years
   Number of research publications: 50
   Number of other Research Schemes (being carried out by PI):
   i. Title of Scheme (s): Crop simulation studies to understand the effect of moisture and temperature stress on growth and yield of wheat
   Name of the funding Agency: ICAR- National Fund for Basic, Strategic, and Frontier Application Research in Agriculture
   Period from **2012 to 2015** Grant: Rs 178.9506 lakhs (52.15 Lakhs)

   ii. Title of Scheme (s): Increasing the productivity of wheat crop under conditions of rising temperature and water scarcity in south Asia 2013-2016
   Name of the funding Agency: BMZ
   Period from **2012 to 2016** Grant: Euro 69285

6. ***Collaborative Investigator (s) (separate set for each)**

1. Name: Dr S. C. Gill
Designation: PS (Agronomy)
Date of Birth: 8-03-1969
Experience: 19 Years
Number of research publications: 36
Number of other Research Schemes (being carried out by PI): Contract research projects on fertilizer molecule evaluation and two Institute Projects on nutrient management in rice-wheat cropping system.
Title of Scheme (S): Evaluation of fertilizer molecules
Name of the funding Agency: Various Fertilizer Development Agencies

2. Name: Dr Gyanendra Singh

Designation: PS (Plant Breeding)
Date of Birth: 05-05-1962
Experience: 29 Years
Number of research publications: 80
Number of other Research Schemes (being carried out by PI): Accomplished 19 internal, 5 external funded and two foreign collaborative research projects.
Title of Scheme (S) ____
Name of the funding Agency: ____
Period from________________ to _______________________Grant: __________Rs.

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

1. Development and validation of CA technologies for sustainable intensification of wheat based cropping systems
2. Quantifying the impact of CA on soil health, weed dynamics, input use efficiency and carbon sequestration.
3. Identifying the suitable wheat genotypes for CA system
4. To test and fine-tune the machines for seeding into loose crop residues including sugarcane ratoon.
5. To evaluate the role of CA practices in tackling the abiotic stresses.

8. ***Practical/Scientific Utility:**

The indiscriminate use, rather misuse, of natural resources has degraded the natural resource base. Depleting soil organic carbon status and under ground water table, decreasing soil fertility and reduced factor productivity are major issues of concern. In future the crop productivity and sustainability is bound to suffer due to over exploitation of natural resources. Therefore, in order to meet the aim of sustainable yields over time it is the need of the hour to avoid further degradation of the natural resources. Rather efforts must be focused on reversing the trend in natural resource degradation, which is possible only if we adopt conservation agriculture practices in systems perspective. Conservation tillage systems particularly direct seeding offer some potential for carbon sequestration and reducing agriculture's impact on green house gases and also moderates the soil temperature. Widespread adoption of conservation tillage could result in C sequestration in agricultural lands as increased tillage intensity increases C losses. Moreover, to mitigate the effect of changing climatic conditions in the country, adopting conservation agriculture is a must. To address the effect of conservation agriculture, a research-for-development agenda should follow a holistic approach that brings together genetic improvement, crop management, product quality, capacity building and knowledge sharing.

9. *Research work conducted

i. At sponsoring institutions: Long term experiments on various tillage options in rice-wheat system, Water usage under CA and residue and nitrogen levels under CA are in progress at the Indian Institute of Wheat and Barley research, Karnal.
ii. In other institution of the country: Some of the ICAR and SAUs are also working on CA aspects to address the region specific problems. However, more holistic studies are needed in the CA in systems perspectives.
iii. Other countries: No-tillage/Conservation Agriculture (CA) has developed as cost effective, technical viable and sustainable alternative to intensive tilled crop production practices. While intensive till crop production systems have resulted in soil degradation and in extreme cases desertification, the adoption of the CA technology has led to a reversion of this process with improvement of organic matter content, soil biological processes and soil fertility which enhances the soil moisture conservation and yields improvement with time. Data presented ten years ago at the 10th ISCO Conference in West Lafayette, Indiana, showed a world wide adoption of the No-tillage technology of about 45 million ha (Derpsch, 2001). Since then the adoption of the system has continued to grow steadily. World wide the maximum area in conservation agriculture is in USA followed by Brazil and Argentina.

10. Technical Programme:

a. Establish long term wheat based CA trials to evaluate the effect on soil health, weed dynamics, input use efficiency and carbon sequestration.
b. Evaluating the performance of wheat genotypes and/or recently released varieties under CA practices to identify suitable cultivars
c. To evaluate the performance of machines for seeding in to surface retained residues including fine-tuning the existing CA machinery
d. To evaluate the role of CA practices in tackling the abiotic stresses like moisture, waterlogging and heat *etc*.
e. To develop the effective weed management practices for CA systems.
f. Participatory adaptation and out-scaling of CA based BMPs

11. Items of Investigation:

1. Soil health
2. Weed dynamics
3. Cultivars/genotypes

4. CA machines
5. Use efficiencies of various inputs

12. Facilities Available:

Equipments/instruments/ apparatus:

(1) Rotary Disc Drill for seeding in loose crop residue
(2) Precision drill
(3) Other field and Lab equipments needed for project running

Area of experimental fields (hectares): One hectare at IIWBR, Karnal and 2 hectares at Hisar Research farm of IIWBR
Laboratory: A well equipped Lab facility available at IIWBR Karnal
Other facilities: (1) Germplasm facility
(2) Salt affected soil at Hisar farm

13. Additional facilities required:

Equipment & apparatus:
(1) Turbo seeder
(2) Power till drill

Area of land for Experimentation (hectares): Nil

Laboratory: Renovation of Lab
Office facilities: Renovation of office chambers

14. Duration: Two years and the long term study established will be carried further

*Detailed information with regard to Sr. No. 6, 7, 8 and 9 may be furnished separately as supplementary annexure.

15. Staff Requirements (Scientific, Technical etc.): Already available for the project

Designation of Post: ____
Number of Post: ____
Scale of Pay: ____
Qualification Prescribed: ____

16. **Estimation of Costs:**

Recurring and Non-recurring contingencies	Year-I (2015-16) Rs Lakhs
Capital	
Equipment/ Machinery	2.0
Revenue	
Contractual service (SRF 2 & other contractual services)	10.0
TA	1.0
Other recurring contingencies including institutional charges @ 5% of recurring contingency	7.0
Total	**20.0**

- Recurring and Non-recurring contingencies: Rs 20 lakhs for first year
- Receipts anticipated : Rs 20 lakhs for first year

UNDERTAKING

- Certified that:

i. The research work proposed in the Platform Project (**Consortia research platform on conservation agriculture**) 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

RChhokar 29/6/2015

(R. S. Chhokar)

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 me 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.

Jharna

निदेशक /Director
भारतीय गेहूँ एवं जौ अनुसंधान संस्थान
Indian Institute of Wheat and Barley Research
Karnal (Haryana) / करनाल (हरियाणा)

Date: **Executive Authority of the Institution**

CAPP-11

Application forAgri-CRP Project

1.	**Title of Platform**	:	**Conservation Agriculture (CA) Platform**
2.	**Title of the Platform Project**	:	Conservation agriculture for enhancing resource-use efficiency, environmental quality and productivity of sugarcane cropping system
3.	**Location:**		
	Institute' s Name	:	ICAR-National Institute of Abiotic Stress Management
	Place	:	Malegaon Khurd, Baramati-413 115
	District	:	Pune
	State	:	Maharashtra, India
4.	**Principal Investigator (PI):**		
	Name	:	Dr. R.L Choudhary
	Designation	:	Scientist (Agronomy)
	Date of Birth	:	05 October 1984
	Experience: (Years)	:	04
5.	**Co-Principal Investigator (PI):**		
	Name	:	Dr. P. S. Minhas
	Designation	:	Director, ICAR-NIASM
	Date of Birth	:	05 April 1954
	Experience: (Years)	:	36
	Number of Scheme handled	:	~350
	Number of important research publications	:	105
	Number of other Research Schemes (being carried out by PI)	:	NIL
	Title of Scheme (s)	:	NA
	Name of the funding Agency	:	NA
	Period from__to__Grant: Rs.	:	NA
6.	**Collaborative Investigator (s) (separate set for each):**		

	Sr. No.	Name	:	Dr. Mahesh Kumar
		Designation	:	Scientist (Plant Physiology)
		Date of Birth	:	15 January 1981
		Experience: (Years)	:	04
		Number of Scheme handled	:	Institute projects: PI-1; Co-PI-03
		Number of important research publications	:	08
		Number of other Research Schemes (being carried out by PI)	:	PI-1
		Title of Scheme (s)	:	Contractual project
		Name of the funding Agency	:	Geolifeagritech India Ltd., Mumbai
		Period from__to__Grant: Rs.	:	2014-2016; 11.34 lakhs
		Name	:	Dr. SunayanSaha
		Designation	:	Scientist (Agricultural Meteorology)
		Date of Birth	:	10 June 1982
		Experience: (Years)	:	04
		Number of Scheme handled	:	Institute projects: PI-1; Co-PI-02
		Number of important research publications	:	06
		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:**			
	1.	Development and validation of location specific CA practices for enhancing productivity,profitability and resource use efficiency in sugarcane cropping system		
	2.	Quantification of the impact of CA practices on soil health, carbon sequestration and emission of green-house gases in sugarcane cropping system		
	3.	Capacity building and knowledge management for accelerated adoption of CA		
8.	**Practical/Scientific Utility:**			

	1. Trash management systems developed for a sustainable soil-environmental health 2. Improved resource-use efficiency to reduce environmental footprint of technologies 3. Basic information on GHGs from sugarcane cropping system generated for addressing climate change issues 4. Water-productivity improvements through synergies of trash management and micro-irrigation system. 5. New CA equipment made available for efficient and eco-friendly residue management with elimination of trash burning 6. Enhanced productivity and profitability of sugarcane cropping systems
9.	**Research work conducted:**
	i. At sponsoring institutions:
	An institutional research project was initiated in 2012 where different options for improving nitrogen-use efficiency and trash management in sugarcane ratoon crop are being investigated. So far the achievements are: • Surface retention of trash was more beneficial than its removal or burning • Application of N through either fertigation or crowbar improved the N-use efficiency vis-a-vis productivity of ratoon sugarcane • A prototype of trash chopper, off bar, root pruner cum fertilizer drill machine has been developed which is being tested in farmers' fields. • Root pruning along with placement of 90 % of recommended N as basal improved the NUE, productivity and profitability of sugarcane ratoon crop
	ii. In other institution of the country:
	Major efforts on adoption and promotion of conservation agriculture (CA) have been made in Indo-Gangetic plains, particularly in rice-wheat cropping system. This has been followed by adoption of CA in rice/maize based cropping in southern/eastern India. However, little attempts have been made with respect to adoption of CA in other crops/cropping systems, particularly sugarcane where large scale burning of trash is still practiced.
	iii. Other countries:
	The leading sugarcane growing countries like Brazil, Mexico and Australia have given priorities in green cane harvesting and retaining of trash in the field instead of its pre-harvest burning. However, improving the efficiency of applied fertilizers in trash retained condition continues to be a major challenge for researchers.
10.	**Technical Programme:(activities and timeline in Annexure-II)**

	Sr. No.	Objectives	Activities
	1.	Development and validation of location specific CA practices for enhancing productivity, profitability	1. Studies on tillage, laser leveling, planting methods, green manuring

		and resource use efficiency in sugarcane cropping system	and trash management practices 2. Optimization of sub surface fertigation for shallow planting; and fertilizer scheduling in ratoon crop with CA equipment 3. Assessment of soil fertility, nutrient uptake, water productivity and energy use efficiency 4. Development/standardization of techniques/ protocols/ spectrum/ colour-image based tools for assessment of nutrient stresses; and impact on root architectural studies
	2.	Quantification of the impact of CA practices on soil health, carbon sequestration and emission of green-house gases in sugarcane cropping system	1. Studies on mean C input, C-sequestration,soil physical health, nutrient dynamics and micro-biological properties, 2. Monitoring of seasonal flux of important GHGs/ soil micro-climate
	3.	Capacity building and knowledge management for accelerated adoption of CA	1. Capacity building for sugarcane based CA systems. 2. Capacity building on development / modification of CA machinery
11.	**Facilities Available:**		
	i.	Equipment/instruments/ apparatus:	
		Kjeltech auto analyzer, Eddy Covariance system, In-situ root image analysis system, Analytical sieve shaker, Guelph permeameter, UV-Vis Spectrophotometer, ICP-MS, GC, AAS, HPLC, , Infrared imaging system, Fluorescence imaging system, Porometer, IRGA, Leaf area meter, Chlorophyll meter, Flame photometer, Other lab equipment like Environmental shaker, Refrigerator, Hot air oven, Deep freezers, Precision electronic balances)	
	ii.	Area of experimental fields (hectares)	~ 18
	iii.	Laboratory:	Central laboratory facility, soil-plant analysis laboratory
	iv.	Other facilities:	Experimental field facilities may be explored from the nearby sugarcane growing farmers
12.	**Additional facilities required:**		

	i. Equipment & apparatus:		
	1. Soil moisture measurement equipment (s) 2. Digital cone penetrometer 3. Double ring infiltrometer 4. Probe/sensor/thermometers for soil temperature measurement 5. SPAD meter 6. Laser land leveler 7. Portable N_2O measurement system 8. Access tubes for root studies 9. Data acquisition, storage and processing systems 10. Other minor equipment/field machinery		
	ii. Area of land for Experimentation (hectares)	:	Farmers' fields nearby NIASM
	iii. Laboratory	:	Other institutes
	iv. Office facilities	:	-

13. **Duration:** 2 years

14. **Staff Requirements** (Scientific, Technical etc.)

15. Estimation of Costs:

(i) Sr. Research Fellows: 2
(ii)Other contractual services: As per requirement

16. Recurring and Non-recurring contingencies: Rs. 20 lakhs (details given below)

Recurring and Non-recurring contingencies	Year-I (2015-16)#
Capital	
Equipment/ Machinery/ Apparatus/ Misc. items[@]	2.5
Revenue	
Contractual service (SRF 2 & other contractual services)	9.5
TA	1.0
Other recurring contingencies including institutional charges*	7.0
Total	**20.0**

***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.

UNDERTAKING

I. Certified that:

i. The research work proposed in the Platform Project on Conservation Agriculture (CA) 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
Name R.L. Choudhary

Signature 01/07/2015

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 me 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.

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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:

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

डॉ.पी.एस.मिन्हास
Dr.P.S.Minhas
निदेशक / Director
राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान
National Institute of Abiotic Stress Management
मालेगांव,बारामती-413115 पुणे,महाराष्ट्र
Malegaon,Baramati-413115,Pune-M.S.

Annexure-II

10. Technical Programme: Activities and timeline

Sr. No.	Objectives	Activities	I Yr	II Yr
1.	Development and validation of location specific CA practices for enhancing productivity, profitability and resource use efficiency in sugarcane cropping system	1. Studies on tillage, laser levelling, planting method, green manuring and residue management practices	√	√
		2. Optimization of sub surface fertigation for shallow planting; and fertilizer scheduling in ratoon crop with CA equipment	-	√
		3. Assessment of soil fertility, nutrient uptake, water productivity and energy use efficiency	√	√
		4. Development/standardization of techniques / protocols/ spectrum/ colour-image based tools for assessment of nutrient stresses; and impact on root architectural studies	√	√
2.	Quantification of the impact of CA practices on soil health, carbon sequestration and emission of green-house gases in sugarcane cropping system	1. Monitoring of weather and soil micro-climate	√	√
		2. Monitoring of seasonal flux of important GHGs	-	√
		3. Studies relating to C sequestration	√	√
		4. Soil quality indices (physical, chemical and biological parameters)	√	√
3.	Capacity building and knowledge management for accelerated adoption of CA	1. Capacity building for sugarcane based CA systems.	√	√
		2. Capacity building on development / modification of CA machinery	√	√