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**	**:**	
	Instituteôs 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. Farmersô 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 riceï 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 ï 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 25ï 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 farmersô 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 ï 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 (TPRï 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 ï 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) ï ZT (with 1/3 residue retention in wheat crop)
- R T (Reduced Tillage) ï 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 ï Wheat

Items of investigation:

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