AICRP-INTEGRATED FARMING SYSTEMS

Objectives

1. Farming System Research Project at Pantnagar undertake basic and applied research for developing strategies that contribute to enhance the efficiency and sustainability of predominant rice-wheat cropping system of the area under different farming situations of agro-ecological region 9 and 14 of Uttarakhand state.
2. Formulation of a farming system model for small and medium farmers of plains and hills of the Uttarakhand region.
3. To characterize the farmers' resources of district Nainital.
4. Demonstration of the results generated at on-station to the farmers of the area and to find out the response of nutrients on farmers fields.

1. Significant Achievements:

A. On station

- Diversification of rice-wheat with potato, vegetable pea, rapeseed or mustard during winter & inclusion of summer green-gram was profitable. Rice-potato-green gram (108 %), rice- veg. pea- green gram (95 %) and rice-veg. pea-wheat (ZT) (91 %) were better cropping systems as compared to existing rice-wheat system as they recorded significantly higher system productivity and more remunerative as compared to conventional rice-wheat system, respectively.
- Diversification of rice-wheat cropping system with vegetable pea or rapeseed during winter and inclusion, summer green gram is profitable.
- Inclusion of legume crop to rice-wheat cropping system maintains soil health for yield sustainability.
- Diversification of rice-wheat cropping system with high productivity sustainable cropping systems like rice-vegetable pea-green gram, rice-mustard-green gram or rice-potato (early)-green gram have been identified and are being advocated for the sustainability of rice-wheat cropping system and maintaining the soil health.
- So, it can be safely concluded that incorporating vegetable crops like broccoli, potato, vegetable pea, okra etc. as well as remunerative basmati rice in the system ensures the economic benefits over traditional rice-wheat system.
- In rice-wheat cropping system, 25 per cent of total nitrogen requirement of rice crop could be substituted through FYM (128 %) and green gram straw (119 %) as they recorded significantly higher system equivalent yield as compared to control. The substitution of chemical fertilizers to the tune of 25% through FYM or green gram straw has resulted into maintenance of soil health and highest B:C ratio(2.38) as compared to control (1.22)under continuous long term cropping system on rice-wheat.
- Rice is responding significantly to 40 & 60 kg. P_2O_5/ha in long term cropping of rice-wheat.
- Productivity of rice-wheat cropping system is significantly increased by application of phosphorus @ 60 kg P_2O_5/ha. About 25% substitution of inorganic nitrogen (urea) by organic sources viz., FYM (6 t/ha) or green gram straw (3t/ha).

- Higher productivity may be achieved by synthesized model (150 kg N) *Sesbania*-GM and recommended dose of PK and Zn under conventional tillage /sowing methods (13.29 t/ha) over the treatments of conventional planting with recommended fertilizer (9.95 t/ ha) and RCT methods of direct seeding rice and zero tillage wheat with recommended fertilizers (10.58 t/ha).
- The yields of rice and wheat with direct seeding of rice and zero tillage wheat may be sustained by using 10% extra fertilizer compared to recommended practices.
- Diversification of rice-wheat with rice-potato–maize or rice-vegetable pea-moongalong with resource conservation technologies viz., direct seeding rice/ zero tillage/ reduced tillage over conventional tillage system,INM (75%N thru urea +25%N thru FYM)over 100% N thru urea and residue as mulch of preceding cropover no mulchresulted into significantly higher system productivity.
- Rice-potato-cowpea produced highest total system rice equivalent yield(32.45 t REY/ ha/yr) about three times higher than conventional rice-wheat cropping system(10.85 t REY/ha/yr). Rice (DSR) - veg. pea – maize (cob + fodder) was most remunerative cropping with B:C ratio of 4.46 followed by system maize + cowpea + sesbania- veg. pea + toria – ground nut + mentha (4.10) & rice (DSR) – potato - cowpea cropping system (4.04) compared to (2.97) under conventional rice – wheat cropping system.
- Under the impact of climate change due to global warming diversification of rice-wheat with rice-potato –maize of rice-vegetable pea-Moong is a good option for higher total system productivity with using resource conservation technologies. .
- Reducing recommended fertilizer for 75% RDF reduced total system productivity but could be restored by using mulch practices.
- Zero tillage in wheat after rice harvest is recommended to increase the profit, to reduce cost of production and to advance the sowing of wheat in medium to light textured soils.
- Mulching during rabi season appears to be moderating low temperature initially high temperature at later stages, conserving moisture, increasing plant vigour, thereby increasing system productivity and higher B:C ratio.
- Integrated farming system model i.e. crops + dairy + horticulture/agroforestry + fisheries+ duckery + vermicompost + biogas recorded higher system productivity (33.3 tREY/ha/yr), net returns (Rs. 235130) and employment (450 mandays) as against most predominant farming system i.e. crops (rice-wheat)+Dairy+ tree (poplar on boundary) with system productivity (12.5 tREY/ha/yr), net returns (Rs 94800) and employment of about 200 mandays.
- Integrated farming system model resulted in recycling of 261 kg of NPK in the system contributed by 114 kg N, 43.7 kg P2O5 and 103.3 kg K2O, respectively.
- Livelihood analysis of an IFS Model revealed that farmer can have savings of Rs. 92504.0 after meeting the family requirements and deducting cost of cultivation and recycled commodities.
- The model had a net GHG emission of -1860 CO_2.e in Kg. The model is sequstering more CO_2, than it is generating. Thus, the model is cabon efficient and environmentally sustainable.
- Yield of rice and wheat reduced by applying organic fertilizers compared to chemical fertilizers and reduction in yield was more in case of wheat crop than to rice.
- 100% organic treatment i.e. 50% N by FYM and Sunnhemp*Sesbania* green manuring + rock phosphate + PSB produced yield of basmati rice comparable to 100% NPK.

- Nitrogen application more than recommended (170 kg ha^{-1}) and @ phosphorus of 30 to 60 kg and potassium 40-120 kg/ha is must to achieve 13t/ha yield of rice and wheat.
- For harvesting more than 12 t of system productivity in rice-wheat cropping system balanced fertilization of 170 kg N, 60kg P_2O_5 ,80-120 kg K_2O along with 25 kg zinc & 5 kg boron per ha is required.
- Direct seeded rice after puddling has been found suitable for intense weedy area.
- Direct seeding of rice with 40-45 kg seed in moist friable soil to lessen the drudgery of the transplanting. It overcomes the shortage of labour and ill effects of puddling.
- Direct seeded rice was found to be as good as transplanted one. It facilitated timely sowing of succeeding crops, saves labour and water besides soil health.
- Resource conservation technologies of zero, strip and rotary till drilling, bed planting, drum seeding and mechanical transplanting saved considerable amount of natural resources like time, labour, diesel, energy and irrigation water and improved productivity, profitability, energy efficiency, water use and soil health, while reducing the weed population.
- Direct seeded rice is as good as transplanting, facilitated timely sowing of succeeding crops, saves labour and water besides soil health.
- Direct seeded rice followed by zero tillage wheat is better option for energy conservation and higher B:C ratio in areas having medium textured soil.
- Resource conserving technologies of zero, strip and rotary till drilling, bed planting, drum seeding and mechanical transplanting saved considerable amount of natural resources like time, labour, diesel, energy and irrigation water and improved productivity, profitability, energy efficiency, water use and soil health, while reducing the weed population.
- Direct seeding of rice with 30-35 kg seed in moist friable soil to lessen the drudgery of the transplanting. It overcomes the shortage of labour and ill effects of puddling.

B. On farm

Application of recommended fertilizer along with Sulphur i.e. 150 N + 60 P_2O_5 + 40 K_2O (60 K_2O for hybrid rice) + 20 S (kg/ha) resulted in highest grain yield of rice (5763 kg/ha) and wheat (5154 kg/ha). Application of recommended fertilizers (NPK) provided additional grain yield of rice and wheat of 1745 kg and 1302 kg, respectively over the farmers' practice.Highest system (rice-wheat) net returns (Rs. 95535/ha) were recorded with the treatment having recommended dose of fertilizers (NP&K)+S.

- Application of recommended fertilizers (nitrogen, phosphorus and potash) in rice and wheat resulted in highest grain yield. Application of sulphur @ 20 kg/ha gave response of 2.11 kg and 6.00 kg grain/ kg sulphur applied.
- Response for phosphorus and potassium was higher (15 kg grains /kg P&K) for rice and wheat whereas for N it was only 6 kg/ha under Deharadun and Pauri districts.
- Interventions in existing crops (rice, wheat, maize) like planting at proper spacing, recommended fertilization, insect – pest management in existing soybean, pulses & vegetables and diversification with high value vegetable crops like coriander, chilli, pea, onion, cucurbits, papaya, etc. increased the income of households. Interventions in livestock components (Mineral mixture supplementation, Deworming drug, round the year fodder supply, sanitation) and diversification with backyard poultry & goat rearing increased net income of households. Grading and packing of vegetables before marketing and

introduction of vermi-compost and organic kitchen garden increased the net income of households. Capacity building module resulted in increased knowledge score by more than 100 per cent of the participating households.

- Diversification of rice-wheat cropping system with rice-vegetable pea- vegetable french bean was found profitable and provided net returns of ₹157607 and 178546 per hectare under irrigated conditions of district Pauri and Dehradun, respectively.
- Rice –mustard–urd system not found suitable for hill condition as growth of urd is slow and maturity gets delay and may coincide with early rains.
- Interventions in existing crops (line sowing/ transplanting, recommended fertilization in rice & wheat, insect – pest management in pulses & vegetables, planting of napier and cowpea + maize for fodder during summer) and inclusion of vegetables (pea, onion, tomato, etc.) and gap filling of existing orchards increased the income of marginal and small housholds.Interventions in livestock components (Mineral mixture supplementation, De-worming drug, round the year fodder supply, sanitation) increased net income of households. Grading and packing of vegetables before marketing increased the net income of households.On the left over un-utilized land near house, planting of good quality papaya, cucurbits and vegetables production (particularly coriander during summer &*kharif*), backyard poultry and vermi-compost and provided additional returns to the marginal and small households.
- Under the agronomic management experiments, recommended package of practices (improved variety, line sowing/ transplanting and recommended fertilization) resulted in highest grain yield of rice and wheat and the grain yields of rice and wheat were higher in this treatment than the farmers' practice of raising these crops.
- Recommended weed control measures produced higher grain yield of rice and wheat as compared to farmer's practice of weed control.
- Improved package and practices with improved variety produced highest grain yield of rice and wheat as compared to farmer's practice (local variety, no line sowing, and low fertilizer dose).

Front line Demonstrations:

- Popularization of oilseeds and pulses with improved packages and practices under front line demonstrations helped the farmers to get better yield.
- Popularization of oilseeds and pulses with improved packages and practices under front line demonstrations helped the farmers to get better yield.

2. Research Publications:

1. A.K. Bhardwaj, R.K. Singh, S.P. Singh, Y. Singh, Govindra Singh and R.D. Mishra. 2004. Weed management in zero till sown wheat. *Journal of Rural Agricultural Research,* 36(3,4): 175-177.
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3. Thesis Research:

Agronomy

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2. Sethi, I.B. (2017).Studies on crop intensification and establishment techniques in rice wheat cropping system under irrigated condition.Ph.D. Thesis (Agronomy), GBPUAT, Pantnagar
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Soil Science

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4. Future Thrusts:

On station:

New cropping systems, meeting the requirement of food, fodder, money of farm family need to be evaluated to be fitted in Integrated Farming system perspective.

New IFS model for marginal farmer (1 acre) is to be developed, as most of the hill farmers have marginal land holdings.

IFS model for small farmers' (1 ha) has to be further strengthened to make it more remunerative and carbon neutral.

The IFS models developed at on station need to be tested at our KVKs and other research stations and has to be made more region specific.

OFR component:

Technical programme for the new mandated district of Udham Singh Nagar has been prepared and approved by the Director, IIFSR, Modipuram to be followed from 2017-18 to 2019-20. Total three types of experiments will be conducted as per the technical programme:

OFR 1: On-Farm crop response to plant nutrients in pre-dominant cropping systems and their impact on crop-livestock-human continnum

OFR 2: Diversification of existing farming systems under marginal household conditions

OFR 3: On-Farm Evaluation of Farming System Modules for improving profitability and livelihood of small and marginal farmers.


Picture of crops grown during different seasons in different cropping systems



Integrated farming system module for small farmers


Integrated farming system module for small farmers



Integrated farming system module for small farmers

Integrated farming system module for small farmers

Integrated farming system module for small and marginal farmers