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RESEARCH ARTICLE

# AGRICULTURAL PROFITABILITY THROUGH RESOURCE CONSERVATION TECHNOLOGIES FOR RESOURCE POOR FARMERS' OF UTTAR PRADESH:AN OVERVIEW

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## ABSTRACT

**In farmer's view of point profitability in agriculture is the ultimate aim but, it has become non lucrative profession due to small land holdings coupled with higher input costs and marginal returns. The risk of crop failure due to vagaries of monsoon and incidence of disease, pests and weeds and pressure of credit loans have threatened and compelled the farmer's to migrate to the cities in search of alternative jobs for their social and livelihood security. To overcome above challenging situation adoption of resource conservation technology for increasing profitability in agriculture is the only solution. The basic primary resource required for agriculture are land, water, human labour and capital, while, quality inputs like seed, fertilizer, insecticide-pesticide, improved machinery and tools are the resources directly related to capital investment leading to get maximum production. Profitability in agriculture depends on efficient utilization of all resources coupled with improved technology and with minimum investment. This paper reviewed several technological options in conservation of natural resources, energy management and input saving technologies for increasing profitability of major food crops with sustained productivity. Wide spread sustained adoption of low input-cost saving technology will depend on farmer's as well as extension workers, with clear decision support frameworks required to provide resource poor farmers.**

**Key Words : Resource conservation technology, Crop Diversification, Integrated soil fertility management**

Uttar Pradesh occupies maximum share in area (16.08%) and production (19.93%) of food grains among different states of India in 2008-09, but productivity is nearly half (2365 kg/ha) as compared to the state of Punjab, which produces 4231 kg grain per hectare. Several reasons like uneven topography and poor fertility status of soil, scared ground water resources, water lodged and rainfed condition etc in specific areas and poor resource condition of farmers and fragmented holdings in whole state were responsible for low productivity. The average size of holding in U.P. is 0.81 ha. There are preponderance of small and

marginal farmer's in the state comprising 14% and 76% respectively of the total farmers, however, these groups owned only 24 and 34 per cent land area, respectively. Apart from the small and marginal farmers categories, huge number of farm workers are landless and they do share farming on lease basis.

Crop production by the resource constraints poor farmers' viz., small, marginal and land less are found many times uneconomic and this is the greatest challenge to the agricultural scientists, extension workers and policy makers of the state. It is worth mentioning that we have no option for horizontal approach ie; bringing more area under cultivation and only alternative is to proceed for vertical increase of quality produce per unit area with lower costs to compete in international and national market as Indian agriculture has entered under the umbrella of world trade organization. To achieve this goal, intervention of location specific resource conservation technologies is the dire need of the day.

There is an urgent need to disseminate the well proven, verified and validated technologies under the situations for which it is recommended. It is also pointed out that the technology must be technically sound, practically feasible, economically viable, socially acceptable, user's friendly, environmentally safe to derive desired output.

## Resource conservation technologies (RCT) enhancing profitability

The issue of resource conservation have assured importance in view of wide spread resource degradation and the need to reduce production costs, increase profitability and make agriculture more competitive. Resource conservation technologies will refer to those practices that enhance resource or input-use efficiency. This cover a lot of ground. New varieties that use nitrogen more efficiently may be considered RCTs. Improved tillage, seeding, irrigation, pest management, machinery and tools save fuel, humen energy and time of operations may also be considered as RCT's. There are many more under RCT's (Harrington and Erenstein, 2005).

### – Role of crop rotations in increasing land use efficiency and profitability

The primary constraints of crop production in Uttar Pradesh are low productivity per unit area, shrinking natural resources i.e. land and water and escalating prices of inputs. Under these circumstances crop diversification or selection of best possible crop rotations can be useful mean to increase cropping intensity under different settings of available resources by adding more crops coupled with efficient management practices, optimizing available resource use. Yadav (2010) studies several crop sequences at Kanpur and found significantly superior in terms of productivity and profitability compared with rice-wheat system. Maize + Blackgram-potato-onion and maize-garlic gave highest net return but hybrid rice-wheat give highest benefit.

### –Sustainability of rice-wheat cropping system through inclusion of legumes

Rice-wheat is the most important cropping system of Indian sub-continent, especially in Indo-Gangetic Plains. For a decade or so, the rice-wheat system has started showing signs of stress with production and deterioration in soil health (Yadav *et*

**Table1:** Yield advantage and benefit : cost ratio of some efficient cropping systems for Uttar Pradesh (mean of 4 years)

| Crop rotations | Rice equivalent yield (t/ha) | Cost of cultivation (Rs/ha) | Net return (Rs/ha/yr) | B:C ratio |
|---|---|---|---|---|
| Rice-wheat | 14.06 | 53805 | 65749 | 2.22 |
| Hy. Rice-wheat | 18-79 | 56895 | 102893 | 2.81 |
| Hy.Rice-wheat-g. gram | 22.32 | 72656 | 117081 | 2.61 |
| Maize-mustard-onion | 21.57 | 82315 | 101048 | 2.23 |
| Maize+b. gram-potato- wheat | 30.58 | 110355 | 149652 | 2.36 |
| Maize+b. gram-potato- onion | 39.29 | 123005 | 210997 | 2.72 |
| Maize-garlic | 31.93 | 107624 | 163784 | 2.52 |

**Source:** Annual Report 2009-10 (AICARP) Kanpur

*al.*, 1998, Timsina and Connov 2001). It is happening so, because nutrient removed by crops from soil has for exceeded replenishment through fertilizer and manures, causing negative balance of nutrients in soil (Tiwari 2006). Studies on the effect of pulses in yield, economics and sustainability of rice-wheat system in eastern Uttar Pradesh conducted for seven years' and found a significant improvement when summer green gram was included in the system (Table-2a) (Singh *et. al.*, 1993). The period between wheat harvesting and rice transplanting (approx 75-80 days) can be well utilized for growing short duration summer pulses (Ahlawat *et al.*, 1998, Yadav *et al.*, 1998, Ali 2004).

Development of short duration (55-65 days) varieties of vegetable pea has helped in crop intensification through introduction of a catch crop in early *rabi/spring* season in rice-wheat cropping system. At Modipuram intensive system involving rice-veg. pea-wheat-mungbean have been found feasible for obtaining high productivity and maintaining soil fertility (Gangwar *et al.*, 2005) (Table-2b).

## Intercropping approach

Considerable research work on intercropping of pigeonpea, potato and sugarcane based intercropping systems have been done to maximize the land use efficiency and increase the net monetary income over sole cropping, (Ahlawat *et al*., 1986, Tewari, 2002).

A case study was made by Tewari, 2002, under FAO project on the appraisal of profitability and sustainability of farm enterprises prevailed under peri-urban areas of Kanpur, reported that guava orchard is an important enterprise in the river bed of Ganga. Wheat, coriander, spinach, radish, cauliflower, brinjal, etc are usually intercropped in quick succession to spring/ summer vegetable (okra, bitter guard, bottle guard, sponge guard) in guava orchard. In Jajmau areas rice-wheat system, vegetable, rose, marigold, jasmine are prevailing enterprises. The economic analysis of these intercropping systems revealed that guava-wheat, bottle guard-spinach-wheat, marigold-wheat and fodder (green)-cauliflower-wheat showing benefit: cost ratio of 1.56, 1.49, 1.42 and 1.41, respectively (Table 3).

## Water saving technology

In Uttar Pradesh rice, wheat and sugarcane collectively utilize more than two thirds of our irrigation water resource (Yadav and Srivastava, 2005). The technologies like direct seeding in rice, zero tillage seeding in wheat, furrow irrigated raised bed system in wheat, ring pit system in sugarcane can save 20-25 per cent of irrigation water reported by several scientists.

**Table 2a:** Effect of inclusion of pulses in rice based crop sequences on yield and economic sustainability (Average of 7 years')

| Crop rotations | Grain yield (t/ha) | | | Rice equivalent yield (t/ha) | Net returns (Rs/ha/year) | Sustainable value Index (SVI) |
|---|---|---|---|---|---|---|
| | Kharif | Rabi | Zaid | | | |
| Rice-wheat | 4.11 | 3.76 | - | 12.52 | 1495 | 0.35 |
| Rice-wehat-moongbean | 4.04 | 3.88 | 0.87 | 16.92 | 2063 | 0.64 |
| Rice-mustard-moongbean | 4.05 | 1.58 | 0.72 | 17.09 | 2257 | 0.70 |
| Rice-chickpea | 4.16 | 1.32 | - | - | 924 | 0.33 |

**Source:** Singh *et al.*, 1993).

**Table 2 b:** Effect of catch crop on productivity and profitability of rice-wheat system

| Crop sequence | Rice equivalent yield (t/ha/yr) | Productivity (kg/ha/day) | Net return (Rs/ha/yr) | Profitability (Rs/ha/day |
|---|---|---|---|---|
| Rice-wheat | 10.52 | 28.82 | 31596 | 86.60 |
| Rice-veg. pea-wheat (L) | 20.34 | 55.73 | 72997 | 200.00 |

**Source:** Gangwar *et al.*, 2005

Resource poor farmers can utilize these technologies by rent paid basis. Mulching is another oldest technology for saving of irrigation water in limited irrigation areas.

Saving of irrigation water in tubewell irrigated areas in Uttar Pradesh is on top most priority. It is well known that on farmers' fields one hectare land takes 12-15 hours' by 4 inches tubeweel operated by pumpset and pumpset engine consumes 1 liter diesel per hour. So the total requirement of diesel (energy) for one irrigation is about 12 to 15 lit per hectare costing Rs. 516 to 645 (price @ Rs. 43.0/Lit). Saving of one or two irrigation per hectare in crop production saves Rs. 1000 to 2000 per hectare (cost including diesel + labour + running cost). Resource poor farmers' having no own irrigation system paid more cost per irrigation.

The rainfed areas of Uttar Pradesh have good potential to meet the needs of coarse cereals, pulses and oilseed. The Semiarid south-west zone and Bundelkhand zone have good potential to boost the productivity to a great extent. The significance of life saving irrigation on crop yield in rainfed areas as well as irrigated areas is evident in Table 4a. The yield advantage have been registered to the extent of 51 to 127 per cent merely by providing 1-2 life saving irrigations at critical stages of growth and development of crops. The results achieved at Kanpur on the effect of mulching on economizing irrigation need in potato and thinning of undesired plants in mustard to enhance water use

**Table 3:** Economic analysis of existing intercropping system of peri-urban areas of Kanpur.

| Intercropping systems in guava orchards | Cost of cultivation & other charges (Rs./ha) | Gross income (Rs/ha) | Net income (Rs/ha) | B:C ratio |
|---|---|---|---|---|
| Guava + wheat | 66744 | 104200 | 37456 | 1.56 |
| Brinjal-maize-wheat | 163410 | 214700 | 51290 | 1.31 |
| B.guard-spinach-wheat | 81347 | 121200 | 39853 | 1.49 |
| Fodder-cauliflower-wehat | 82816 | 116760 | 33944 | 1.41 |
| Marigold-wheat | 47450 | 67300 | 19850 | 1.42 |

Tewari *et al.*, 2002.

**Table 4a:** Effect of life saving irrigation on yield of different crops

| Crop | Irrigations | Yield (t/ha) | % increase over unirrigated |
|---|---|---|---|
| Wheat | Un-irrigated | 1.84 | - |
| | Only at CRI | 3.47 | 88.6 |
| | Only at flowering | 2.48 | 34.8 |
| | CRI and flowering | 3.88 | 110.8 |
| Mustard | Un-irrigated | 1.34 | - |
| | Flowering | 2.07 | 51.5 |
| | Flowering+pod filling | 3.34 | 126.8 |
| Chickpea | Un-irrigated | 1.93 | - |
| | Pre-flowering | 2.82 | 51.0 |
| | Pre-flowering+grain filling | 3.11 | 60.1 |

**Source:** A profile of 25 years' achievements 2002 at CSAU, Kanpur

**Table 4b:** Effect of mulching on economizing irrigation and tuber yield of potato

| Irrigations | Tuber yield of potato (t/ha) | |
|---|---|---|
| | No mulching | Mulching (paddy straw) |
| 8 | 33.7 | 35.2 |
| 5 | 32.0 | 37.1 |
| 4 | 30.5 | 34.6 |

**Source:** A profile of 25 years' achievements 2002 at CSAU, Kanpur

efficiency could be utilized for adoption (Table 4b).

**Integrated soil fertility management**

ISFM should be defined as a set of soil fertility management practices that necessarily include the use of fertilizer, organic inputs and improved germ plasm combined with knowledge as how to adopt these practices to local conditions aiming at maximizing agronomic use efficiency of the applied nutrients and improving crop productivity. Combining organic and mineral inputs has been advocated as a sound management principle for small holder farmers' because both inputs are needed in the long term to sustain soil fertility and crop production (Vanlauwe and Zingore, 2011).

Efficient utilization of organic residues under local conditions is not only essential for increasing crop productivity but profitability also by lowering cost incurred in the purchase of costly chemical fertilizers. Addition of organic matter in soil ensures the fertilizer use efficiency (Yadav and Raskar, 2011). In India, the estimated organic crop residue yield is about 205263 thousand tonnes/year of principal crops having 3320 thousand tonnes of total NPK potential (Yadav and Srivastava, 2005) (Table 5a). To harness above local organic crop residue (excluding rice and wheat straw) farmers' have options to adopt different aerobic and unaerobic composting techniques, vermi-composting etc. to produce valuable nutrient in local condition.

**Weed management**

The infestation of weeds in different crop rotation pose several problems by competitive mechanism for nutrient, water, space, solar energy which ultimately reduce crop yield and increase cost of cultivation. In Uttar Pradesh due to implementation of MANREGA scheme the increase of cost and low availability of labour in rural areas for agricultural operations seems to be biggest problem for agriculture. Ones upon a time the herbicides were not attractive to

Table 5a: Estimates of organic crop residue yield and realizable plant nutrient potential from the residues of principal crops in India

| Crop | Residue yield (000 tonnes) | Nutrient concentration% | | | Total NPK potential (000 tonnes) |
|---|---|---|---|---|---|
| | | N | P | K | |
| Rice | 80744 | 0.61 | 0.09 | 1.15 | 1493.8 |
| Wheat | 44987 | 0.48 | 0.07 | 0.98 | 688.3 |
| Sorghum | 11563 | 0.52 | 0.12 | 1.21 | 216.2 |
| Maize | 6219 | 0.58 | 0.09 | 1.25 | 119.4 |
| Pearlmillet | 8283 | 0.45 | 0.07 | 0.95 | 121.6 |
| Barley | 3180 | 0.52 | 0.08 | 1.25 | 58.8 |
| Sugarcane | 15645 | 0.45 | 0.08 | 1.20 | 270.7 |
| Potato | 5062 | 0.52 | 0.09 | 0.85 | 73.9 |
| G.nut | 9580 | 1.65 | 0.12 | 1.25 | 277.3 |

**Source:** Yadav and Srivastava (2005).

Table 5b: Estimates of biological nitrogen fixed by important pulses in India

| Crop | Biological N fixed (kg/ha) | N released into soil (kg/ha) |
|---|---|---|
| Chickpea | 26-63 | - |
| Cowpea | 53-83 | 50.3 |
| Lentil | 35-100 | 32.8 |
| Green gram | 50-55 | 34.5 |
| Pigeonpea | 68-200 | - |
| Field pea | 46 | 59.4 |
| Blackgram | - | 38.3 |

**Source:** Brahmaprakash *et al.* 2004, Singh *et al.,* 1981.

the farmers' in controlling weeds due to high cost input. But now weedicides an attracting attention of farmer's at present to control weeds. Herbicides can manage weed problem effectively with cheaper rate than traditional manual weed control methods (Ramakrishna *et al.,* 2005).

**Epilogue**

It can be concluded from the study that introduction of RCT's would result in reducing cost of cultivation with potential for achieving yield advantages. Thus, the improved productivity on the various system may eventually lead the growth in production of food crops as well as enhance livelihood opportunity and profitably of resource poor farmers, as these resource conservation technologies create future pathways towards sustainable and more profitable agriculture.

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