

Vegetable based diversified farming

enhanced farm profitability under sodic environments

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For enhancing income of reclaimed or marginal sodic lands irrigated with alkali water, vegetable based partial crop diversification module was synthesized at farmer's field under Farmer FIRST Programme. Out of total 4.5 acres land area, only one acre was converted into vegetable and fodder based diversified cropping systems depending on the farmer's resource base and family size/ labour availability. Two crop sequences including short duration vegetables in cereal (rice–garden pea–onion) and fodder (sorghum–cauliflower–okra) based cropping systems enhanced productivity and profitability margins with an additional income of ₹ 1,11,903 and incremental benefit cost ratio of 3.74 for each rupees incurred towards the cultivation of vegetable crops compared to traditional rice-wheat system.

Key words: Crop diversification, Reclamation of sodic soils, Sodic environments, Vegetables

INDIA is an agrarian country with 70% of population residing in rural areas. Agricultural situation in the country is characterized by small land holdings (average farm size ~1.57 ha). Indian agriculture is now facing the twin challenges of sustaining the productivity and enhancing the farm income. Further, the herculean task is to bring the waste and marginal lands under profitable crop production. Out of the total waste lands in the country, about 6.73 m ha is salt affected underlain with poor quality waters (32–84% in different states) for irrigation. The reclamation of these salt affected lands with introduction of profitable diversified cropping systems can help in meeting the national goal of increasing the food grains production and doubling farmers' income.

Agricultural crop diversification is an important stress relieving option for economic growth of the farming community. Crop diversification refers to the addition of new crops or cropping systems to agricultural

production on a particular farm taking into account the different returns from value added crops with complementary marketing opportunities. Crop diversification and inclusion of the new varieties in stress environment can be one of the important technologies in increasing the farmers' income to a satisfactory level. Mono-cropping is more prone to high risks of unforeseen climate events that could severely impact agricultural production, such as emergence of pests and the sudden onset of frost or drought. Diversification of agricultural production system also increases natural biodiversity, strengthening the ability of the agro-ecosystem to respond to these stresses. The introduction of new cultivated species and improved varieties of crop is a technology aimed at enhancing plant productivity, quality, health and nutritional value and/or building crop resilience to diseases, pest organisms and environmental stresses.

Problem identification and prioritization

To sustain the productivity of

problematic soils irrigated with poor quality waters, ICAR-Central Soil Salinity Research Institute (CSSRI), Karnal adopted 5 villages in Kaithal district of Haryana state under Farmer FIRST Programme (FFP). More than 40% of farm lands are sodic (soil pH_e 8.2) and 90% of groundwater is of alkali nature (RSCe 2.5 meq/l) reducing crops productivity to a greater extent. Different technological intervention for reclamation of sodic soils and neutralization of high RSC waters through gypsum and pressmud, introduction of salt tolerant varieties, installation of drainage-cum-groundwater recharge structures etc. substantially enhanced the agricultural productivity in the affected areas. Increasing the farm profitability (total income) from these reclaimed marginal lands was taken up as the next initiative for improving the farmers' livelihood. For this, crop diversification including short duration vegetables in the prevalent rice-wheat system was taken as next step of intervention.

Table 1. Economic analysis of diversified cropping systems

Crop/ Activity	Area (acres)	Crop	Total yield (q)	Cost of cultivation	Gross returns ($\times 10^3$ ₹/ha)	Net returns	B:C ratio
<i>Traditional system</i>							
Rice (Basmati CSR 30)–	4.0	Rice	48	60.0	201.6	141.6	3.36
Wheat (HD 2967)		Wheat	80	38.8	138.8	100.0	3.58
Sorghum*–Berseem*	0.5	Sorghum				Fodder purpose	
		Berseem				Fodder purpose	
Total	4.5			98.8	340.4	241.6	3.45
<i>Diversified system</i>							
Rice (PB 1509)–	0.5	Rice	10	8.8	27.0	18.3	3.09
Pea–Onion		Pea	12.5	7.3	20.3	13.0	2.78
		Onion	50	20.0	86.3	66.3	4.32
		Onion nursery	-	6.7	15.0	8.3	2.23
Sorghum*–Caulifl- ower–Okra	0.5	Sorghum				Fodder purpose	
		Cauliflower	40	6.9	30.0	23.1	4.36
		Okra	17.5	8.5	34.1	25.6	4.02
Rice (CSR 30)–	3.0	Rice	36	45.0	151.2	106.2	3.36
Wheat (HD 2967)		Wheat	60	29.1	104.1	75.0	3.58
Rice (CSR 30)–	0.5	Rice	6	7.5	25.2	17.7	3.36
Berseem*		Berseem				Fodder purpose	
Total	4.5		–	139.7	493.2	353.5	3.53

*Fodder for animal component, not considered while calculating the system economics

Farmer selection, Training acquisition and Confidence Building

Focused group discussions *vis-à-vis* individual farmers were contacted initially though the farmers were little bit hesitant to take initiative. The farmers were of the opinion that dominant sodicity stress may not support the cultivation of high value crops like vegetables and they may not be able to harvest equivalent to what they are earning through traditional rice-wheat system. For this, the interested farmers were taken to the demonstration sites twice-thrice and interacted with the farmers growing vegetable under almost similar climatic conditions. This practice not only helped in their confidence buildup (believing by seeing) but also motivated themselves to transform themselves and raise their interest towards vegetable cultivation from the usual rice-wheat sequence.

A farmer from Kathwar village of Kaithal district, Shri Pyarelal Singh (58 years old) was selected as a part of pilot project study. Shri Singh owns 4.5 acres of land and cultivating field crops such as rice, wheat, fodder sorghum and berseem along with 3 milch animals. He is a hardworking

and progressive farmer who motivated himself to take new initiative of diversifying the traditional system including short duration vegetables in marginal sodic soils and improve his farm profitability. Despite of risk-taking capabilities and eagerness to learn something new, Shri Singh lacked technical approach towards vegetable cultivation and related activities. To improve his skills further, he was trained at specialized training centers (NHDRE, Salaru, Karnal and Center of Excellence for Vegetables, Gharaunda, Karnal) through short-term capacity building programme.

Technology assemblage

For the business as usual (farmer's practice), Shri Singh would have opted for cultivating 4 acre of land with traditional rice (CSR 30 Basmati)-wheat (HD 2967) system and rearing half acre under sorghum-berseem sequence for

fodder requirement of animals. To explore the bio-economic feasibility through vegetables and confidence building, only one acre of land was put under crop diversification replacing traditional CSR 30 Basmati with short duration PB 1509 and wheat with short duration vegetables (Table 1). Within occupied area, cereal (rice–garden pea–onion) and fodder (sorghum–cauliflower–okra) based cropping sequences were designed in such a way that need based household and fodder requirements of the concerned farmer be fully justified without much variation from the traditional farming practice.

Under diversified cropping sequence (2017-18), after the harvest of *khari* sown early maturing rice (PB 1509), garden pea (Kashi Ageti) was sown on 13 October on half acre of land and harvested on December 25 2017. Later, onion seedlings (L 28) were transplanted on 15 January

Table 2. Comparison of diversified and traditional cropping systems

Cropping system	Productivity (q WEY/ha)	Production efficiency (q WEY/ha/day)	Net returns ($\times 10^3$ ₹/ha)
Traditional	43.6	0.81	242
Partially diversified including vegetables	63.2	1.86	354

and harvested on May 25 2018. Shri Singh also gained additional monetary benefits through the sale of onion seedlings to the neighbouring farmers. On another half acres of land, he took fodder sorghum as the first crop in *kharif* season for fodder purpose, later transplanted cauliflower (hybrid) seedlings on 25 October 2017. After cauliflower, okra (Kashi Kranti) was sown on Mar 5 and harvested on June 8 2018. The same cropping sequence was followed during 2018–19. All the crops were grown with recommended package of practices with regular consultation/guidance from CSSRI experts.

Components crop yields and profitability

Most of the cultivated vegetables were sold at the farm itself to the retail vendors besides meeting his household requirements. The economic analysis of diversified cropping sequences *vis-a-vis* traditional rice–wheat system is presented in Tables 1 and 2. An additional expenditure of ₹ 40,885 was incurred towards diversifying one acre area with vegetables as against

the traditional farming of cultivating rice and wheat crops in sequence on total 4.5 acres of land (Table 1). However, an additional income of ₹ 1,11,903 was generated with incremental benefit cost ratio of 3.74 for each rupees incurred towards the cultivation of vegetable crops compared to traditional rice–wheat system. Further, the productivity of partially diversified system remained 63.2 q/ha as against the 43.6 q/ha with traditional farming practice (Table 2). The production efficiency was quite high (1.86 q WEY/ha/day) compared to 0.86 q WEY/ha/day under the traditional rice–wheat system.

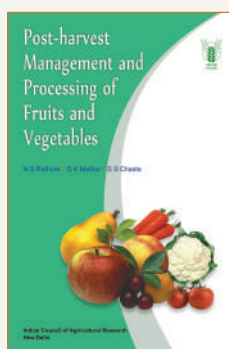
SUMMARY

Corrective diagnosis, reclamation and management practices helped to better manage RSC water irrigated sodic land for growing wide range of crops. Strong farmers–scientist interface keeping farmer in a centric mode, expert guidance and participatory approach convinced the selected farmer to opt for crop diversification, getting good crop harvest and fetching remunerative

prices of his produce. Adoption of diversified cropping sequence in only 20–25% of total land area substantially enhanced the farm profitability, besides meeting the daily household needs of fresh vegetables and fodder for the animals. The neighboring farmers are also convinced with the demonstrated technological module and some of them have even started growing vegetables on commercial scale depending on their resource base and family size/labour availability. Therefore, partial crop diversification through short duration vegetables or other suitable crops could be a viable option to convince the farmers regarding feasibility of crop intensification and enhancing their productivity and profitability margins, employment generation, nutritional and livelihood security in marginal or reclaimed sodic lands irrigated with alkali waters.

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