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Changing Agricultural Pattern Post Green Revolution in South Eastern Rajasthan

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ABSTRACT: In general, the cropping pattern encompasses the study of area allocation to various crops, production and yield. To understand the cropping pattern holistically, we broaden the scope of the definition and include seed and fertiliser use pattern in it as the use of these inputs directly influences cropping pattern. Thus, the objectives of the study are to examine (1) changes in crops grown including expansion and shrinkage of area under various crops; (2) growth in horticultural crops; (3) seed replacement rate; (4) trend of chemical fertiliser use among different crops and area; and (5) yield scenario. This study does not delve into the identification of determinants of changes in cropping pattern as that has already received adequate attention. Job of agriculture stays imperative in empowering the State to accomplish and keep up nourishment self-sufficiency, particularly, in a poverty-stricken State. Supportable development of agriculture depends essentially on the procedure of horticultural change, which thus is very much associated with movements in cropping patterns. Lazy move in the cropping pattern towards non-sustenance grain crops in the State is because of moderate development of irrigation, low degree of fertilizer utilization, slow technology adoption and low degree of infrastructure. The lull during the time spent cropping pattern change implies that most government endeavors to diversify agriculture have neglected to take off. Covering south eastern Rajasthan, the Sidhmukh canal has radically caused an adjustment in land use land spread.

KEYWORDS: agricultural, crop, Rajasthan, south-eastern, post green revolution, pattern

I. INTRODUCTION

Cropping pattern implies both existence grouping of crops. It incorporates the escalation of the most productive crops of the district which is viewed as a homogenous soil and climatic qualities, the turn wherein the crop fits in and the force of cropping. Along these lines the term cropping pattern is used in increasingly far reaching sense when we examine in term of cropping pattern for farmers it will mean notwithstanding cropping plan and cropping force most appropriate to the farmers. Cropping pattern alludes to the proportionate area under various crops during an agricultural year. It implies the arrangement of crops at a point of time. Cropping pattern must guarantee the best effectiveness of man, fertilizers, irrigation and different information sources. It is dynamic idea as no cropping pattern can be reasonable for all occasions to come. An effective cropping pattern infers the most productive use of arable land, endless supply of water resources, bio-chemical data sources and the like. Likewise, it must offer the cultivators the likelihood to boost agricultural efficiency per unit area per unit of time. A cropping pattern is dictated by the connection of physical[1,2] and financial factors over some undefined time frame. No cropping pattern can be useful for all occasions to come. Be that as it may, there is regularly a propensity for the cropping pattern to balance out over some undefined time frame in various agro-climatically homogeneous cultivating area.

Treatment	Weed density* (No./m^2)		Weed dry matter (g/m^2)		Weed control efficiency (%)	
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS
Weedy check	13.11 (170)	14.1 (196)	292.6	415.5	-	-
Two hand weedings 30 & 45 DAS	0.7 (00)	5.1 (25)	0.00	53.7	99.9	81.6
Alachlor 2.0 kg/ha PE	8.8 (77)	8.9 (80)	83.6	158.0	71.4	46.0
Trifluralin 1.0 kg/ha PPI	7.5 (56)	7.8 (61)	64.8	124.2	77.9	57.6
Imazethapyr 75 g/ha POE	5.5 (35)	6.3 (40)	41.8	84.8	85.7	71.0
Imazethapyr 100 g/ha POE	5.3 (32)	6.1 (36)	37.3	79.0	87.3	73.0
LSD (P=0.05)	0.31 (8.7)	0.27 (12.6)	11.2	21.1	-	-

*Data subjected to $\sqrt{X+1}$ transformation and figures in parentheses are original.

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Agro-Economic cropping pattern of Weed Management in Soybean Grown in Vertisols of South-Eastern Rajasthan

Change in cropping pattern is one of the significant parts of changing agricultural situation of Sidhmukh Canal Catchment Area. In the prior investigation, it has been seen that the cropping pattern has been experiencing ceaseless changes as far as real esatate designation or production creation since 1970-71. The expansion in real esatate portion or production arrangement has been described by a noteworthy move of area from different crops to boro rice, potato and mustard or increment in part of boro rice, potato and mustard to add up to agricultural production contrasted with different crops. Presently, all out agricultural production in value terms of any topographical area at whatever year is the entirety of the output in value terms of various crops created in that district during that specific year. Output of any individual crop in value terms again relies upon real esatate appropriated for developing that crop, yield and price of that crop. On the off chance that prices are thought to be steady, value of output of each crop changes because of variety in area and yield level. Subsequently, all out agricultural production of some random locale shifts because of changes in gross cropped area (GCA) (entirety of area under every one of the crops, developed in the district), yield of each crop and reallocation of all out area for the production of each crop expecting, prices to be consistent. Changes in agricultural output because of reallocation of land resources to various crops, when all out area under development, yield of each crop and prices stay consistent, speak with the impact of crop enhancement or changing cropping pattern[3,4] on agricultural production. Decay of agricultural production growth in Sidhmukh Canal Catchment Area, into the commitments of changes in area, yield and cropping pattern is a further disclosure of dynamic growth process.

The study brings out that foodgrains continue dominating the cropping pattern in the state. Decline in the acreage of foodgrains is mostly due to reduction in the proportion of area under coarse cereals. The share of pulses in total cropped area has rather gone up. There is a marginal increase in acreage of oilseeds and fodder crop. Minor crops like spices, drugs & narcotics and vegetables have also recorded marginal increase in their acreage. There is dominance of coarse cereals, pulses and fodder crop in rainfed agriculture in arid and semi-arid areas in western and northwestern parts of Rajasthan. But semi-humid and irrigated areas experienced dominance of fine cereals and remunerative crops. The cropping pattern in the state continues to be quite diversified with not much change over last two decades. Central and southern parts of the state dotted with Aravalli hills have had most diversified cropping pattern. Least diversified cropping pattern in the state is found in the core desert area in the core of Thar Desert. But there is a tendency of diversification in the cropping pattern away from foodgrains in the state particularly in northwestern and extreme southwestern region. The tendency of diversification in the cropping pattern in favour of non-foodgrain crops such as guar and soybean may be attributed to price factor and commercial value. However, there are not many indications to suggest that economic liberalization has effected significant changes and diversification in cropping pattern in Rajasthan Diversified cropping pattern in the state, indeed, is a reflection of the diversity in agro-ecological conditions, and diffusion of irrigation and agricultural technology in some areas.

II. DISCUSSION

A major section of Farm families of Rajasthan falls in the category of small and marginal farmers. Farmers of this category are most affected people by natural calamity like drought.

Rain fed agriculture is common practice in this region, predominantly pearl millet - fallow mono culture system. Only around 35 percent area is irrigated and is under double more crops in a year.[5,6]

Dependency mainly on crop production might have led to a high degree of uncertainty in income and employment to the farmers. In this context, it is imperative to evolve suitable strategy for augmenting the income of a farm with integration of various agricultural enterprises viz., Crop production, animal husbandry, fishery, forestry etc. have great potential in the agricultural economy with minimum risk to farming community.

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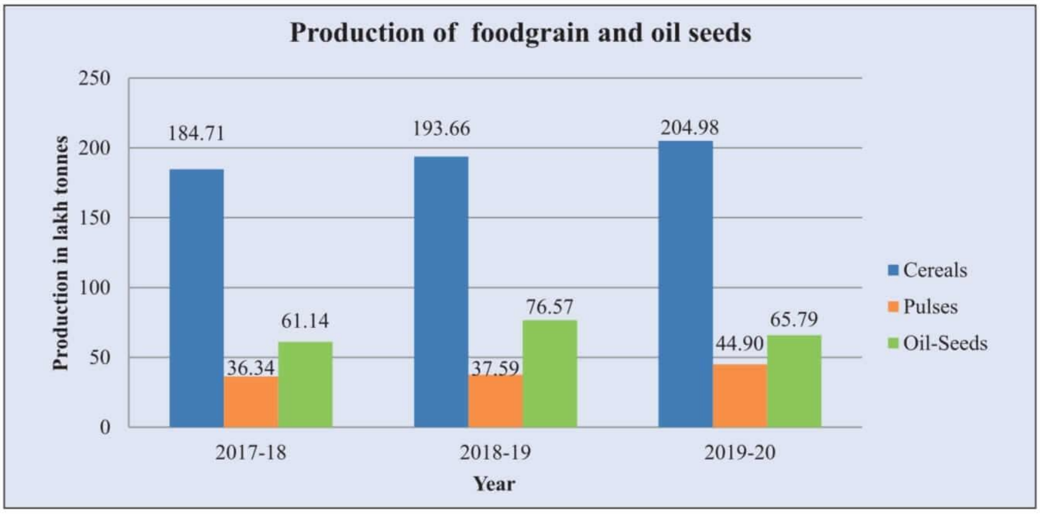

Production by cropping pattern change in south eastern Rajasthan

These enterprises not only supplement the income of the farmers but also help in increasing the family labor employment. The integrated farming system approach introduces a change in the farming techniques for maximum production in the cropping pattern and takes care of optimal utilization of resources.

There are four categories of farmers noticed in Rajasthan state viz., marginal farmers (less than 1.0 ha holding size), small (1.0-2.0 ha holding size), medium farmers (2.0—4.0 ha holding size) and big farmers (4.0-10.0 ha holding size).[7,8]

Important Integrated Farming Systems defined for Rajasthan in relation to holding size, land situation and irrigation facilities are described as under.

MARGINAL & SMALL FARMERS, MEDIUM LAND SITUATION AND PARTIALLY IRRIGATED CONDITIONS

Crops +Vegetable +Poultry + Piggery .

MARGINAL & SMALL FARMERS, LOW LAND SITUATION AND IRRIGATED CONDITIONS

Crops + Fishery + Poultry/Duck keeping + Piggery

Paddy +Fishery + Duck keeping

MEDIUM FARMERS AND BIG FARMERS, MEDIUM LAND SITUATION

Crops +Dairy Cattle +Fodder crops/Vegetables

Crops +Dairy Cattle + Fruit crops +Fodder crops/Vegetables

MEDIUM FARMERS AND BIG FARMERS, LOW LAND SITUATION

Crops +Poultry + Fishery +Piggery

UPLAND, RAIN FED AND FOREST COVER AREAS

Crops + Goat keeping + Apiary + Lac cultivation / Sericulture

Crops + dry land fruit crops + Rainy season vegetables + Fodder trees

Convergence of compatible farm enterprises which constitutes Integrated Farming System is Demand of the time for increasing and sustaining the productivity and generating employment in agriculture Furthermore, integrated Farming System provides safety to farmers from total loss due to failure of crops in changing climate. [9,10]

In Rajasthan, it is grown on an approximate 10000 ha of land as vegetables and it occupies nearly 0.5 per cent of total area in the country. The productivity in the state is 116.96 q/ha (2012-13) (and was almost 40% of the nation (227.6 q/ha) productivity on such harsh and non-traditional areas (WWW.agriexchange.apeda.gov.in/production/). The crop is

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grown by many vegetable growers for local household consumption either in very small area or in kitchen gardens but these are not in black and white in the state production statistics. The contribution was totally rainfall dependent and production varies from 54.82 to 178.02 (000'tonnes) from 2005 to 2013-14 (Agricultural Statistics at a Glance 2014). Under such harsh climatic condition (non-traditional areas for potato cultivation) where soil and water along with climate pose a great threaten to cultivation, crop has great potential for increase. It is sure that the production may be boost up and may be touch the national status if managed properly by following improved agronomic practices under changing climate and global warming situations. Potato is grown in almost all the districts excluding Barmer, Jaiselmer and Jodhpur of Rajasthan. The major potato producing districts are Dholpur, Bharatpur, Kota, Sirohi, Jhalawar etc. in the state. The production is largely dependent of rainfall pattern (Rajasthan Agriculture Statistics at a Glance 2012-2013).

III. RESULTS

In rainfed arid regions where soils are very poor in nutrients and loss of applied nutrients are more due to adverse climatic situations, INM can be a rewarding strategy. Leaving crop residues in soil has shown positive effects on grain yield of crops (Hadmani et al. 1982). Green manuring with Leucaena improved the efficiency of fertilizer N and helped overcome N immobilization (Katyal and Das 1993). Substituting 50% of fertilizer with organic manure (FYM) resulted in higher yields nearly similar to those obtained with full fertilization (Rao and Singh 1993). Rao and Singh (1993) reported crop residues to be as efficient a source of nutrients as FYM and compost. It also increased the organic matter content of soil. High yield stability was observed when recommended NPK was used with 10 t FYM/ha (Hegde and Gajanan 1996). The application of 5 t/ha FYM on pearl millet-cluster bean rotation and monoculture of pearl millet gave 17.2% and 6.1% higher yields than pearl millet monoculture without FYM, respectively (Saxena et al. 1997). The integration of chemical fertilizers with organic manure and biofertilizers can maintain soil fertility and sustain crop productivity (Jeyabal et al. 2000). The increase in water-use efficiency under treatments involving the combined application of FYM and inorganic fertilizer is due to relatively rapid root and shoot growth (Ghosh et al. 2003). The combined application of 10 kg N /ha+ 9 kg P/ha + (Rhizobium + PSB) gave at par seed yield in cluster bean but higher net returns compared to the application of 20 kg N/ha + 18 kg P/ha (Singh et al. 2004). Kumar et al. (2005) reported that application of 5t FYM + 50% of recommended dose of fertilizer (40 kg N/ha + 8.75 kg P/ha) gave significantly higher dry matter in forage sorghum over the control. In cluster bean, inoculation with Rhizobium and PSB individually increased yields by 17.06% and 19.69% respectively, whereas their combined application increased yield by 22.35% (Anonymous 2006a). At SK Nagar, the inoculation of moth bean seed with PSB alone or in combination with Rhizobium resulted in significant increase in seed yield over the control (Anonymous 2008). A barley-moth bean rotation study at Bikaner revealed that application[11,12] of 10 t compost/ha + 50% recommended dose of fertilizer in barley recorded the highest grain and straw yields over the control and its residual effect on moth bean crop gave 235 and 345 kg higher grain and straw yield over the control (Anonymous 2007). Rao et al. (2007) working in Pali district of Rajasthan reported that the application of 5 t FYM + 50% of recommended dose of 30 kg N/ha and 8.75 kg P/ha significantly increased green and dry fodder yields of sorghum by 35.1% and 35.7%, respectively over the control. The water use efficiency in FYM-treated plots was also higher over that of the control. These studies clearly show a large variation in crop responses to fertilizer and manure application across locations. This could be because arid soils vary with land use pattern, soil moisture status and soil organic matter content. Therefore, soil test-based application of fertilizers and manure is of utmost importance and developing soil test-based health cards for each farmer should be a priority intervention.

In arid regions with very low soil organic matter and weak soil structure, soil amendments like pond/ tank sediments, vermiculite, FYM, etc. were found very promising in improving the moisture retention capacity of, soil. The mixing of pond silt up to 30-40 cm of the soil depth at 76 t/ha increased available water storage capacity from 6.5-6.9%, reduced infiltration rate from 15-13.2 cm/ha and hence increased yields of pearl millet by 40-50% and of mung bean by 35-40% over the control. Use of vermiculite at 20 t/ ha increased 0.1 bar moisture retention from 10.03% to 12.4%, reduced saturated hydraulic conductivity from 8.6 to 6.5 cm/h and bulk density from 1.62% to 1.57 g/cu cm (Gupta et al. 1979). Surface application of FYM (5 t/ha) and Calotropis procera residue (2t/ha) increased the yield of pearl millet by 30% (Agarwal and Sharma 1980, CAZRI 2007a). Therefore, the desilting of village ponds and tanks as done under various governmental schemes such as MGNREGS, integrated watershed management program (IWMP) should be properly dovetailed with agriculture development programmes in dry areas of western Rajasthan and be utilized for improvement of soil quality and water availability on cultivated lands. Further, the use of FYM, compost and vermicompost would improve soil productivity and moisture conservation.[13,14]

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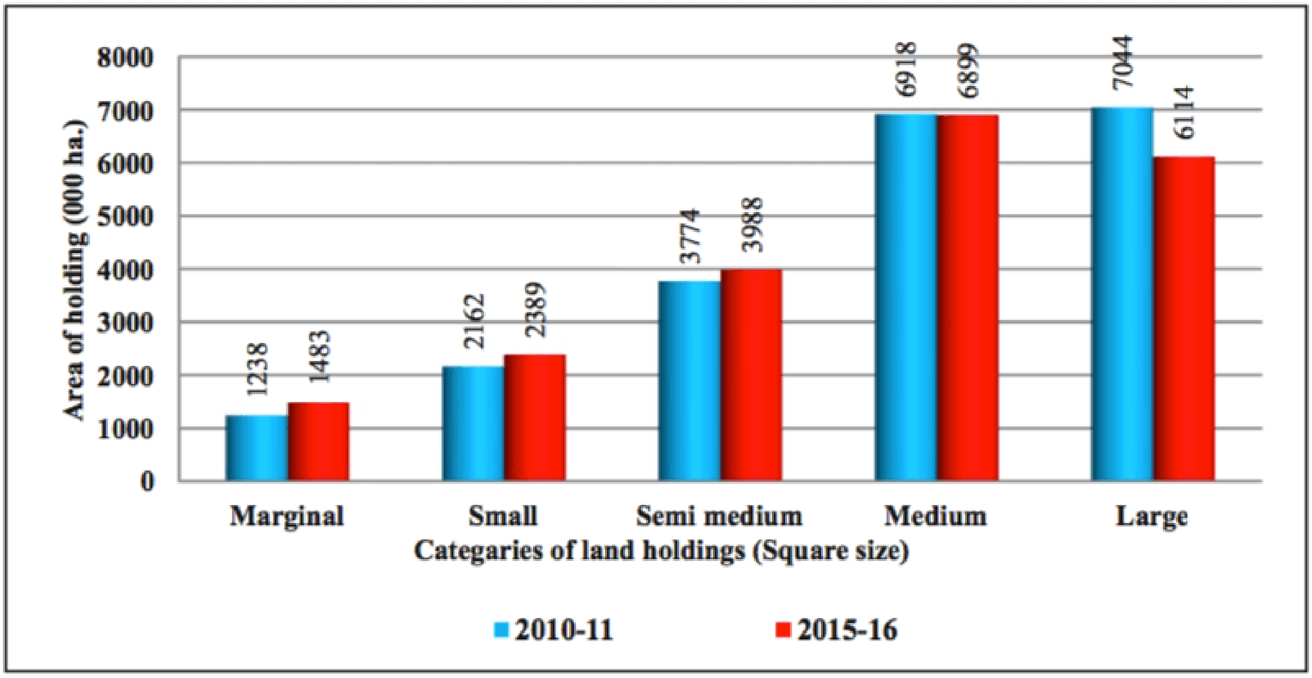

Land holding pattern in south eastern Rajasthan

With changing times, agricultural labor is becoming scarce and timely harvest becomes a challenge for farmers, leading to heavy losses of produce during harvesting. Overdrying of arable crops, specially pulses, results in splitting of pods and shedding of leaves that cause heavy losses in valuable fodder resource. Also, delayed harvesting invites birds and insect pests to damage seed in the field. Even after harvesting, the nonavailability of a proper threshing floor makes farmers keep the harvest in the field for a longer time, subjecting it to heavy damage by birds, rodent and insects. The losses are maximum in kharif pulses and minimum in cluster bean. Heavy damage to a standing crop of pearl millet by birds has been observed. Similarly, overdrying of the sesame crop may result in total loss of seed due to splitting of capsules. In rabi crops too, unscientific management during harvesting and postharvest has been observed to lead to heavy losses due to insectpests, diseases, rodents, birds and untimely rains. Proper facilities to store grain are almost nonexistent with small and marginal farmers of this arid tract. However, medium to large farmers store the grain in their houses for two to three months. In the absence of proper storage facilities, the dryland farmers sell the surplus produce at the earliest, mostly at a lower price. However, traditional storage bins called 'obries' where grain is stored for year round consumption are still prevalent. [15,16] Other traditional storage structures are 'kothis', or wooden boxes, straw bins, iron boxes, etc. It is estimated that about 20-30% of produce gets damaged due to harvest and postharvest losses in arid Rajasthan.

IV. CONCLUSIONS

Proper harvesting practices, both manual or with tractor-drawn implements, need to be popularized among farmers of the arid zone. The traditional sickle in use is not very efficienct and needs to be replaced by serrated sickles developed by various research institutes [Central Research Institute for Dryland Agriculture (CRIDA), Central Institute of Agricultural Engineering (CIAE), and State Agriculture Universities (SAUs)]. Studies conducted on farmers' fields revealed that serrated sickles are 25-30% more efficient than the traditional implement. Similarly, tractor-drawn threshers need to be made popular among the farmers to save time and reduce drudgery, especially for women who mainly carry out this operation. Removing potential pests and their food before filling grain bins will greatly prevent postharvest losses. New grain should never be stored on top of existing grain. Treating empty bins is most effective when insect activity is likely [17,18] (in temperatures over 30°C). The inner walls and floors should be treated with residual insecticides such as Malathion after thorough cleaning. The external walls (up to 15 feet) and outer base of the bins may also be treated. The kernels must be cleaned prior to storage. Dirty grain can prevent adequate air flow and uniform aeration. Any grain protectant (neem products, etc.), top dressing or fumigation will be more effective with clean grain. It is crucial that the grains mass temperature be reduced to 20°C and the moisture is below 9-11% soon after storage. Whenever the grain mass is above 32°C, it should be inspected for insects every two weeks. Samples should be taken from several depths and locations, paying particular attention to the grain mass surface, central core and development of any hot spots.

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If grain is expected to remain in storage bins for over 12 months, use of protectants may be considered. These are generally applied to whole grains as they are being augered, loaded, or turned into storage facilities. Application is avoidable before high temperature drying. Sometimes, top dressing with insecticides is recommended instead of treating the entire grain mass. Application should be made as soon as the grain bin is filled and the surface is levelled. Fumigation is done for stored grain infested with internal feeders (eg, weevils and lesser grain borer). Fumigants are extremely hazardous and should be applied by a professional. Fumigants have no residual activity and grain will become susceptible to reinfestation.

In order to avoid the risk of frequent drought, farmers in western Rajasthan traditionally grow arable crops in conjunction with perennial trees and shrubs. Besides ensuring production even during the worst drought, the traditional agroforestry components provide most of the family's requirement for food, fodder, fuel, timber, etc. The common tree, shrub, crop and grass combinations in the traditional agroforestry systems in different rainfall zones of western Rajasthan are given in Table 8. Prosopis cineraria (khejri) and Ziziphus nummularia (bordi) are the two most important multipurpose woody components in traditional agroforestry systems of the region (Kar et al. 2009). However, due to overexploitation and faulty management of perennial components, the existence of these traditional agroforestry systems is threatened. For example, uprooting Calligonum polygonoides for firewood, removal of Z. nummularia due to tractorization of cultivated lands, almost complete removal of Tecomella undulata for furniture and heavy mortality in fully grown trees of P. cineraria are the major causes of reduction in the density of these multi-purpose tree species (MPTS) in croplands resulting in reduced productivity and unsustainable livelihoods. Due to mechanization, new seedlings of many of these agroforestry plants are not coming up. Most of these tree species are very slow growing and even after replanting, take a long time to come to production stage; for example, P. cineraria requires at least 10 to 15 years to produce leaf twigs (loong) and T. undulata takes at least 20-30 years to be used in the furniture industry. [19] Trees have been the backbone of the rural economy in Barmer district. Most of the traditional fodder tree and shrub species of the Thar desert are not only slow growing but are of low productivity in the early years of growth. Better alternatives which yield faster results (Hardwickia binata, Ailanthus excels, etc.) are available on cultivated lands depending on the sub-agroclimatic situation in the Thar desert.[20]

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