DECLARATION

I do hereby declare that the dissertation entitled upon "Viability of Rainfed Agriculture –per unit cost reduction due to technology adoption and value capture by farmer" is an original and independent record of project work undertaken by me under the supervision of Dr. MCS Bantilan ,at ICRISAT,Patancheru,India ,during the period of my study as a part of curriculum of masters in agri-business economics.

HYDERABAD

Date- 14th July 2012

By

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VIABILITY OF RAINFED AGRICULTURE-per unit cost reduction due to technology adoption and value capture by farmers

Report Submitted to

International Crops Research Institute For The Semi-Arid Tropics

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Title :Viability of rainfed agriculture – per unit cost reduction due to technology adoption and value capture by farmers

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ABSRACT:

Indian Agriculture continues to be dominated by rainfed agriculture with nearly 52% of the net cultivated area not having any access to irrigation. It accounts for 40% of the country's food production .It has been estimated that even if the entire irrigation potential of the country is utilised ,half of the cultivated area will continue to be rainfed. Hence it is necessary to increase the productivity levels of major rainfed crops to meet the ever increasing demand of food ,which emphasizes the critical importance of rainfed agriculture in The Indian Economy and food security.

This paper attempts to examine the performance of the major rainfed crops. The Village Level Studies of ICRISAT have been used to compute the cost, returns and profit levels. It is a comprehensive study using the VLS of the households from the two villages Shirapur and Kinkheda in Maharashtra ,undertaken from 1975-1984 and later resumed in 2001-02 with a more representative sample.The farmers of the villages changed their cropping pattern over time .The study examines the viability of different crops to assess whether the farmers are better off with the new crops vis a vis the old.

A comparative study of the profitability levels have been done of the majorly irrigated and rainfed crops cultivated in the two villages .A similar comparison has been undertaken between the crops that are solely grown with those that are intercropped ,using the profitability levels. This paper also gives a clear picture of the cost reduction due to technology adoption, particularly the improved variety of seeds used by the farmers.

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Contents

INTRODUCTION:

India's agriculture has been described by many analysts as a gamble with monsoons.The Royal Commission on agriculture (1929) found that "Indian farmer is born in debt ,lives in debt and dies in debt."We are no doubt self-sufficient in food grain production today yet the farmers in the rainfed areas continue to gamble with the monsoons and live in debt. The Green Revolution in the irrigated tracts of the country has largely bypassed the arid and semi arid regions ,which constitute the bulk of the dryland areas.

The "NEW DEAL" to rural India is aligned with a "pro-poor" people centered perspective for development.It underlines growth based on efficiency and equity and stimulates the agricultural economy to boost incomes, demand and growth across the vast rural heartland.,home to 72% of india's population. Increased intensification of agriculture through intensive use of irrigation, fertilisers,pesticides and high-yielding varieties in more favoured high potential zones were the major driving forces behind the green revolution success. However many regions in less-favored areas like drylands have not benefitted from this agricultural transformation .Low productivity of rainfed agriculture ,widespread poverty, water scarcity and degradation of productive resources are threatening to further marginalize dryland agriculture and livelihoods. If future agricultural growth is to benefit the poor and contribute towards equitable economic growth ,it is important to recognize the potential of the dryland regions ,and design suitable strategies and policies for stimulating sustainable productivity growth in these regions.Agriculture must receieve the priority attention it deserves .The second green revolution needs to be focused on the dryland areas.

One lesson learnt from the Green Revolution experience in Asia was that its benefits did not reach the poor and the less favourable Rainfed regions.These areas are likely to require approaches that differ from the green revolution strategy.This calls for an interdisciplinary and crosscutting approach to address poverty and design interventions for rainfed agriculture that is long term and sustainable.

The most recent estimates put rainfed croplands at 1.75 billion hectares, which are about five times the irrigated areas of the world.South ASIA and Sub-saharan Africa are home to the largest droght prone areas.

Table 1. Comparison of important characteristics of predominantly rainfed and irrigated regions of India

Parameters	Rainfed regions	Irrigated regions	All regions
Poverty ratio, head count, %	37	33	35
Land productivity, INR/ha	5716	8017	6867
Labor productivity. INR/ha	6842	9830	8336
Per capita consumption of food grains, kg/year	260	471	365
Infrastructure development index	0.30	0.40	0.35
Social development index	0.43	0.44	0.43

Rainfed agriculture is practiced under a wide variety of soil type, agro-climatic and rainfall conditions ranging from 400 mm to 1600 mm per annum. It is estimated that 15 M ha of rainfed cropped area lies in arid regions and receives less than 500 mm rainfall, another 15 M ha is in 500-700 mm rainfall zone, and bulk of 42 M ha is in the 750-1100 mm rainfall zone. The remaining 20 M ha lies in 'above 1150 mm/ annum' zone. As rainfed production is spread over different climatic regions, it offers great scope for raising a number of diversified crops. At the same time, potential of improving agricultural productivity under rainfed conditions thus also varies considerably. The last four decades of Indian agriculture which registered overall impressive gains in food production, food security and rural poverty reduction in better endowed 'Green Revolution' regions , bypassed the less-favored rainfed areas which were not the partners in this process of agricultural transformation. Both national and international research at experiment stations, operational projects and demonstrations at farmers' fields have conclusively shown that highest gains and acceptance of the interventions was seen when insitu-exsitu rainwater harvesting and its subsequent utilization in the field was made an important component of technological interventions for improving productivity of drylands.

PRESENT SCENARIO:

The Indian Economy is now passing through a critical phase and poised to take off to a higher growth path. Performance of agriculture is critical to achieve and sustain higher growth rates that are required to address the goals of reducing poverty and underdevelopment .For agriculture to contribute to the economy ,performance of rainfed agriculture is very important.As investments in irrigated areas continue to increase ,their marginal returns come down gradually,whereas in the rainfed areas ,the marginal returns from additional government investments in technology and infrastructure are larger.In fact ,rainfed agriculture assumes importance from the considerations of growth, equity and sustainability.

AREA SOWN UNDER VARIOUS RAINFED CROPS AND PERCENTAGE RAINFED AREA DURING 2008-09

CROPS	AREA SOWN(mha)	% RAINFED AREA
RICE	45.54	42
COARSE CEREALS	27.45	85
JOWAR	7.53	91
BAJRA	8.75	91
MAIZE	8.17	75
PULSES	22.09	83
REDGRAM	3.38	96
BENGALGRAM	7.89	67
OILSEEDS	27.56	70
GROUNDNUT	6.16	79
RAPESEED	6.30	27
SOYBEAN	9.51	99
SUNFLOWER	1.81	69
COTTON	9.41	65

This table gives the extent of rainfed area in the total area sown to major crops in India.A large proportion of coarse cereals,pulses and oilseeds and a significant proportion of rice is grown under rainfed conditions.Also, nearly 65% of cotton is grown in farms without access to irrigation.

AREA PRODUCTION AND YIELD OF MAJOR RAINFED CROPS IN INDIA:

CROP	AREA(mha)		PRODUCTION		YIELD(kg/ha)	
	1998-99	2008-09	1998-99	2008-09	1998-99	2008-09
Sorghum	10.67	7.92	8.96	7.44	837	942
Pearl Millet	9.65	9.28	7.49	9.09	776	981
Maize	6.26	8.06	10.91	17.93	1743	2220
Coarse Cereals	30.66	28.21	31.95	38.24	1042	1357
Chickpea	7.63	7.64	6.17	6.38	809	834
Pigeonpea	3.44	3.56	2.41	2.55	698	716
Pulses	22.94	22.97	14.04	14.51	612	632
Coarse cereals+Pulses	53.60	51.81	45.99	52.74	858	1030
Groundnut	7.36	6.02	8.33	7.07	1131	1163
Castor	7.24	7.60	8.36	9.36	1165	1233
Sunflower	1.83	1.96	1.03	1.28	570	657
Soybean	5.98	8.91	6.33	9.91	1055	1113
Rapeseed and Mustard	6.70	6.31	5.67	6.82	851	1080
Oilseed	26.23	26.92	23.48	27.26	895	1012
Coarse cereals +Pulses+Oilseed	79.83	78.10	69.47	80	870	1024
Cotton	9.11	9.32	2.12	4.01	232	430
Rice	43.89	44.42	83.45	96.41	1901	2170
Wheat	26.70	27.93	69	78.35	2585	2806

The table gives the area, production and yield of major rainfed crops during triennium 1998-99 and triennium 2008-09.It can be observed from the table that the area sown under coarse cereals fell by 8% from about 31 m ha to 28 m ha during the last ten years .In spite of the fall in area ,the production increased by about 20% to 38 m t during this period because of the yield gains from about 1042 to 1357 kg/ha. The production of sorghum fell by about 17% to 7.4 m t. The fall in production would have been much steeper had the yield not increased by about 13% from 837 to 942 kg/ha. In case of pearl millet ,the area declined to 9.28 m ha from 9.65 m ha and the yield increased from 776 to 981 kg/ha resulting in an increase in production by about 21%.

The area under pulses did not show much changes between 98-99 and 2008-09 as it stagnated at about 23 m ha and the production increased by about 0.5 million tons.There was a marginal improvement in yield from about 612 to 632 kg/ha during this time. Chickpea and pigeonpea the to important pulses grown in India ,which account for about 60% of the total pulse production in the country also experienced an increase in productivity. The productivity of chickpea increased by about 3.09% and that of pigeonpea rose by 2.53% between 98-99 and 2008-09.

The situation with respect to oilseeds is much better compared to that of pulses.The area, production and productivity of oilseeds increased by 2.63,16.10 and 13.07 % respectively. Within oilseeds ,the area sown under groundnuts decreased from 7.36 m ha during 1998-

99 to 6.02 m ha during 2008-09.As a result production fell to 7.07 m t from 8.33 m t. Among other oilseeds , significant productivity growth was observed in rapeseed and mustard which more than compensated for a marginal decline in the acreage under this crop. On the other hand , the area under soybean increased conspicuously from about 5.98 m ha to 8.91 m ha, an increase of about 49%..

Cotton ,an important commercial crop ,is also largely cultivated under rainfed conditions. The production increased to 4.01 m t in 2008-09 from 2.12 m t in 1998-99 and this was attributed to the growth in productivity .The area under cotton increased from 9.11 to 9.32 m ha only, about 2.3% over a decade.

COMPOUND ANNUAL GROWTH RATE IN AREA ,PRODUCTION,AND YIELD OF MAJOR RAINFED CROPS ,1998-99 TO 2008-09

CROP	GROWTH RATE		
	AREA	PRODUCTION	YIELD
SORGHUM	-2.82	-1.19	1.77
PEARL MILLET	0.07	4.11	4.04
MAIZE	3.00	5.60	2.52
COARSE CEREALS	-0.52	2.73	3.26
CHICKPEA	1.69	2.24	0.54
PIGEONPEA	0.34	0.16	-0.17
PULSES	0.61	1.08	0.47
GROUNDNUT	-1.32	0.93	2.29
CASTOR	0.22	1.44	1.21
SUNFLOWER	4.94	7.32	2.25
SOYBEAN	4.39	5.59	1.15
RAPESEED AND MUSTARD	1.97	4.24	2.22
OILSEED	1.60	3.65	2.02
COTTON	0.54	10.20	9.60
RICE	-0.12	1.28	1.40
WHEAT	0.39	0.85	0.46

The compound annual growth rates are presented in the table. It is observed that the production of coarse cereals increased ,though the area under it declined. Yield growth was

fastest among pearl millet and slowest in case of sorghum. The production performance of pulses continued to be slow ,both area and yield did not show any significant growth and remained stagnant. This is also reflected in declining per capita production levels of pulses in the country. As far as oilseeds are concerned faster growth rate is noticed in groundnut, sunflower, rapeseed and mustard and slower growth rate in soybean and castor. It can be seen that all the three crop groups coarse cereals,oilseeds and pulses witnessed significant production and productivity growth during the last decade.

VILLAGE LEVEL STUDIES

Economists use both micro and macro level data to analyze trends. While studying micro level data they are often faced with the question as to how many households should be studied taking into account the limitations of time and cost .Villages are settlements of people who use diverse skills to produce a range of goods and services and exchange them locally or externally .Study of village yields knowledge about interrelationships, common property resources and social networks.

The Village Level Studies conducted by the International Crops Research Institute For The Semi –Arid Tropics (ICRISAT) have created a long term panel dataset. Instead of including all the households of a village, these studies chose only a sample of them to collect data on various aspects of farming and housekeeping.The resident investigators visited theses households once in three weeks to collect data in order to minimize recall bias .The data collection started in the villages in the year 1975 and continued up to 1984.It then stopped in between and resumed again in 2001 and has been continuing till date.The period 1975-84 is referred to as the first generation while the time period of 2001-09 is called the second generation.

The need to collect uniform data across a panel of households over several years arose from three mutually reinforcing considerations catering to-

1) The nature of interdisciplinary research at ICRISAT

2) The variability of agricultural production in the SAT

3) The potential of complementarities in data collection and analysis to address a range of research topics.

The sample for the VLS was selected in four stages. Indias ’s vast SAT encompasses 15-20 large regions ,each straddling several districts. The regions were selected in the first stage: Telangana in the state of Andhra Pradesh and Bombay Deccan and Vidarbha in Maharashtra.Within these regions ,representative districts were selected: Mahbubnagar in Telangana ,Solapur in Bombay Deccan and Akola in Vidharbha.

In the second stage ,typical talukas were chosen and the talukas so selected were Kalwakurty and Atmakur in Mahbubnagar district,Mohol and North Solapur in Solapur district and Murtizapur in Akola district.In the third stage ,villages representing the charecteristics considered in the selection of districts and talukas were picked.The villages thus selected were Aurepalle ,Dokur,Shirapur, Kalman,Kanzara and Kinkheda.In the fourth stage ,the village census provided the basis for drawing the sample of households which were selected mainly based on size of their operational landholdings and occupation.A sample size of 40 households were selected in each village .A sample size of 30 cultivator and 10 landless labor households was drawn in each village .The cultivating households in each village were stratified according to the size of the operated farm into three equally numerous groups.

OBJECTIVES OF THE STUDY-

1)To compare the profitability levels of the majorly irrigated and the rainfed crops in the VLS villages using ICRISAT'S Village Level Studies.

2)To analyse the extent of diversity and risk minimisation.

3)To analyse the potentiality of technology in per unit cost reduction of rainfed crops.

4) To examine the cost,returns and profitability levels of important rainfed crops in SAT Region

METHODOLOGY OF STUDY-

I n order to conclude whether rainfed agriculture is viable or not it is essential to determine the profitability levels in the production of crops in the VLS villages and making a note of the changes in the levels of profits between the first generation VLS studies and those of the present VLS studies.By comparing the variation in profitability of the most important dryland crops it would be easier to conclude whether rainfed agriculture is viable or not.

Cropping patterns change over time in response to changes in weather patterns,technological improvements and relative prices.An essential task was to study changes in cropping patterns and make an account of agricultural drivers followed by farmers.An extensive study was done using the Y schedule of the VLS Data which does mention the cropping information to account for the crops grown in different periods of time and also the area covered by them to estimate the changes in croppin patterns.Using this information then,the important crops were selected to find out the profitability levels.

The villages of Shirapur in the Solapur region and the village of Kinkheda were then identified as the areas of study on the basis of cropping,soil and climatic criteria.During the interregnum between the first generation and second generation of VLS, many changes can be expected to have taken place in terms of inputs used,method of production and technological development in the villages of Shirapur and Kinkheda which can be accounted for by examining the variations in levels of profits.
The Input-output data collected from farmers were aggregated and analyzed to compute the cost and returns of different crop enterprises.Both incurred and imputed costs of crop enterprises were computed .At first the costs are divided amongst two major heads wages and material used.The per acre wages and per acre material used was calculated by dividing the wages and material used both ,by the crop area.After this the total amount of wages and material used were separately aggregated and divided by the number of plots growing that crop in order to find out the cost per plot.Then finally adding these two costs would give an account of the total cost or expenses incurred by the farmer in growing that crop.The gross returns from the crops cultivation was also calculated on a per acre basis and then divided by the number of plots.Comparing these two would yield the net returns .The benefit cost ratio was also calculated to get a more clearer view of the profits or losses borne,and it was calculated by dividing the total returns by the total cost.The average productivity levels of crops were also computed to deduce which crop yielded better in which village.

These results so produced were then analysed and used to compare the difference in profitability levels of majorly irrigated and the rainfed crops.Analysis was done to also make a note of the changes that occur in the levels of profits when a farmer produces sole crops or intercrops.Thus the input-output data in the Y schedule of VLS studies were analysed to fulfill the objectives of the study.

VILLAGE OF KINKHEDA;

Villages in the semi-arid tropics of India have been changing very rapidly with the availability and adoption of new technology,better access to markets for their products and labor ,implementation of development programmes such as construction of new roads and also spread of education and ease in information flow through advent of mobile phones.

Kinkheda village is located in Murtizapur Taluka of Akola district .This village is located 12km south of Murtizapur on the Murtizapur-Yavatmal State Highway.This village is the smallest village among all the villages selected for the VLS studies.It has a group Gram Panchayat of four villages.It is situated on the banks of Uma river and a dam was constructed on this river 4km from Kinkheda.The villagers communicate with each other in Marathi which is the official language of Maharashtra State.

The village consists of 189 households with a population density of approximately 169 persons per sq. Km.Around 20% households were labour households during 2007.Literacy percent increased from 43% in 1975 to 88% in 2007.More than 60% of the households are below poverty line in the village.There are 876 persons in thevillage in 189 families out of which there are 456 males and 420 females.Most residents in the village are hindus and relatively few are Brahmins.People of Kinkheda belong to 12 different castes and the village is dominated by the Maratha Kunbi caste.

A total of 131 students are attending school out of which 77 are boys and 54 are girls.Food is prepared for these children in the school premises by a cook appointed by Gram Panchayat who is paid by the Goverment.Primary Co-operative credit society was established in the village in the year 1958.This society was formed with four villages and Kinkheda is having the highest number in the society.Around 60% of total loan of farmers in the village comes from PACCS.

Land is considered as one of the important assets in Kinkheda village .The government fixed the minimum price for rainfed lnd as Rs.20,000 per ha in Kinkheda village.The actual price is determined by the land quality,nearness to village ,access to canal water and needs of sellers and purchasers .The current rates for dry lands is Rs. 75000 per ha and for irrigable land it is Rs.200,000 per ha in Kinkheda village.

PERCENTAGE DISTRIBUTION OF OPERATIONAL LANDHOLDINGS IN KINKHEDA VILLAGE

Size group(ha)	1975	1985	2001	2007
Up to 2.0	34.95	28	24	51.59
2.01-4	27.71	24	28	24.60
4.01-8	19.28	12	24	16.67
Above 8	18.07	36	24	7.14
total	100	100	100	100

The above table clearly shows that more than 50% of the households are operating in less than 2 ha during 2007 which was earlier below 35% during 1975.Only 7% households operate in more than 8 ha land in Kinkheda village during 2007,which was more than 18% during 1975.

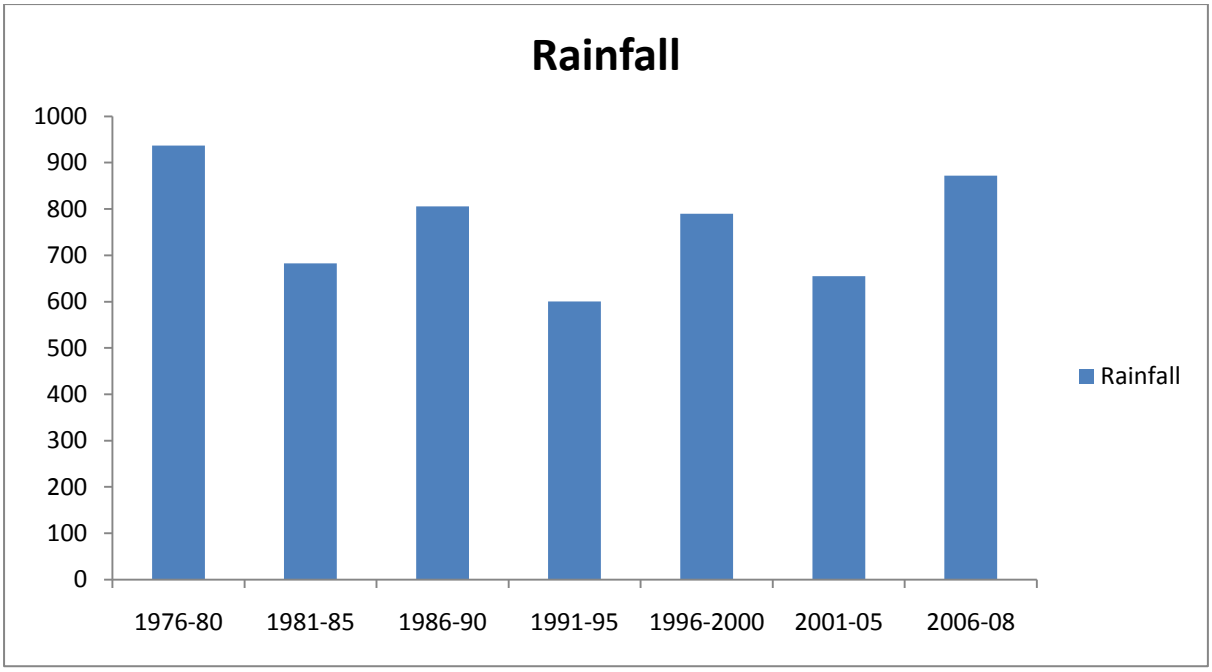
LEVELS OF HOUSEHOLD INCOME AND PER CAPITA INCOME IN 1975-78(average) AND 2001-02(Rs.)

PARTICULAR	1975-78	2001-02	% INCREASE
NET HOUSEHOLD INCOME	16242	28535	59.06%
PER CAPITA INCOME	2986	5629	88.51

The above table shows that net household income increased rapidly ,more than 80% in Kinkheda Village.The growth in per capita income is higher than that of net household incomedue to a reduction in the average family size.In Kinkheda village the income shares from crops and livestock in net household declined while the non-farm sources and labor income has increased considerably over a period of 34 years.

RAINFALL PATTERN IN KINKHEDA VILLAGE

MONTHS	AVG 1976-80	AVG 1981-85	AVG 1986-90	AVG 1991-95	AVG 96-2000	AVG2001-05
JAN	34.4	34.2	6.9	5.6	18.4	4
FEB	16.2	10.6	11.8	1	6	1.4
MARCH	1	0.2	8	23	11.6	12
APRL	0	2.9	0	5.6	0	0
MAY	9.5	1.8	25.9	9.3	7.2	10
JUNE	214.4	112	172.8	92.6	114	137
JULY	264.9	153.1	280.5	131.4	178	152.2
AUGST	217.5	187	159.4	217.6	159.8	163.4
SEPT	101.8	132.5	57.9	70.1	140	96.9
OCT	29.9	44.1	61	42.4	107	76.8
NOV	40.5	0.6	11	0.6	31	1
DEC	6.9	3.9	10.3	1	16.6	0
TOTAL	937	682.9	805.5	600.2	789.6	654.7



This bar diagram explains the rainfall pattern in Kinkheda village from 1976-2008.The Akola region is a more assured and dependable rainfall area compared to other selected locations of the VLS.The average annual rainfall recorded at Murtizapur tehsil is 722mm with 49 rainy days.The average annual rainfall declined from 937mm during 1976-80 to 600.02mm during the year 1991-95.Generally maximum rainfall is received in the month of July followed by August ,June and September.During the last five years the average annual rainfall recorded in Kinkheda Village was 872.1mm with lowest in the year 2008 and highest during 2005.

NEGATIVE DEVIATIONS FROM MEAN RAINFALL

1971-1980	40%
1981-1990	50%
1991-2000	60%
2001-2010	88.9%

Climate change is a major issue which is being discussed in terms of rainfed agriculture.Akola region which is supposedly a region of assured rainfall has also not been able to save itself from the evil effects of climate change.An average of the rainfall received in this area was calculated and then negative deviations from mean was computed using the rainfall data in each of the different 10 year periods which shows that ,the negative deviation from mean has increased from 40% to 88.9%.Thus Kinkheda village is very much affected by climate change.

IRRIGATION SOURCES

In the late 1970's the irrigated land relative to gross cropped area was 1% in Kinkheda.Wells were the only sources of irrigation and there were 7 wells out of wshich 3 were not in use.In the year 1983-84 ,Uma project was started on Uma river near KInkheda village to provide water to irrigate rabi crops .From 1985-86 canal irrigation was available for irrigating tha

post rainy season crops.Gross command area of Kinkheda village by canal is 158.2ha ,where as the irrigated command area is106.5ha Rates for canal irrigation is Rs.476per ha for post rainy season wheat.

SOIL CLASSIFICATION

The soil of Kinkheda can be classified into three major groups.The soils are predominantly medium vertisols covering around 50-60% of the area.Most of the deep black soil fields which occupy around 10% of the area are located on the banks of Uma river towards the east side of the village.Approximately 25-30% soil of the village is recorded as shallow soil towards west side of the village .Average value of land ranges from Rs.75000 to Rs.200,000 per hectare ,depending upon the type of soil and fertility status of land.About 7-8% of the soils have problem of water logging.

Soil type	Area(acres)	Percentage area
Medium black	420	50
Shallow black	210	25
Deep black	125	15
Water logging	80	10

Land degradation is a major problem in this area .Bunds and check dams were constructed to prevent soil erosion.

SEASONS EXPERIENCED IN KINKHEDA VILLAGE:

According to the farmers of Kinkheda Village the year is divided into three seasons :

1)The Unhala or Summer season from February to May

2)The Pavsala or rainy season fron June to September

3)The Hiwala or cold season from October to January

ADOPTION OF MODERN TECHNOLOGY AND MECHANISATION :

TRENDS IN ADOPTION LEVEL OF MODERN TECHNOLOGY IN MAJOR CROPS(in acres)

CROPS	1975	1983	2001	2009
SORGHUM	16.35	10.75	8.5	4.75
SORGHUM MIXTURE	192.32	104.45	0	2
COTTON	11.9	21.25	6.5	9
COTTON MIXTURE	206.1	193.5	112.5	92.25
CHICKPEA	0	0	0	2
CHICKPEA MIXTURE	0	0		0
GROUNDNUT	4.5	3.5	0	0
GROUNDNUT MIXTURE	6.5	1	0	O
PIGEONPEA	0	0	0	4.25
PIGEONPEA MIXTURE	0	0	0	0

There is a wide adoption of improved technology in Kinkheda village ,such as the use of high –yielding varieties such as hybrids ,fertilizers ,pesticides and farm machinery.In case of seed technology ,almost all farmers used either hybrid or high yielding varieties of all crops during 2006-07,which was previously restricted to only the wealthy farmers.Moreover every farmer of Kinkheda village has adopted ICRISAT based variety of pigeonpea namely,MARUTI(Icp 8863).

TIMELINE FOR ADOPTION OF NEW TECHNOLOGY

NEW ADOPTION	YEAR
HYBRID SORGHUM	1962
FERTILIZER	1964
HYBRID COTTON	1964
TRACTOR	1972
THRESHER	1978
SPRINKLER	2004
BT COTTON	2005
HARVESTER	2007
DRIP IRRIGATION	2007
HYBRID PIGEONPEA	2008
WEEDICIDE	2009

This table explains that the farmers of Kinkhead village are very much inclined towards the use of modern technology.They are growing either the hybrid or high yielding variety of cotton .BT Cotton was just introduced in the year 2005-06 with 0.6ha area ,and now it has spread to 8.50ha during 2006-07.There is also huge adoption of hybrids in sorghum ,pulses and oilseeds.

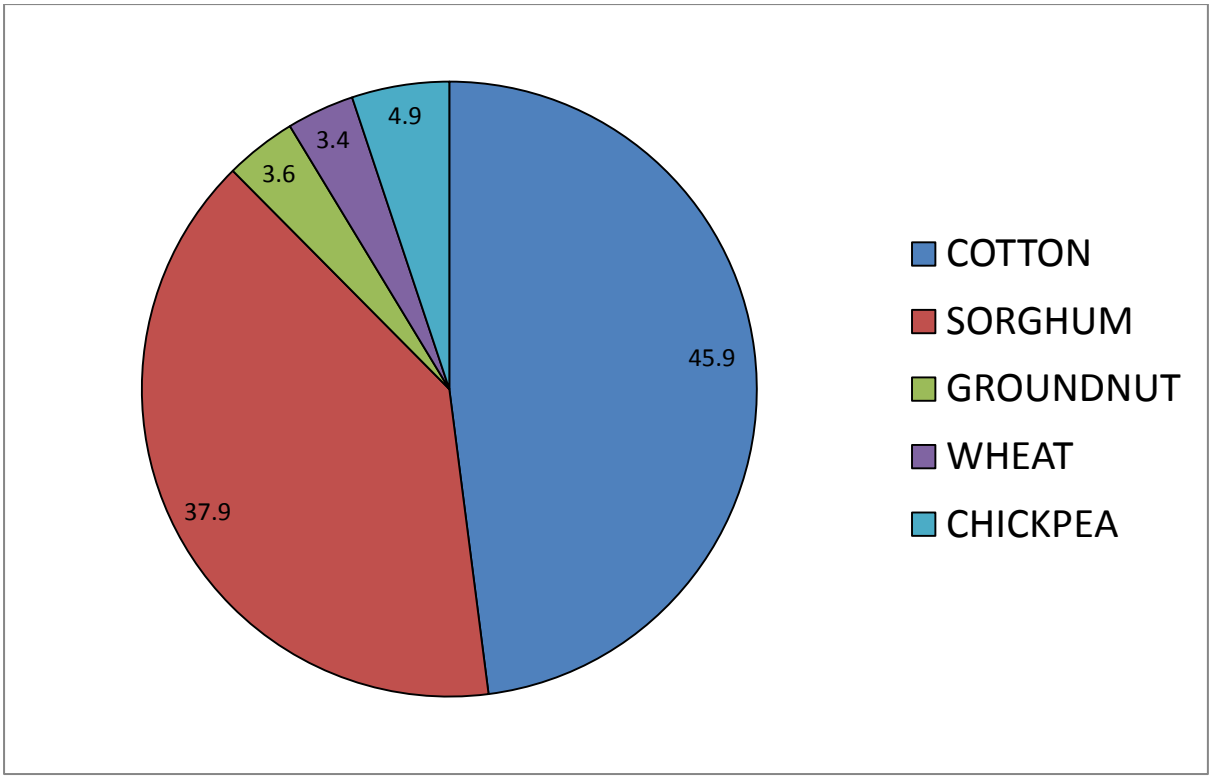
MECHANISTION(TOTAL NUMBER)	1975-76	2009-10
TRACTOR	1	5
THRESHER	0	8
POWER SPRAYER	0	15
IRRIGATION (AREA)		
OPEN WELLS	8	30
BOREWELLS	0	20
CHEMICAL FERTILISER(kg/ha/yr)	30	75

Mechanisation has also enhanced in Kinkheda village,while there was only one tractor in the first generation ,presently there are more tractors in the village mainly used for land preparation,sowing and transporting input and output.Threshers have started to be used for threshing sorghum,chickpea ,soyabean,wheat ,black gram and pigeonpea.The use of harvester for harvesting wheat just started in the year 2006-07.Farmers are also using sprinkler irrigation for irrigating chickpea,groundnut and vegetables while drip irrigation is used for irrigating cotton and fruits.

CROPPING PATTERN :

Cropping patterns change over time in response to changes in weather pattern,technological improvement and relative prices.Over the last several decades,Indian Agriculture has moved from a scenario of foodgrain deficit to one of the surplus.An elaborate Public Distribution System is now in place ,and competitive private trade has emerged.Food security which used to be a matter of concern,has been by and large dispelled.Transaction costs have come down and farmers and farmers have to some extent been freed from the compulsion to produce foodgrains and other agricultural commodities for their own consumption.Given the advances in foodgrain productivity ,there is no longer an urgent need to allocate more land for food production.For instance,a few decades ago,nearly three-fourths of the cultivable land in India was allocated to foodgrain crops,now this proportion has fallen to two-thirds.

CROPPING PATTERN IN KINKHEDA(1975-77)



1)Kinkheda Village falls under an assured rainfall area with medium –deep black soils and is essentially kharif cropped.During the first generation around 92% to 94% area was sown in the rainy season.The important kharif crops grown were cotton,sorghum ,groundnuts and chickpea.Thus initially very little area was planted during post rainy season because of lack of irrigation.Now the farmers have access to canal water and they plant post rainy season crops after harvesting short duration kharif crops like hybrid sorghum ,soyabean ,green gram and local cotton.The rabi crops grown are wheat and chickpea.

2)Farmers in Kinkheda have water in their wells to irrigate crops during summers and they plant sunflower,green gram and vegetables including onions.Under canal irrigation during summer season farmers generally plant green gram.No annual or perennial crops are grown in the village.

3)Cotton and cotton based mixtures are the main cropping systems in the village as this area has been a well-known cotton growing tract since centuries.Pigeonpea and green gram is intercropped with cotton or high value cotton seed like hybrid cotton or BT cotton is cultivated.Area under cotton and its intercroppings has increased from 45.9% of the gross cropped area in 1975-77 to 64.5% of the gross cropped area in 2005-07.Farmers plant 10-12 rows of cotton and 1-2 rows of pigeonpea while intercropping.

3)Sorghum is the food and fodder cropping system cultivated in the village.Area under this system has declined from 37.9% of the gross cropped area in 1975-77 to 4.3% of the gross cropped area during 2005-07.The major reason behind this fall in area is because sorghum fetches low price for the farmer and an additional reason being the incidence of grain mold in sorghum.Moreover fine cereals are available to villagers at subsidized rates through the Public Distribution System and thus their inclination towards growing sorghum is declining.

4)Area under groundnuts has declined to zero presently ,while in the first generation 3.6% of the gross cropped area was devoted towards growing groundnuts.The erratic rainfall,high seed cost and and uncertainity in production are responsible for this downfall in area under cultivation.

5)Soybean grown in the Kharif season occupied 5.5% of the gross cropped area during 2005-07.The advantage enjoyed by farmers while growing soybean is that it fetches good price and also promises an assured income.Soybean and pigeonpea in the ratio of 4:1 is generally planted.

6)Area under fruits and vegetables is less than 1% because of lack of enough irrigation opportunities and greater dependence of farmers on wells.

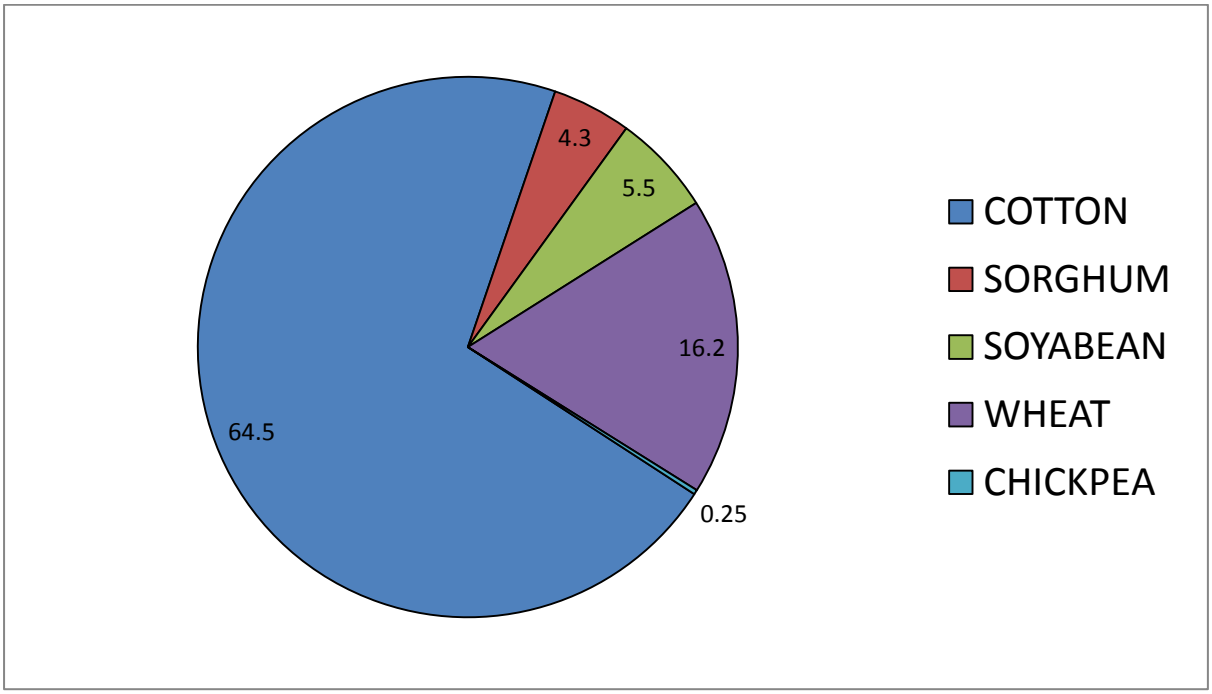
7)Wheat has displayed a rising trend in area under cultivation.Area under wheat has increased from 3.4% of the gross cropped area during 1975-77 to 16.2% of the gross cropped area during 2005-07.The reason behind this is the availability of canal water and an additional reason being better prices for wheat being offered in the market.

8)Chickpea cultivation has decreased over the years.The area under chickpea has fallen from 4.9% of the gross cropped area in 1975-77 to 0.25% of the gross cropped area in the period 2005-07.The only problem that is faced by farmers while growing chickpea is the wild animal problem which is causing this decline in the area under production.

9)Safflower was grown earlier in the village but is not preffered now because of labor problem and sunflower is grown by farmers in the summer season if they manage to get water from the canal.

CROPPING PATTERN IN KINKHEDA(2005-07)

This piechart described the cropping pattern in the second generation of the VlS Studies and we can see that drastic changes have occurred over time.The area under cotton ,wheat and soybean has increased while that under groundnuts and chickpea has fallen considerably.



VILLAGE OF SHIRAPUR;

Shirapur is located in The Solapur Region which is situated in the northeast corner of Maharashtra covering an area of 14886sq.kms.,in the Mohol taluka.Shirapur is located 27 kms to the west of Solapur on the Hyderabad-Pune highway.The Sina River flows about 0.5kms to the west of this village.

According to the 1981 census,Shirapur had a population of 1989,with an average family size of 7.There were 297 households during this period constituting, 32.7% labour households,61.60% cultivator households and 5.7% other households where the family members were artisans and traders.As of 2007 VLS census data ,Shirapur had a population of 2518 with an average family size of 5.4.The number of households have increased to 546.The traditional joint family system has lost its importance over the years.In 2008-09 there were 24 castes in the village the dominant ones being Marathas and Shepards.

Average years of schooling have increased in 2009-10 for both male and female children irrespective of their family wealth and caste.In 1975-76 male population of sample households ,on an average had 3.77 years of schooling,while it was 1.58 years for the female population.In 2009-10 average years of schooling for male and female students increased to 7.54 years and 6.89 years respectively.In the Second Generation Period of 2009-10,50% of the girls and about 56% of the boys aged between 15 to 20 years were studying ,as against 32% of the boys and 25% of the girls in 1975-76.Thus,it appears that government's efforts accompanied by awareness and positive attitude towards education have increased access to and achievement in education for the new generation.

There is a village Panchyachat that looks after the development and welfare activities of the villagers. It is a Group Panchayat consisting of three villages namely, and presently three members of this group belong to this village.

The village also has Registered Primary Credit Cooperative Societies and these are functioning satisfactorily since their establishment in 1954.In Shirapur the nearest Land Development Bank and other commercial banks are located at Mohol.

The average ownership of holding has reduced drastically in the village .In 1985,an average household owned around 7.3ha which has reduced to 3.2ha in 2008.This has led to several disadvantages as economies of scale achieved through technology are not optimum ,moreover this fragmentation has also caused fight over natural resources which has increased internal household conflicts.

LAND OWNERSHIP

LANDHOLDING SIZE(%)	1975	1985	1989	2010
Upto 2 ha	32.25	31.5	39.3	47.8
2.1-4 ha	18.03	17.4	15	24.5
4.1-6.1 ha	13.12	14.2	13.4	9.8
6.2-8.1 ha	10.38	10.3	7.7	6.6
8.2-12.1 ha	16.38	8.3	7.3	4.3
12.2-16.2 ha	3.28	6.4	4.2	4
More than 16.2	6.56	11.3	9.0	2.7

SOURCES OF INCOME

The rich as well as the poor maintain several sources in income to maintain their livelihood .In 1975-84 ,the maximum source of income came from agriculture and farm labor income .The Importance of non-farm income is also immense ,women also along with men in bringing home a piece of share from the non-farm income .Moreover ,all households participated in the sale of livestock ,especially goats ,and those owning cows derived majority of their income from selling milk products.

SOURCES OF INCOME(%)	1975	1984	2001	2004	2008
CROPS	33.7	42	24	9	29
LIVESTOCK	15	15	16	30	8
FARM LABOR	42.6	40	15	7	11
NON-FARM WORK	0.2	-	2	4	7

RAINFALL PATTERN :

ANNUAL RAINFALL-

2005	**560.85**
2006	590.6
2007	553.4
2008	562.1
2009	591.4
2010	899.1
2011	507.2

Solapur has a bimodal rainfall pattern with an average rainfall of less than 700mm.Rains are received mostly in June and September.If there are excess rains then the operations of weeding and inter culture becomes difficult.Rainfall during September are more assured than the rains in the month of June.Due to bimodal and erratic behavior of rainfall ,Rabi cropping offers more assured crop prospects than Kharif cropping. The region had received a three year continuous drought from 1971-74.The rainfall data from 1976-2010, shows that the average number of rainy days during this period is 35 rainy days, and the average rainfall is around 580mm.

SOURCES OF IRRIGATION

Open wells continue to be an important source of irrigation, it also receives partial support of surface irrigation. An aqueduct was built on Sina river to improve the water supply. The proportion of cropped area receiving irrigation support is highest that is 49.2% in Shirapur, compared to Kalman which has only 15.6% of area under irrigation and is 30 kilometers away. However the village is under water stress with the passing years as it was claimed that the availability of groundwater has gone down by almost fifty percent.

OPEN DUG WELLS	10
DEEPENING OF WELLS	18
NEW BORE WELLS	20
IN-WELL BORES	5
TOTAL	53

SOIL HETEROGINITY-

Six major soil types are recognized by farmers in the Sholapur villages .Soils are more spatially homogenous in the Akola villages ,where only three major groups appear in the farmers' taxonomy and where variation in soil depth and texture is significantly less than in Solapur Villages .Shirapur is endowed with deep black soil .

ADOPTION OF MODERN TECHNOLOGY:

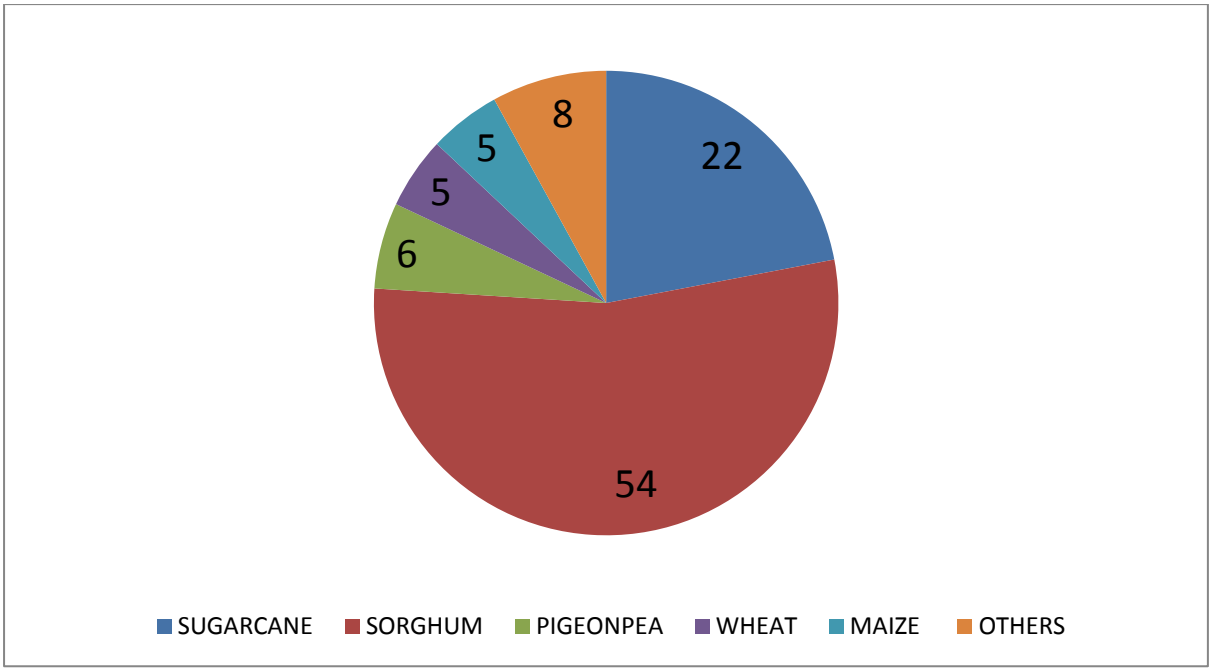
There is a wide adoption of technology in Shirapur Village ,such as the use of high yielding varieties and hybrids, fertilizers, pesticides and farm machinery like tractors ,harvesters along with the use of sprinkler and drip irrigation.

According to the VLS First Generation Data ,agricultural technology was skewed towards the large and medium landowners and the technology mostly consisted of oil pumpsets and electric motors.The small farmers could only afford the cheapest technology which was available to them and agricultural work was more labor intensive.From 2001 onwards the use of agricultural capital equipments was not skewed towards the large landowners.In fact the adoption was done more by the small landowners ,compared to the medium and large landowners.

OWNESHIP OF AGRICULTURAL EQUIPMENTS

TRACTOR	1
OPEN DUG WELLS	37
SPRINKLER IRRIGATION	1
THRESHER	1
DIESEL PUMP	1

CROPPING PATTERN :



CROPPING PATTERN IN SHIRAPUR 2005-07.

1)During the kharif season the important crops grown are pulses, maize, onion and fodder. The total area under pulses had been around 70% in 1975-77 ,however the share has fallen down as the farmers prefer growing maize and onions. The improved varieties of pigeonpea used by the villagers are MARUTI and ASHA. The area under maize has been growing in importance since 2001and rose to 35ha in 2007 and 8ha in 2008 respectively.The production of onions had been low till 1979,but with the introduction of irrigation facility in the village it has picked up.The area under production of onions varies from 25% in 2006 to 27% of the cropped area in 2007.This crop has grown in prominence as it fetches a good price and can be sold in the Solapur market.The rowth of fodder is related to the livestock population in the village.The production of fodder has been over 20-35% of the total area of production.

2)Sorghum is the crop which is cultivated the most in the Rabi season and constitutes to around 80% of the total cropped area. It is a staple crop grown in this village and is grown as a sole crop and also as a mixed crop along with safflower.

3)Groundnut is an important crop grown in the summer season .The area under groundnut production has been fluctuating.

4)Sugarcane is the most important crop grown in Shirapur.It is grown annually as a mixed as well as a sole crop.The availability of canal irrigation as well as rhe increase in number of sugar factories has led to this rise.

5)Lemons and fruits are grown as perennial crops in Shirapur. After 1984 the production of lemons declined but the area under production of fruits picked up.The production of bananas and pomegranate is done in this village

COMPARING THE PROFITABILITY LEVELS OF THE MAJORLY RAINFED AND IRRIGATED CROPS

Initially wells were the only source of irrigation in Kinkheda. Moreover it had the lowest average area irrigated per well amongst all the VLS villages .However with the start of the Uma Project water could be used for irrigating crops. As the introduction of canal water started ,the water table in the wells also increased .Wheat is the crop which is most importantly irrigated in this village .Rates for canal irrigation of post rainy wheat is Rs.476 per hectare .Area under wheat has also increased from 3.4% of the gross cropped area in 1975-78 compared to 16.2% of the gross cropped area in 2005-07.While on the other hand sorghum is essentially a rainfed crop. Farmers use the canal water to cultivate wheat ,but on the other hand they simply depend on rainfall to cultivate sorghum.

COST AND RETURNS (RS/ACRE) OF WHEAT CULTIVATION IN KINKHEDA

Thus the total cost in growing wheat was Rs. 4330 in 2005-2006 while it fell down a bit to Rs.4818 in the consecutive year giving an average of Rs. 4574. The gross returns in 2005-06 was Rs.6231 which increased drastically in the year 2006-07 and increased up to Rs.9513 per acre. On an average of the two years the gross returns are Rs.7892 per acre ,and on computing the benefit ratio which is gross returns divided by the total cost we get 1.72.

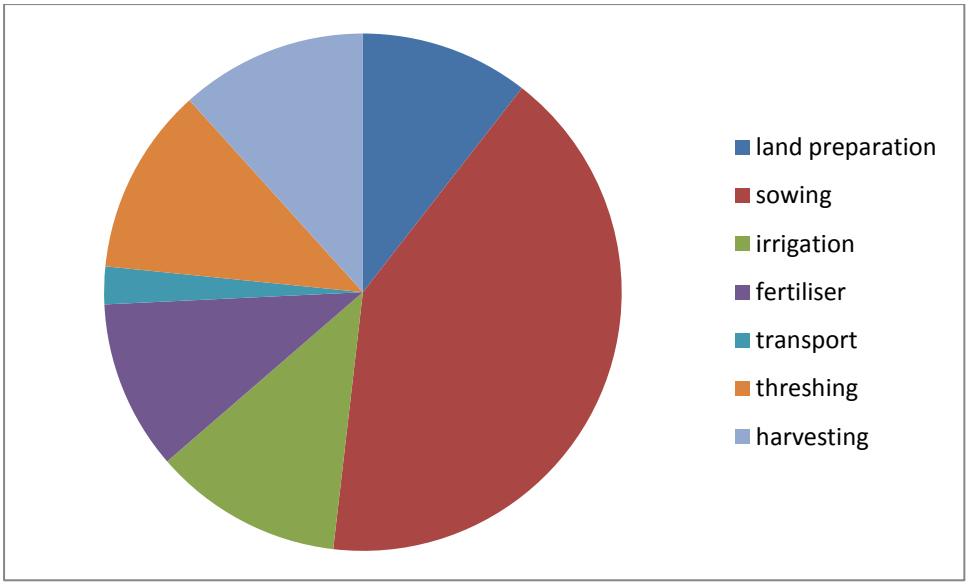
COST AND RETURNS	2005-06(WHEAT)	2006-07(WHEAT)	AVERAGE	2005-06(SORGHUM)	2006-07(SORGHUM)	AVERAGE
TOTAL COST	4330	4818	4574	3740	2885	3312.5
GROSS RETURNS	6231	9513	7892	4620	2691	3655.5
NET RETURNS	1901	4695	3298	880	-193	343
BENEFIT COST RATIO			1.72			1.1

This table explains the profitability in growing the irrigated crop wheat and the rainfed crop sorghum in Kinkheda. While the total cost in wheat cultivation was 4330 in 2005-06 it fell down by 11.27% in 2006-07 and became 4818. In the case of sorghum as well the total costs fell by 22.86% as they went down from 3740 in 2005-06 to 2885 in 2006-07. The gross returns in wheat cultivation in 2005-06 was 6231 ,a drastic increase can be noticed in the very next year where the gross returns increased by 52.67% and rose upto 9513.A very interesting fact to note is that while in case of wheat

the gross returns increased in the following year,the same did not happen in case of sorghum. The gross returns in sorghum was 4620 in 2005-06 and fell down in 2006-07 by 41.75% percentage and became 2691 in 2006-07. Due to the high increase in gross returns in wheat , 2006-07 the net returns were also way higher in 2006-07 that is 4695,as compared to 2005-06 where it was only 1901.Thus the average net returns in 2005-07 is 3298, where as in sorghum the average net returns for 2005-07 are 343.Therefore it is explicitly clear that the irrigated crop has greater profitability levels than the rainfed crop sorghum., and the benefit cost ratio makes the conclusion even more clear as the benefit cost ratio for wheat is 1.72 while it is just 1.1 for sorghum.

COST AND RETURNS IN KINKHEDA FOR GROWING WHEAT(2005)

OPERATION	FAMILY FEMALE	FAMILY MALE	HIRED BULLOCK	HIRED FEMALE	HIRED MALE	OWNED BULLOCK	MATERIAL USED	TOTAL
LAND PREPARATION	27.18	103.25	23.95	40.13	39.24	193.15	28.12	455.02
SOWING	11.53	39.92	23.95	4.60	42.92	20.83	1639.30	1772
IRRIGATION		231.25			53.30		220.87	509
FERTILISERS	5.13	45.71			6.15		417.80	474
TRANSPORT		35.80	6.90			22.09	36.22	101
THRESHING	1.95	60.31	1.56		92.08	7.3	342.01	505
HARVESTING	3.33	25.83		213.77	172		90	504
TOTAL RETURN-	6231							
TOTAL COST	4330							
PROFIT	1901							

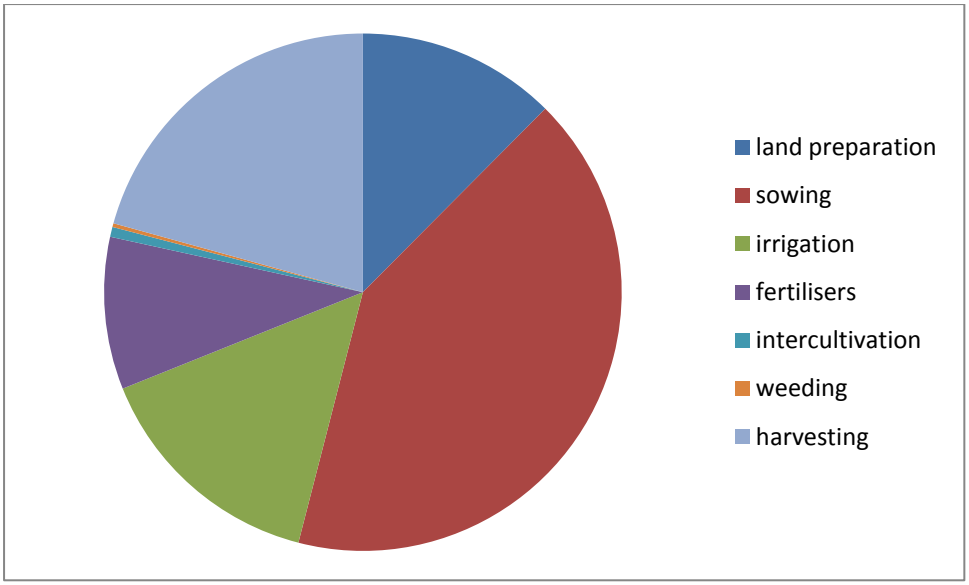


ITEMS OF COST:

The items of cost displayed in the reveal that sowing is a major item of cost which occupies around 40.9% of the cost. Irrigation is another item which is expensive and in 2005,the cost incurred on it has been 509 and it is 11.75% of the total cost incurred. The costs borne by farmers in land preparation, fertilizers nd transport is 455, 474 and 101 respectively. Threshing and harvesting both occupy 11.66 % and 11.63% of the total cost and the amounts spent on the two operations are 505 and 504 respectively. Thus the total cost on wheat cultivation in 2005 is 4330, while the gross returns is 6231, yielding net returns worth 1901.

COST AND RETURNS IN GROWING WHEAT (2006)

OPERATION	FAMILY FEMALE	FAMILY MALE	HIRED BULLOCK	HIRED FEMALE	HIRED MALE	OWNED BULLOCK	MATERIA USED
LAND PREPARATION	19.08	70.32	33.55	13.40	103.81	233.5	390
SOWING	6	40	11	1.44	18.52	8	1796
IRRIGATION		433			57		184
FERTILISERS	9	42.63		0.6	6.7		372
INTERCULTIVATION	4.44			2.66	21.85		
WEEDING	6.4			4.16			
HARVESTING AND THRESHING	0.7	20	4.8	121	171	23.6	595
TOTAL COST	4818						
TOTAL RETURNS	9513						
TOTAL PROFIT	4695						



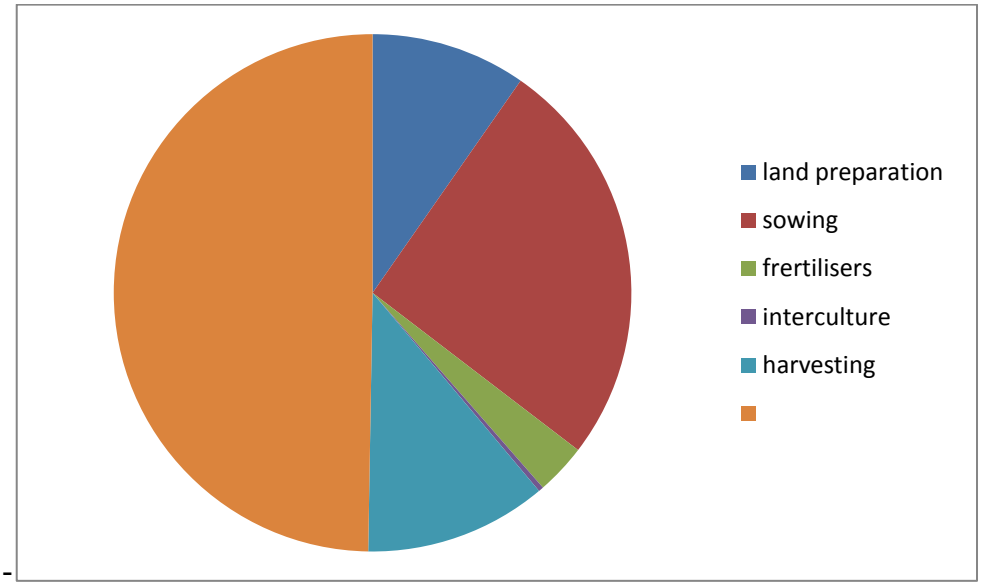
ITEMS OF COST-

Here again like in the year 2005-06, sowing is an important item of cost, covering around 38.9% of the total cost. Irrigation is another item of cost where the farmers incurred 674, which is 13.98% of the total cost. Land preparation, fertilizers and harvesting including threshing occupy 17.91 % ,8.92% and 19.42% of the total cost respectively and the amounts spent by the farmers are 863,430 and 936 rs on each of these operations. Interculture and weeding were not very significantly expensive operations and the cost borne by the farmers in interculture was 28,while on weeding it was 10.56.So in the year 2006-07 the total cost was 4818, while the net returns were greater 9513,yielding positive net returns worth 4695.

COST AND RETURNS IN SORGHUM CULTIVATION-2005

OPERATION	WAGES	MATERIAL USED	TOTAL
LAND PREPARATION	401	180	581
SOWING	1329	481	1810
FERTILISERS	68	265	333
INTERCULTURE	28		28
TRANSPORT	72	68	140
HARVESTING, THRESHING	672.5	175	847.5
TOTAL COST	3740		
TOTAL RETURNS	4620		
NET RETURNS	880		

ITEMS OF COST



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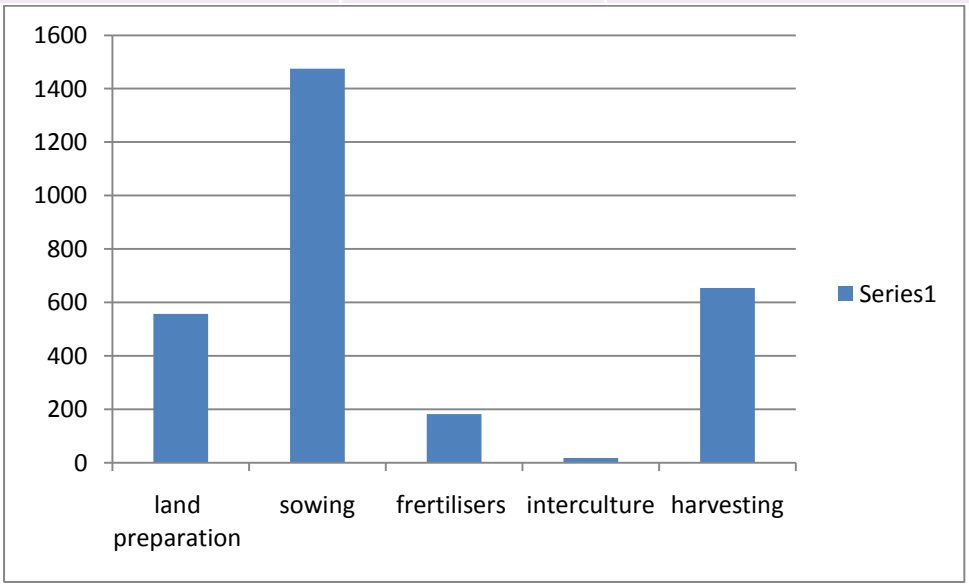
Like in the case of wheat, even in sorghum sowing occupies an important part among the items of cost, it is around 48.39% of the total cost and the cost incurred is 1810. There is no cost spent in irrigation, as sorghum is rainfed. Fertilizers cost 333 and are 8.9% of the total cost. Intercultural and transport are less cost bearing operations, 28 and 140 is spent on the

two respectively. Land preparation and harvesting occupy 15.53% and 22.66% respectively. The total cost spent by the farmers is 3740 where the gross returns are 4620, and they enjoy net returns of 880.

COST AND RETURNS-SORGHUM CULTIVATION (2006)

	WAGES	MATERIAL USED	TOTAL
LAND PREPARATION	364.8	192	556.8
SOWING	1005	470	1475
FERTILISERS	32.9	149	181.9
INTERCULTURE	18		18
HARVEST	553	101	654
TOTAL COST	2885		
TOTAL RETURNS	2691		
TOTAL LOSS	193		



This bar graph explains the various operations and the costs incurred on them. Similar to the sowing cost in 2005-06, the cost is again highest in 2006-07 and the cost incurred on it is 1475.Land preparation and harvesting are two other major items of cost which occupy

19.50% and 22.90% respectively and the amounts incurred on these operations are 556.8 and 654 respectively. Following a similar trend as in 2005-06 even in 2006-07, very less amount is spent by farmers in operations of interculture and fertilizers and they form 0.63% and 6.37% of the total cost respectively.

Area under wheat has increased from 3.4% in 1975-78 to 16.2% in 2005-07.This is because of availability of canal water and better price of wheat.

Wheat is grown in rabi season and the variety used was BALRAM and LOK-1.

The number of plots under cultivation increased from 32 to 45 plots from 2005 to 2006 and the rate of return from cost of cultivation increased from 43% to 90% in 2005-07

The average productivity yield for wheat rose from 1393 per hectare in 1975-77 to 2494per hectare in 2005-07.

Area under sorghum and sorghum mixtures has declined from 37.9% in 1975-78 to 0.43% 0f gross cropped area during 2005-07.

This is so because hybrid sorghum fetches lower price in comparison to other crops and also finer cereals are available to people at subsidized rates through pds.

It is a kharif crop and the varieties grown in 2005-07 were JK-235, CSH-9, JK-JYOTI and MAHALAXMI-296.

The number of plots cultivating sorghum mixtures were 36 in 2005-06 and 38 in 2006-07.

The returns from cultivation were 23.5% in 2005-06 while farmers faced losses of 6.6% in 2006-07.

The average productivity yield increased from 433 per hectare to 1207 per hectare in 2005-07.

Thus the cost and returns analysis explains that cultivating the irrigated crop wheat in Kinkheda yields more profits to the farmers when compared to the rainfed crop sorghum.

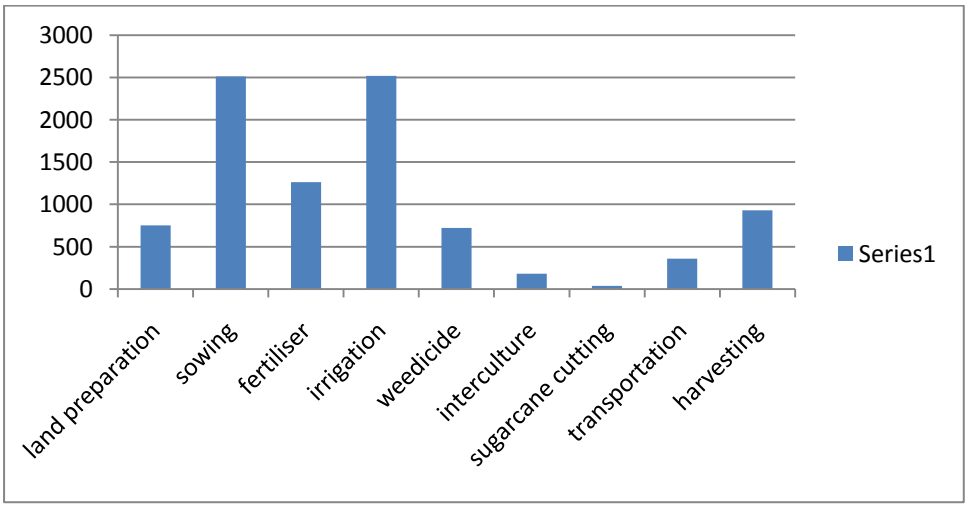
COMPARING THE PROFITS OF IRRIGATED AND RAINFED CROPS-SHIRAPUR

COST AND RETURNS	2005-06(SUGARCANE)	2006-07(SUGR)	AVERAGE	2005-06(SORGHUM)	2006-07(SORGHUM)	AVERAGE
TOTAL COST	8342.82	7499.25	7921.05	1371	1636	1503.5
GROSS RETURNS	15988.18	16097.7	16042.97	3232	3146	3189
NET RETURNS	7646	8597	8121.93	1861	1510	1685.5
BC RATIO			2.02			2

This table explains the profits enjoyed by farmers in cultivating sugarcane which is the irrigated crop in Shirapur and sorghum which is essentially rainfed. The cost in growing sugarcane was 8342.82 in 2005-06 and it fell down by 10.10% and is 7499.25 in 2006-07.Thus the average cost in the period 2005-07 is 7921.05.On the other hand a different movement in cost can be noticed in the case of sorghum ,where the total cost increased by 19.32% and rises from 1371 in 2005-06 to 1636 in 2006-07. The average cost in 2005-07 is 1503.5.The gross returns in 2005-06 is 15988 and then increases to 16097 in 2006-07 ,so there is an increase of 0.68% only. Thus average of gross returns in the period 2005-07 is 16042.The gross returns in sorghum unlike in the case of sugarcane have declined in the two year period by 2.66% .In the year 2005-06 it was 1861 and fell to 1510 in 2006-07.The average net returns for wheat in 2005-07 is 8121.93 where as the average net returns in 2005-07 is 1685.5 in the cultivation of sorghum. The benefit cost ratio when calculated makes it explicitly clear that the profits in growing sorghum are competing the profits enjoyed by the farmers in cultivating sugarcane.

COST AND RETURNS –SUGARCANE 2005

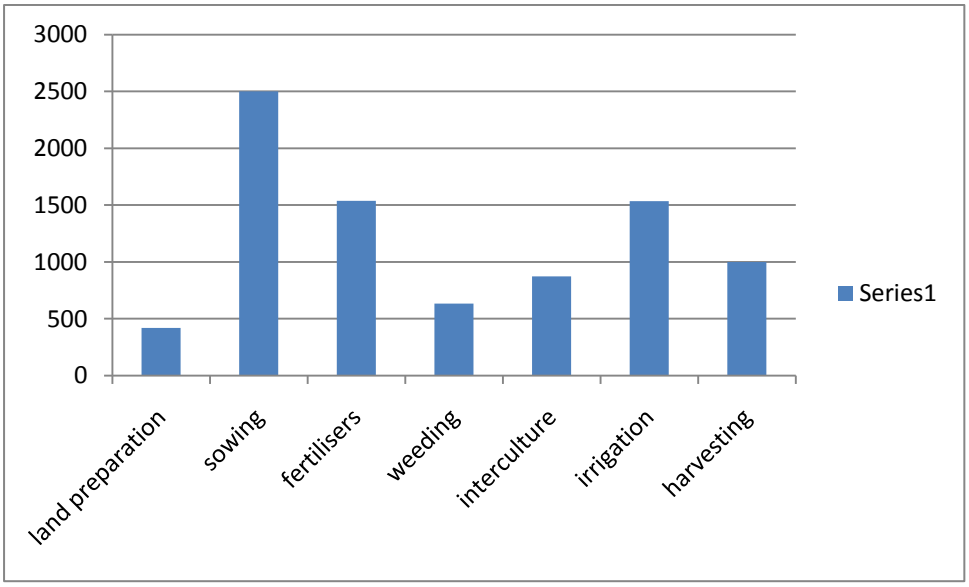
OPERATION	WAGES	MATERIAL USED	TOTAL
LAND PREPARATION	618.7	134.1	752.8
SOWING	529.32	1980.25	2509.57
FERTILISERS	67.55	1195.5	1263.05
IRRIGATION	1311.95	1204.15	25161.1
WEEDICIDE	695.5	25.33	720.84
INTERCULTURE	178.12	4.07	182.19
TRANSPORT	4.13	355.71	359.84
CUTTING	6.87	31.51	38.38
HARVESTING			930.29
TOTAL COST	8342.82		
GROSS RETURNS	15988.18		
NET RETURNS	7646		



This explains the various items of cost incurred in the production of sugarcane. Irrigation and sowing are the two operations which are the major items of cost. The amount spent on sowing is 2509.57,which forms 30.08% of the total cost ,while irrigation cost is 2516.1, which is 30.15% of the total costs. The next important operation in terms of expenses incurred is fertilizer application where the cost is 1263.05, coming upto 15.13% of the cost. For Land preparation the amount spent by farmer is 752.8.which is 9.02% of the total cost while weedicides form 8.64% of cost. The expenses borne by farmer in interculture, sugarcane cutting and transportation is 182.19, 359.84 and 930.29 respectively. The cost of harvesting does not get added as an item of cost, in fact it is added in the gross returns because that cost is given to the farmers by the sugarcane factories. So in 2005-06 the net returns received by farmers are 7646 per acre.

COST AND RETURNS – SUGARCANE (2006-07)

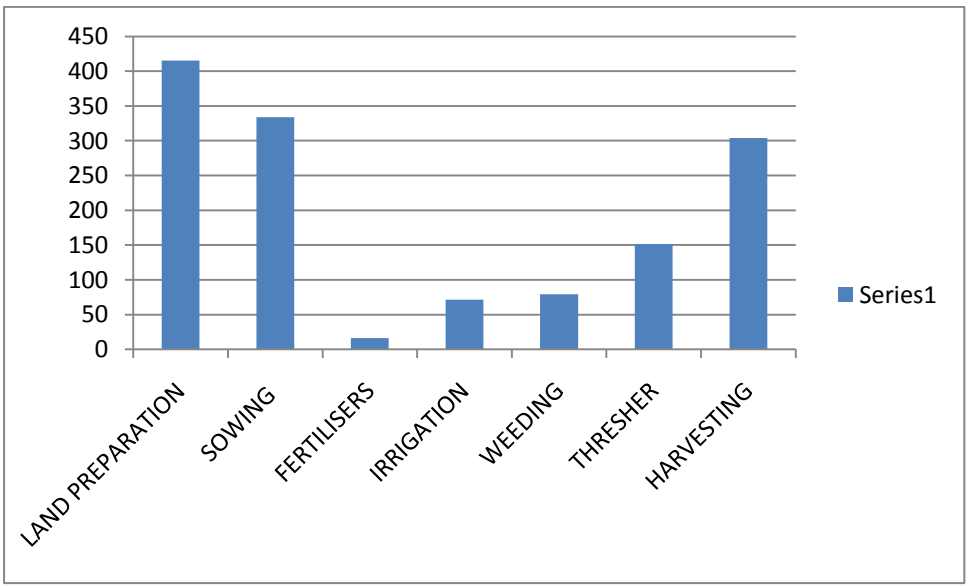
OPERATION	WAGES	MATERIAL USED	TOTAL
LAND PREPARATION	332.52	88.44	420.96
SOWING	745	1755	2500
FERTILISERS	103.37	1435.12	1538.49
WEEDING	633.91		633.91
INTERCULTURE	872.40		
IRRIGATION	34	1500	1533.49
HARVESTING	1000.75		1000.75
TOTAL COST	7499.25		
GROSS RETURNS	16097.7		
NET RETURNS	8597		



As can be seen from the bar graph, sowing and irrigation are the two operations which cost the most. The amount spent on sowing and irrigation are 2500 and 1533 Rs. Which accounts for 33.33% and 20.44% of the total cost respectively. Fertilizers also do form 20.51% of the total cost as the amount spent is 1538.49. Moreover the cost spent by farmers in the operations of land preparation, weeding and interculture is420.96, 633.91 and 872.40 respectively. All cost items when summed up together become 7499.25 and harvesting, is not considered an item of input cost ,as the amount is given to the farmers by the sugarcane factories.

COST AND RETURNS-SORGHUM 2005

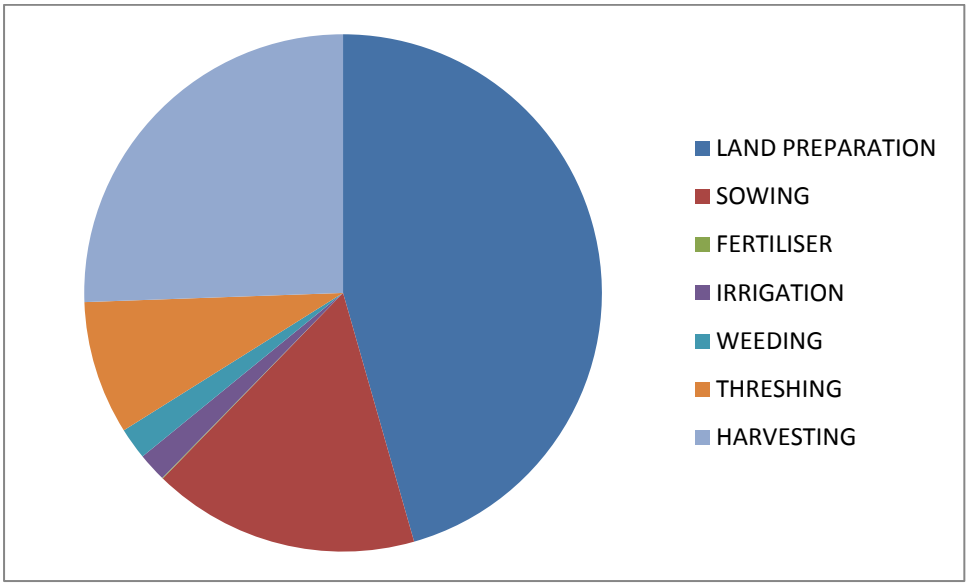
OPERATION	WAGES	MATERIAL USED	TOTAL
LAND PREPARATION	386.27	28.94	415.21
SOWING	275.08	58.61	333.69
FERTILISERS	2	14.64	16.31
IRRIGATION	52.74	18.86	71.6
WEEDING	79.47		79.47
THRESHING	66.59	84.79	151.38
HARVESTING	304		304
TOTAL COST	1371.69		
GROSS RETURN	3232		
NET RETURNS	1861		



As sorghum is mainly a rainfed crop, the cost spent on irrigation is not much and it is 71.6, which forms 5.21% of the total cost. Land preparation, sowing and harvesting cost 415.21, 333.69 and 304 Rs respectively. Fertilizers and weeding operations do no occupy a major share in the cost items as they form only 1.18% and 5.79% of the total cost accounting for 16.31 and 79.74 being spent respectively.

COST AND RETURNS- SORGHUM-(2006-07)

OPERATION	WAGES	MATERIAL USED	TOTAL
LAND PREPARATION	688.41	75.70	764.11
SOWING	200	80.08	280.08
FERTILISER	1	0.24	0.84
IRRIGATION	18.67	11.43	30
WEEDING	33.19		33.19
THRESHING	54.77	85.13	139.9
HARVESTING	428.66		428.66
TOTAL COST	1634		
GROSS RETURNS	3146.81		
NET RETURNS	1510		



The pie chart above explains the distribution of costs incurred by farmers in cultivating sorghum in Shirapur. Similarly as in the previous year 2005-06, the major item of cost is land preparation, which covers 45.56% of the total cost and computes upto 764.11.Harvesting and threshing occupy 25.56% and 8.34% of the total cost respectively. The price paid by the farmer for the operation of harvesting is 428.66 and the cost of threshing is 140. Sowing which forms 16.69% of the total cost adds upto 240 being paid by the farmer. Fertilizer, irrigation and weeding are not the very expensive operations and their share in the total cost is 0.05%, 1.79% and 1.97% respectively. All these operations and the expenses incurred on them, when added together account for 1634 and the gross returns are 3146.81, thus the net returns that the farmers receive is 1510.

Sugarcane is the most important crop in Shirapur and is grown annually as a sole as well as mixed crop.

The availability of canal irrigation has led to this success as it gets water from Ujni project.

It is grown annually and the variety used is CO-671.

The average productivity yield has increased from 23749 per ha to 48317 per ha.

Sorghum is the most important crop in the rabi season and constitutes around 80% of the total cropped area. It is also the staple crop here and is grown as a sole crop and also as a mixed crop along with safflower.

It is a rabi crop and the variety used in Shirapur is M-35-1.

The number of plots under sorghum production increased from 104 plots in2005-06 to 107 plots in 2006-07.

The average per hectare yields has increased from 263 per ha to 598 per hectare in 2005-07.

Therefore in case of Shirapur when the profitability levels of the irrigated crop sugarcane and the rainfed crop sorghum is compared ,the observation is that the sorghum is able to compete in terms of profit and bc ratio with sugarcane production.

COMPARING THE PROFITBILITY LEVELS FOR GROWING SOLE CROPS AND INTER CROPS-KINKHEDA

PROPORTION OF CROPS OR CROP MIXTURES IN THE GROSS CROPPED AREA IN KINKHEDA

CROP/CROP MIXTURES	1975-78	2007-09
COTTON	2.3	2.39
COTTON MIXTURES	43.6	35.49
SORGHUM	2.3	2.36
SORGHUM MIXTURES	35.6	0.34
GROUNDNUT	3.6	0
SOYABEAN AND MIXTURE	0	38
SUNFLOWER	0	0
CHICKPEA	4.9	1.20
OTHER PULSES	2.2	4.45
FRUITS AND VEGETABLES	0	0.67
WHEAT	3.4	15.10
FODDER	2.1	0

IN Kinkheda Village the percentage of area under sole cropping is positively associated with size of operational holding. The BT or hybrid varieties of cotton and hybrid sorghum are the crops which are generally grown as sole crops. Sole cropping occupied around 32% of the

gross cropped area in Kinkheda, in the year 2006-07.On the other hand intercropping is a common feature in the village. Farmers grow two, three or even four crops together. This is basically to avoid risk of crop failure and to be able to sustain. Cotton, green gram and pigeonpea and even the combination of cotton and pigeonpea is one of the commonly grown intercrops. Soybean together with pigeonpea is becoming a popular combination during recent years.

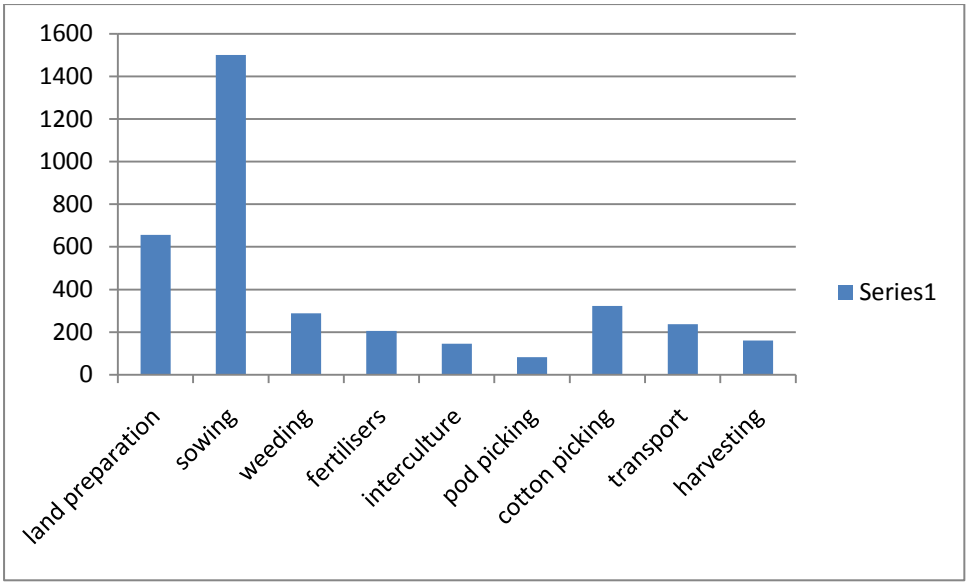
COST AND RETURNS	2005-06 (cgp)	2006-07	AVERAGE	2005-06(sorghum)	2006-07	AVERAGE
TOTAL COST	3601	3832	3716.5	3740	2885	3312.5
GROSS RETURNS	4958	5082	5020	4620	2691	3655.5
NET RETURNS	1357	1250	1303.5	880	-193	343
BC RATIO			1.35			1.1

The cost in production of cotton, green gram and pigeonpea increased in 2006-07 as compared to 2005-06 by 6.41 % and rises from 3601 to 3832. While on the other hand in case of sorghum the costs fall by 22.86%. The cost in 2005-06 was 3740 in 2005-06 and falls down to 2885 in the following year. Thus the average cost of cultivating sorghum in the two year period becomes 3312.5.When it comes to gross returns the cotton, green gram and pigeonpea have shown a positive trend and have increased, although by a small percentage increase of 2.5% and have risen from 4958 in 2005-06 to 5082 in 2006-07. Therefore the average gross returns are 5020. In the case of the intercropping, the gross returns had risen in the consecutive year but an opposite movement in gross returns takes place in case of sorghum. For sorghum the gross returns fell down by 41.75% and decreased from 4620 in 2005-06 to 2691 in 2006-07.The average gross returns sum upto 3655.5 for 2005-07.The net

returns in cultivating 2006-07 reduced in compared to the earlier year, while it was 1357 in 2005-06 it became 1250 in 2006-07.In case of sorghum the net returns were negative in 2006-07 .Net returns in 2006-07 was losses worth Rs 193 ,where as it was positive a year before and accounted to 880 in 2005-06.The benefit cost ratio is also better in case of intercropping of cotton ,green gram and pigeonpea as compared to the sole cropping of sorghum. The benefit cost ratio in cultivation of cotton green gram and pigeonpea is 1.35, while it is 1.1 in cultivation of sorghum.

COST AND RETURNS- COTTON , GREEN GRAM AND PIGEONPEA-2005

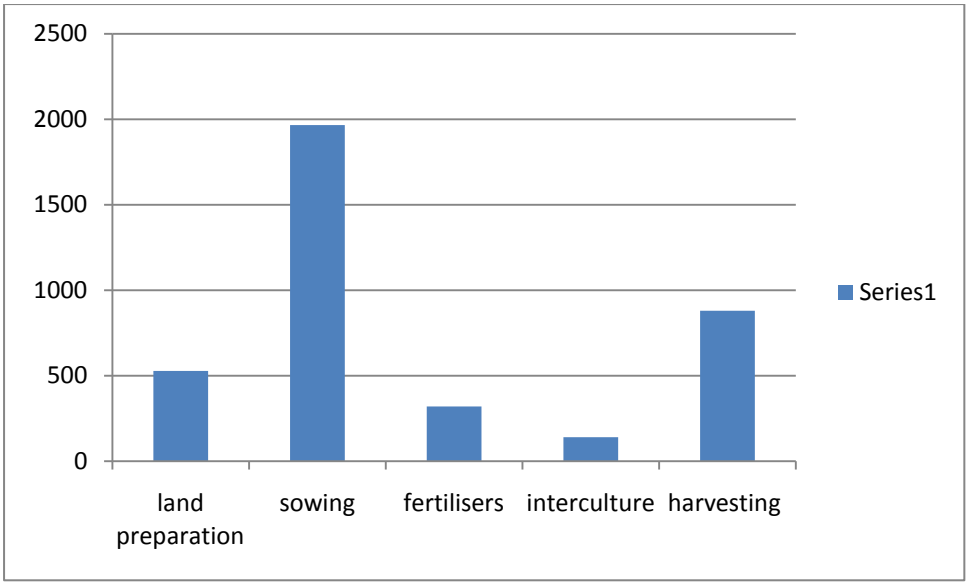
OPERATION	WAGES	MATERIAL USED	TOTAL
LAND PREPARATION	422	234.86	656.86
SOWING	1029	471	1500
WEEDING	289		289
FERTILISER	43	163	206
INTERCULTURE	146		146
POD-PICKING	83		83
COTTON-PICKING	323		323
TRANSPORT	194	43	237
HARVESTING	160		160
TOTAL COST	3601		
GROSS RETURNS	4958		
NET RETURNS	1357		



Sowing is the component of cost which occupies the greatest percentage of 41.65% and accounts for 656.86. On the other hand weeding, fertilizer application, interculture, pod picking and cotton picking form 8.02%, 5.72%, 4.05%, 2.3% and 8.96% respectively. The cost incurred by the farmers in the operation of land preparation is 656.86 and it accounts for 18.24% of the total cost. Threshing and harvesting, both combined sum upto 4.44% of the total cost and the expenses incurred by the farmers on it has been 160.Thus the total cost incurred is 3601, while the gross returns are 4958.Therefore the net returns got from the cultivation of this intercropping is 1357.

COTTON , GREEN GRAM , PIGEONPEA- KINKHEDA(2006-07)

OPERATION	WAGES	MATERIAL USED	TOTAL
LAND PREPARATION	347	180	527
SOWING	1410	555	1965
FERTILISERS	58	262.3	320.3
INTERCULTURE	140		140
HARVESTING	783	97	880
TOTAL COST	3832		
GROSS RETURNS	5082		
NET RETURNS	1250		



As is clear from the bar graph sowing is that component of cost which occupies the major percentage of 51.27% and the amount incurred on it is 1965 in 2006-07.Land preparation and harvesting are the two other important components of cost forming around 13.75% and 22.96% of total costs respectively. The amounts incurred by the farmers are 527 and 880 for theses two items of cost. The application of fertilizers and interculture are the less expensive operations and the expenses incurred by farmers of Kinkheda on it have been 320.3 and 140 respectively. Thus the total cost is 3832 and gross returns are 5082, leading to net returns worth 1250.

COST AND RETURNS IN SORGHUM CULTIVATION-(2005-06) KINKHEDA

OPERATION	WAGES	MATERIAL USED	TOTAL
LAND PREPARATION	401	180	581
SOWING	1329	481	1810
FERTILISERS	68	265	333
INTERCULTURE	28		28
TRANSPORT	72	68	140
HARVESTING, THRESHING	672.5	175	847.5
TOTAL COST	3740		
TOTAL RETURNS	4620		
NET RETURNS	880		

In sorghum sowing occupies an important part among the items of cost, it is around 48.39% of the total cost and the cost incurred is 1810. There is no cost spent in irrigation, as sorghum is rainfed. Fertilizers cost 333 and are 8.9% of the total cost. Interculture and transport are less cost bearing operations, 28 and 140 is spent on the two respectively. Land preparation and harvesting occupy 15.53% and 22.66% respectively. The total cost spent by the farmers is 3740 where the gross returns are 4620, and they enjoy net returns of 880.

COST AND RETURNS-SORGHUM (2006-07) KINKHEDA

OPERATION	WAGES	MATERIAL USED	TOTAL
LAND PREPARATION	364.8	192	556.8
SOWING	1005	470	1475
FERTILISERS	32.9	149	181.9
INTERCULTURE	18		18
HARVEST	553	101	654
TOTAL COST	2885		
TOTAL RETURNS	2691		
TOTAL LOSS	193		

This explains the various operations and the costs incurred on them. Similar to the sowing cost in 2005-06, the cost is again highest in 2006-07 and the cost incurred on it is 1475.Land preparation and harvesting are two other major items of cost which occupy 19.50% and 22.90% respectively and the amounts incurred on these operations are 556.8 and 654 respectively. Following a similar trend as in 2005-06 even in 2006-07, very less amount is spent by farmers in operations of interculture and fertilizers and they form 0.63% and 6.37% of the total cost respectively.

Thus on comparing the profitability levels of intercropping of cotton, green gram and pigeonpea, with the sole crop sorghum, the observation is that the farmers get higher profits in the intercropping as compared to the sole crop.

Cost reduction due to technology adoption

Cost and returns – chickpea 2005 SHIRAPUR	LOCAL VARIETY	IMPROVED VARIETY-VISHAL
Total cost	2112	2090
Gross returns	4160	4480
Profit	2048	2390
BENEFIT COST RATIO	1.96	2.14
AVERAGE PROUCTIVITY PER ACRE	111	160

This is an illustration of how the use of improved variety of cultivors can lead to a rise in the profits. This is a comparison of the cost and returns in case of pigeonpea production, in which on the one hand on some plots the local varietr of pigeonpea has been used,and on the other hand some farmers are using the improved variety VISHAL.The total cost when using the improved variety is lower than when the local variety is used,although marginally only by 1.04%.The total cost in the year 2005-06 was 2112, while it fell down to 2090 in the consecutive year.The gross returns had increased as well by 7.69% ,as the gross returns in 2005-06 was 4160 while in 2006-07 it rose upto 4480 in 2006-07.Following a similar trend the net returns have also been more when the improved variety was used,in comparison to when the farmers used the local variety. The net returns when using the local variety was 2048, and it increased to 2390 iwhen using the improved variety.The average productivity per acre as well as the benefit cost ratio is greater when the improved variety seed of chickpea was used.

COST AND RETURNS-SOYABEAN (2005) KINKHEDA

OPERATION	WAGES	MATERIAL USED	TOTAL
LAND PREPARATION	580	300	880
SOWING	298	671	969
WEEDING	226		226
INTERCULTURE	12.5		12.5
TRANSPORT	18.75	118.75	137.50
THRESHING AND HARVESTING	438	131	569
TOTAL COST	2794		
TOTAL RETURN	3425		
TOTAL PROFIT	631		

COST AND RETURNS- SOYABEAN (2006) KINKHEDA

OPERATION	WAGES	MATERIAL USED	TOTAL
LAND PREPARATION	405	141	546
SOWING	606	760	1366
FERTILISER	40	200	240
INTERCULTURE	5		5
THRESHING	601	300	901
TOTAL COST	3060		
TOTAL RETURNS	4607		
TOTAL PROFITS	1547		

Soyabean occupies 5.5% of gross cropped area during 2005-07 and is grown along with black gram,sorghum and pigeonpea.

It is a kharif crop and the variety used in 2005 is JS-335 and in 2006 KUSHIDAN-336 was used along with JS-335.

The number of plots cultivating soyabean increased from 4 in 2005 to 10 in 2006.

The returns from cultivation over costs increased from 22.6% in 2005-06 to 50.5% in 2006-07

The average productivity yied of soyabean in 2005-07 was 974 per hectare.

Soyabean is replacing groundnut as it gives more assured income and fetches a good price.Soyabean and pigeonpea in the 4:1 ratio is commony grown in kinkheda.

COST AND RETURNS- CHICKPEA(2006-07) KINKHEDA

OPERATION	FAMILY FEMALE	FAMILY MALE	HIRED FEMALE	HIRED MALE	OWNED BULLOCK	MATERIAL USED
LAND PREPARATION	6	30	30	220	370	250
SOWING	20	25	45	25	100	1100
FERTILISER		37.5		87.5		938
IRRIGATION				150		190
THRESHNG AND HARVESTING			75	175		75
TOTAL COST	3609					
TOTAL RETURN	3037.5					
TOTAL LOSS	571.5					

Chickpea which was considered a major post rainy crop in Kinkheda has declined in area from 4.9% in 1975-77 to 0.25% in 2005-07 and the reason generally being wild animal problem.

It is a Rabi crop and the variety used was JGK-1.

Chickpea was not grown at all in 2005-06 but in 2006-07 there was a sole farmer who grew it and incurred losses as well.

Chickpea grown in 2006-07 incurred losses of 15.8% on cost of cultivation .

GROUNDNUT KINKHEDA (2005-07)

AREA UNDER GROUNDNUT HAS DECLINED TO ZERO IN KINKHEDA FROM 3.6% AREA IN RAINY SEASON.

The result is that farmers completely ignore growing groundnuts because of high seed cost, erratic rains and uncertainty in production.

In the period 2005-07 not even a single farmer has grown groundnuts.

This crop has been replaced by soybean and the productivity of groundnuts was from 430 per hectare in 1975-77.

COST AND RETURNS-GROUNDNUT (2005-06) SHIRAPUR

OPERATION	WAGE	MATERIAL USED	TOTAL COST
LAND PREPARATION	358	51	409
SOWING	149	416	565
IRRIGATION	496	219.8	715
FERTILISERS	14	199	213
WEEDING	770		770
TRANSPORT		22.5	22.5
HARVEST	2146		2146
TOTAL COST	4840		
TOTAL RETURNS	8019		
NET RETURNS	3179		

COST AND RETURNS-GROUNDNUTS(SHIRAPUR)2006

OPERATION	WAGES	MATERIAL USED	TOTAL
LAND PREPARATION	480		480
SOWING	260	642	902
FERTILISERS	6.4	114.6	121
HAND WEEDING	418		418
IRRIGATION	389	165	554
HARVESTING	978		978
TOTAL COST	3453		
TOTAL RETURNS	4124		
NET RETURNS	671		

Groundnut production has been exhibiting fluctuating trends in Shirapur.The maximium production was in 1978 as it covered around 75% of the cropped area.

Number of plots growing groundnuts

2001-02 4

2002-03 8

2003-04 1

2004-05 13

2005-06 16

2006-07 5

It is generally grown in the kharif season and various improved varieties are grown here and one of the majorly used variety is KARAD-4-11.

The returns in 2005-06 are that they are able to cover65% of the costs but in 2006-07 the returns are able to cover only 19% of the costs.

The average productivity yield per hectare has risen from 359 per hectare in Shirapur in the first generation to 800 per hectare in the second generation.

CONCLUSION:

The analysis presented in this paper of different facets of household economies in the semi- arid tropics highlighted certain bright as well as disturbing features. While there has been an improvement in income, consumption standards , literacy levels ,infrastructure and social mobility , the agriculture sector seems to be stagnant.

The deviations from the average rainfall can be observed in both the villages of Shirapur and Kinkheda. Cropping patterns have changed considerably in the villages over time. When comparing the profitability of rainfed and irrigated crops, in case of Kinkheda the levels of profits are greater in irrigated crops than the rainfed crops .However in Shirapur the rainfed crop was able to compete with the irrigated crop in terms of profit level. On comparing the profit levels of sole grown crops with those that are inter cropped , a general conclusion is that farmers are better off in growing inter crops in the village of Kinkheda.

Cost and return analysis between the two cases ,one in which the local variety of seed is used and the other where the improved variety is utilized , it is amply clear that the net returns as well as average productivity per acre is more when the improved variety is used by the farmer.

Other major conclusions are that in Kinkheda ,the cultivation of soybean is on the rise and it is replacing groundnuts. Chickpea which was considered a major post rainy crop in Kinkheda has declined in area because of the wild animal problem .The production of groundnuts in Kinkheda have declined to zero because of erratic rains and uncertainity in production, where as the cultivation of groundnuts in Shirapur has been exhibiting fluctuating trends.

In Shirapur the production of sugarcane is viable but this is not the case for some crops ,and groundnuts reveal different trends in profitability also over different time periods.Where as in Kinkheda the cultivation of wheat, soybean and intercroppings like cotton, green gram and pigeonpea or soybean and pigeonpea is viable but cultivation of chickpea is not

.In both the villages even if profits are there for some crops ,they are not immense ,not enough to grant the farmers a decent standard of living .In such an environment , one can expect a flight of capital from rural to urban areas and from agricultural to non-agricultural sector.The question to be answered is if rainfed agriculture , which in general is non-viable, why do innumerable farmers depend on farming as their major occupation?

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