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Contents

Focus

Organic Agriculture Programming for Sustainability in Primary Sector of India: Action and Adoption

ARUN K. SHARMA

Realizing the effects of Conventional System (CS) of agriculture by the stakeholders that are leading to unsustainable trends in productivity of primary industry, society and environment, organic agriculture (OA) is being gradually established as a viable option for sustaining growth of primary sector in India. In this article logical standing of OA as scientific, resources & energy efficient and climate resilient system has been presented with the experimental results and experiences of the farmers. Organic agriculture got significant momentum in India in all direction i.e. production, marketing, research and policy etc. during last 2-3 decades. During this period this has been proved that sufficient organic inputs are available and productivity & profitability remained almost at par with CS, if managed prudently, besides environmental (biodiversity, carbon sequestration) and human health improvement. However, there is need of programming for quantity and quality production of organic produce to meet the increasing indigenous as well as export demand. This programming and its execution will lead to gradual shift on OA, firstly in drylands and later on in irrigated areas, without losing food security. Consortium approach of all stakeholders in policy, research, and market and production is the need for success of this programming.

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Physical science (PS) has done tremendous progress as compared to biological science (BS). The main reason of slow progress in BS is numerous interactions in a biological system due to which any new intervention in that system never gives a calculated results as mostly happened in PS. Therefore, if any approach of PS is applied in BS it may give unexpected results in short/long term. PS is mostly used for secondary industry while BS is for primary industry e.g. agriculture, forestry, fisheries, animal husbandry etc. Therefore, in primary industry any new intervention may give positive or negative effects beyond the calculations. These effects may be visible in short term or in long term when system buffer capacity exhausts. This is being exactly realized all over the globe and in Indian primary industry too. Grow more food campaign that started in 1950s and later on continued with new term green revolution, had the base of technologies for targeted or cure and control approach that are mainly followed in PS e.g. use the synthetic form of nutrients that are found deficient in soil or kill the pest and weed with poisonous pesticides & weedicides. In other words these chemicals were used to cure the problem of food scarcity in Indian agriculture. Although at that time(1950-60) food was in the top agenda in the nation's program and it was done, at war level so nothing is to be criticized as it was need of the time. In late 1970s India achieve self sufficiency in food grain production, However, even after attaining the self sufficiency the use of chemicals was continued, in other words the medicine was continued even after the disease is cured because this has been found an easy short cut to sustain the production and the basic nature of biological system has been continuously ignored that converted remedy into

malady. In 1980s the consequences of disturbance in BS of production with chemicals were becoming visible and the production growth become almost stagnated or in some of the cases following negative trend with several socio-economical and environmental problems. The major reason of this negative trend is the BS of primary industry has been treated like machine in PS.This approach need to be rectified for sustaining the productivity. In the present article this system is described as "conventional system (CS)".

The Unsustainable Trend In Production and Profitability In CS

Productivity of CS that mainly dependent on external inputs e.g chemicals, irrigation, seed, exotic animals etc. gets a stagnation in productivity or in many cases it started following negative trend (Ladha et al., 2003; Timsina & Connor, 2001). This also affected not only the productivity of agriculture per se but also the regenerative capacity of natural resources like soil, sharp decrease in population of beneficial flora and fauna (particularly pollinators), deficiency of micronutrients e.g. Zinc, Iron, Boron etc., resistance in pest to pesticides, secondary salinization (Pingali and Shah, 2001), decline of ground water table (Ambast et al., 2006), decrease in soil organic carbon content (Lal, 2004) etc. are being observed and this is the actual cause of unsustainable trend. In this unsustainable trend even after using more and more external inputs the productivity will not follow to positive trend due to disturbed biological system of production and it cannot be repaired easily as machine in PS but takes very long time to restore. Now after soil health deterioration the more serious thing is that the CS is starting to disturb the life of producer/farmer, by several diseases (cancer, birth of deformed children etc.). Since the end of the 1990s, increased incidence of farmer suicides in India has been the most dramatic outcome of the hopelessness faced by many farmers, due to a combination of factors like high input prices, crop failure, indebtedness, etc. (Mishra, 2007). An estimated 27% of farmers did not like farming because it was not profitable. In all, 40% felt that, given a choice, they would take up some other career.(NSSO,2005 P:11). There are several reports and references on the decreasing productivity of CS and its adverse effects on environments and society and, lower marginal returns with continuous intensification (Gupta & Seth, 2007). Dr M.S.Swaminathan who was the pioneer of green revolution in India has also accepted the need of evergreen revolution described 'Evergreen Revolution,' as the increasing productivity in perpetuity without ecological harm, he laid stress on the 'organic agriculture' which meant cultivation without use of chemical pesticides and 'green agriculture' which meant conservation agriculture with the help of integrated pest management, integrated nutrient supply and integrated natural resource management. Agro forestry system involving fertilizer trees was another component of evergreen revolution(Swaminath,2011). Adverse effects of CS is now being accepted by most of the stakeholders of agriculture production. Hence, rather entering in detail discussion of adverse effects of CS on agriculture this article is devoted to find best possible option for sustainable agriculture based on integration of two or more than two components e.g. crops, trees, animals, fish, poultry (agroforestry, rice+fish, farming systems etc.) etc. of production system for efficient cyclic use of mainly local resources. Obviously, any approach for sustainability has to be taken into consideration of primary sector as a whole.

Organic Agriculture(OA): The Imperative Option for Sustaining Productivity and Profitability

In late 1970s farmers world over realized the adverse effects of conventional farming and started their own efforts to develop a sustainable system; in 1990s consumers are also realizing the ill effects of produce with pesticides and due to that demand of safe and sustainable food production was increasing that forced policy makers to promote such systems and one such system is now very well recognized is OA that consider agriculture or in wider sense the primary industry is nature's system and long term productivity can be maintained only by understanding and providing all possible support so that nature can work at its best to meet the three goals of agricultural development. These are: (a) achieve sustainable growth in agriculture and raise incomes by increasing productivity (land, labor), diversification to high value agriculture and rural non-farm by maintaining food security; (b) sharing growth (equity) by focusing on small and marginal farmers, lagging regions, women etc.; (c) third is to maintain sustainability of agriculture by focusing on environmental concerns (Dev, 2012).

Two words ecological agriculture and organic agriculture are synonymous in the context of this article but use of OA is opted because of its wider acceptance and knowledge. Before going into details of OA the scope of OA that will be dealt in this article need to be clear. In this article organic agriculture is a nature, producer and

consumer friendly system with the optimum use and recycling of mainly local resources and maintaining diversity. Although for trade use it may be having some rules and regulations but for this article it will be limited to the ecologically and economically sustainable production system. Also, work is going on, on every aspect of organic agriculture world over, however, preference in this article is given for refereeing the work in India to increase relevancy because OA is designed mainly on the basis of climate, soil and social environment of the area. Complexity in experiments in OA, experiences are equally important to complete the story of a system and the author has shared some of his or farmers' experiences (documented) about organic agriculture in this article.

Interestingly, many a times OA is projected as a new system with several apprehensions however, before the synthetic chemicals were invented it was all OA based on times tested traditional technologies and civilization was thriving for millenniums. In India the production of rice had been recorded upto 9.0 t/ha during 17th century (Alvares, 2009). Later on productivity has gone down during British period and recorded only 700 kg/ha in 1947.Therefore, food production technologies (obviously organic only) were capable to maintain sufficiency level during ancient time and these technologies can be revalidated and improved with the integration of modern ecofriendly technologies. Modern science has not only developed the synthetic chemicals (fertilizers, pesticides,weedicides) but also the several ecotechnologies i.e. use of enriched compost, biofertilisers, biopesticides, rainwater conservation, crop rotation, mulching, agroforestry etc. and OA is just integration of them considering the local conditions and traditions with a set ideology(described below).Therefore, this is a highly scientific system with all possibility of need based improvements.

Productivity with profitability

Many factors contribute in long term productivity and profitability of organic system that also support to decide OA may be the best option considering the farming and environmental conditions of India . These factors include ideology and ability to meet the challenges from production to consumption (e.g. climate, society, market etc.) chain.

A. *Ideological superiority*

In last few decades awareness about social and environmental issues has been increased. Agriculture is one of the basic enterprise that has major role in these two issues. OA is one of the agriculture production system that not only supportive to the environment but also sensitive to the social issues like employment, health, migration etc. Definitions given by two international organizations also verifies this concept. These definitions are-

1. Organic agriculture is a holistic management system, which enhances agro-ecosystem health, utilizing both traditional & scientific knowledge. Organic agriculture systems rely on ecosystem management rather than external agricultural inputs. (IFOAM,2006)

2. Organic agriculture is an environmentally and socially sensitive food supply system. The primary goal of organic agriculture is to optimize the health and productivity of independent communities of soil life, plants, animals and people.(FAO,2002)

In simple words organic agriculture is the production system with the optimum utilization of local resources in such a way so that sustainability of production and wellness of the society and environment can be maintained for fairly long time. Although organic agriculture seems to be just the exclusion of synthetic external inputs but it is the ideological differences with conventional agriculture (Sharma, 2001) that makes OA friendly to society and environment. These differences are given in table 1.

After going through the ideological differences the questions arises - Are two systems comparable ? and many times they (CS to OA) are compared on yield basis only. With the comparison shown in table it is clear that OA has ideological superiority over conventional agriculture, as far as its sensitivity concern the society and environment. With such a vast difference in approach in both systems, on one side OA is based on traditional methods (some improvement by incorporation of modern science) and traditional seeds and no subsidy rather tax on organic inputs on the other side CS with High Yielding Varieties and modern technologies and heavy subsidy to inputs (fertilizers pesticides etc.), it is difficult to compare CS to OA on the basis of yield only. A logical comparison need to be done before referring OA capacity to meet the requirements of society. It needs a long term study for budgeting tangible and nontangible inputs and outputs of both the system for comparison. Also, there is immense scope for research in organic farming to develop technologies for efficient resource use, and policy support to organic system and whenever, level playing status will be achieved, than there is possibility of fair comparison.

Table 1 : Ideological differences between organic agriculture and conventional agriculture

Organic Agriculture	Conventional (chemical) Agriculture
Holistic approach: Any technology applied considering the system as a whole- No imbalance	**Reductionist approach**: Targeted approach for one commodity or one pest or deficiency of nutrient- creates imbalance in system
Decentralize production: Most of the inputs e.g. seed, manure, biopesticides etc. produced at farm/village level- suitable to local environment+ generate employment+ low cost of production	**Centralize production**: Produced in factories/farms, away from the place of use- no proper use of local resources+ least employment+ increase cost of production
Harmony with NATURE: Harness the benefit of natural resources, flora and fauna by using or giving favorable environment to them- sustained productivity of natural resources	**Domination on NATURE**: Agriculture system is forced to produce more- Regenerative capacity of natural resources decreased+ decrease productivity in long term.
Diversity: Includes all possible organisms complimentary in a system. Work as mutual service providers for nutrient and pest management. Least cost and time required of system owner.	**Specialization**: Only one crop or tree or animal. All cost and time of nutrient and pest management has to be borne by system owner/ farmer.
Input optimization: best use/recycling of available resources. System regenerative capacity and owners economic capacity maintained/enhanced.	**Output maximization**: Over use of resources disturbs system and resources productivity in long term- increasing cost.
Knowledge intensive: Only few resources but need how timely and best integrated. Least dependency on experts/imported technologies, once farmer trained-possible in remotest area.	**Input intensive**: Comprehensive list of chemicals with time and method. Needs experts for timely updating. Only possible in resources sufficient areas.
Preventive, protective and proactive approach: All the actions/ applications are done in anticipation of system requirement-least use of inputs.	**Cause and control approach**: Most of the actions/applications are done to control the damage to system-heavy use of inputs.
Decreasing input use: As the system reaching at perfection it conserve/generate its own resources e.g. for nutrition and protection- decreasing requirement of inputs	**Increasing input use**: Target and action approach that rather, deteriorate systems regenerative capacity- increasing requirement of inputs.

B. Market competitiveness and Demand

Competitiveness in terms of price, premium and quality: Production of food in organic farming and maintaining quality is becoming a compulsion for standing in international and gradually in the domestic market also, because :

1. International demand of organically produced foods from India is increasing by almost 30% every year. According to the recent data (APEDA,2013), statistics of organic farming in India (2010-11) is as follows-
   - Total production (organic) – 3.88 million MT
   - Quantity export – 69837 MT
   - Export Value – 157.22 million US$
   - Share of export to total production – 4%
   - Certified area (including wild harvest) – 4.43 million ha
   - Certified are under cultivation – 0.24 million ha
   - Increase export (from 2010 to 2011) – 33%

Enforcement of phytosanitary regulations in Europe and other countries is also compelling to export only the food items free from residues of synthetic chemical.

2. Indian is a growing economy and the demand of organic produce within the country is also increasing at a very fast rate, and at the same time being open economy consumers are free to buy a quality with low priced produce from international market. Therefore, if India wants to discourage import, indigenous organic produce has to be made available in market. In a survey it has been found that within India presently there is potential market of Rs.23000 million for organic produce that will increase as the consumer awareness increases (Menon et al. 2011).
3. With the scientific advancement, many of our monopoly crops are being grown by several other countries and quoting lower rates in international market. For example, cumin was a monopoly crop of Indian but now it is being grown by China, Iran, Turkey

and Egypt. To remain competitive India has to produce organic for meeting the international demand.

4. Most of the spices like cumin,coriander,fennel, ajwain(carom), fenugreek, cardamom, clove etc. and medicinal plants are important ingredient of ayurvedic, unani and homeopathic preparations. These all medicines are supposed to be given to patient and if these ingredients have residues of pesticides it may have poisonous effect instead of curing the patient. Therefore, it is our ethical duty to grown spices and medicinal plant, only organically, as social obligation.

With the above discussion it is clear that organic farming is becoming necessary not only for market point of view but also for the welfare of farmer and society as a whole.

Therefore for maintaining our monopoly or rather competitiveness in international as well as domestic market, economic as well as quality production is becoming imperative.

Organic farming also helps in getting either low cost or high price quality produce. These are-

1. In organic production system, no external synthetic chemical is used, moreover emphasis is given on recycling of locally available resource. With this approach cost of production can be reduced upto 10-30% as compared to conventional chemical farming in irrigated areas (Ramesh et al., 2010; table 2). However, yield was comparable or slightly low to CS and that is presently easily compensated by premium

Table 2: Economics of crop production in organic versus conventional farming (Ramesh et al., 2010)

State	Crop	Cost of cultivation (Rs. ha^{-1})			Net returns (Rs. ha^{-1})		
		Organic farming	Conventional farming	Per cent increase(+)/ decrease (-) in organic farming	Organic farming	Conventional farming	Per cent) increase (+ decrease (-)/ in organic farming
Maharashtra	Vegetables	25,000	26,000	-3.8	25,000	29,000	-13.8
	Fruits crops	70,000	78,000	-10.2	50,000*	47,000	+6.4
	Rice	10,000	11,500	-13.0	20,000*	18,000	+11.1
	Wheat	8,000	9,000	-11.1	10,000*	9,000	+11.1
Karnataka	Soybean	7,200	7,800	-7.7	9,000	10,350	-13.0
	Chickpea	6,700	7,250	-7.6	4,700	4,750	-1.1
	Fruit crops	20,000	23,500	-14.9	84,000*	64,500	+30.2
	Groundnut	13,000	14,500	-10.3	17,000	23,000	-26.0
	Sugarcane	55,000	60,000	-8.3	101,000	108,000	-6.5
Tamil Nadu and Puducherry	Cotton	10,000	10,000	0	11,000*	10,000	+10.0
	Cashew	12,500	14,000	-10.7	13,500	6,000	+125.0
	Banana	60,000	80,000	-25.0	240,000*	170,000	+41.2
	Mango	25,000	30,000	-16.6	135,000	90,000	+50.0
	Guava	20,000	25,000	-20.0	80,000	90,000	-11.1
	Coconut	30,000	34,000	-11.7	111,250	109,250	+1.8
	Rice	25,000	20,000	+25.0	37,500*	40,000	-6.2
Kerala	Pepper	36,500	40,200	-9.2	88,600*	44,300	+100.0
	Banana	61,000	75,000	-18.6	194,000*	145,000	+33.8
	Coconut	50,000	60,000	-16.6	166,000*	120,000	+38.3
	Coffee	40,000	54,000	-25.9	75,000*	48,000	+56.2
	Turmeric	87,000	140,000	-37.8	130,000*	85,000	+52.9
Uttarakhand	Rice	18,000	20,700	-13.0	28,800*	17,750	+62.2
	Wheat	20,000	23,000	-13.0	17,500*	16,000	+9.3
	Potato	20,000	18,000	+11.1	28,000	42,000	-33.3
Mean				-11.7			+22.0

*Premium price available to organic produce

price but in future, research and development certainly make OA comparable productive to CS that to with sustainability. In a comprehensive study the unit cost of production was found lower in OA ,compared to CS and there is ample scope of improving efficiency under OA (Charyulu,2010). Interestingly, in rainfed areas OA yields 7-15 % more due to better nutrient and rainwater management (Yadav and Gahlot, 2011).

2. There are several example of experiments and farmers' (Alvares,2009) experiences which shows that due to balanced nutrient supply through organic sources, the quality of organic produce increases in terms of aroma, essential oil content, texture, taste and shelf life(helps in long distance transportation). Author himself experienced a much better (than chemically grown) aroma, luster, and keeping quality in leafy coriander at village Ballon-ka-guda in Udaipur (Rajasthan)district. In that whole village vermicompost was produced and used for coriander production. Farmers told that they get 1.5-2.0 times higher price in vegetable market and for coriander seed as well. Even people are ready to give premium price to organic by simply considering at least the product is free from pesticide residues. In exhaustive studies(Woese et.al, 1997and Worthington, 2001) organic foods were found nutritionally superior. Significant increase in micronutrient (Fe,Zn,Mn) contents was observed in Basmati rice under OA (Singh et al.2007).

Therefore, organic farming is the only option for low cost quality production.

C. Able to meet future challenges

Agriculture is going to face several challenges due to changing climatic and social environment. These challenges will affect the agriculture production in totality. OA can be a good option to meet these challenges.

1. Substitute of low & reducing supply of fertilizers and burden of subsidy: To some extent nitrogenous fertilizers and most part of other fertilizers are imported from various countries. Supply of Phosphate and Potash fertilizers is going to be reduced in future as their natural reserves are shrinking. Nitrogen fertilizers are produced with the use of petroleum products and its reserves also decreasing .Therefore planning has to be done to find out a system that is least dependent on these fertilizers. Moreover, most of the fertilizers companies give priority to irrigated areas Punjab, U.P., Haryana, Maharashtra etc.and supply in rainfed areas remained short supplied. Therefore, to reduce dependency on imported fertilizers and recurring problem of short supply in rainfed areas, opting OA is the only solution. Subsidy (Rs.1200 billion) on fertilizers not only encouraged over and improper use of fertilizers, also this subsidy goes mainly to irrigated areas (Roy et al,2010). Therefore, this subsidy needs to be rationalized and part of need to be diverted to the rainfed/drylands for promoting organic agriculture. This will be a remedy of several problems that arise due to CS.

2. Mitigating effect of climate change: Worldwide 90 million tons of mineral oil or natural gas are processed to get Nitrogenous fertilisers every year. This generates 250 million tons of CO_2 emission. On the contrary, organic farms returns 575 to 700 kg CO_2 to the soil. Organic farming thus reduces CO_2 emission by eliminating synthetic fertilisers, and at the same time reduces atmospheric concentration of this gas by storing in the soil, a win-win system.(Niggli, 2008) Further, soils with higher humas content can adopt to the adverse effect of climate change. It has been found that organic system provided better yield during climatic extremes(that happens due to climate change) as compared to conventional system (Sharma, 2013). Organic agriculture is a promising strategy to face these challenges. Many of its core concepts and practices focus on sustaining healthy and fertile soils with high organic carbon levels, a well- aerated structure and a rich diversity of the soil biota. Such soils are able to absorb large amounts of water from heavy precipitation without water logging or erosion. They also store the available water better, thus hedging against water scarcity and droughts and reducing irrigation needs.

Organic agriculture uses local knowledge which is highly adaptive to local variations, and combines it with modern agro-ecological methods. Moreover, the high diversity on organic farms improves economic and ecological stability and increases resilience against adverse impacts of climate change. A higher diversity of income sources hedges against the risk of crop losses. Optimized and diverse crop rotations can break life-cycles of pests. Landscape elements such as fallow land, buffer or flower strips provide resorts for beneficial animals.

Diversification towards combined crop and livestock production also increases resilience. Grasslands

can be used for animal feed production, also in situations where no crops can be grown, in particular on marginal and degraded lands. This adds to food security, as it helps utilizing land for human nutrition that cannot be used for this directly via crops. Economic risk is also reduced as organic agriculture is a low external input farming system. Absence of costly farm inputs reduce potential financial losses from crop failure, while net profits can still be higher for conventional farms, in particular if organic price premiums can be realised on the markets. The risk of indebtedness is thus reduced, which is particularly important for smallholders and poor farmers as it helps to avoid the poverty trap. Published studies show that organic farming systems are more resilient to the predicted weather extremes and can produce higher yields than conventional farming systems in such conditions (Drinkwater et al,1998; Pimentel et al, 2005).

3. Ensuring food security : As discussed above, organic farming provide resilience to climatic extremes and helps in sustaining food production. Rainfed/ dryland agriculture with nearly 58% of the cultivated area contributes 40% of the country's food production. Even after full irrigation potential of the country is realized, half of the cultivated area will continue to be under rainfed farming. Much of the acreage under coarse cereals (85%), pulses (83%) and oilseeds (70%), substantial area under rice (42%) and nearly 65% of cotton area is rainfed. Increasing the yields in the 42 % that comes from the irrigated areas will show little benefit for two reasons. Firstly, this sector is already high-yielding, and it has very little scope for large increases in yields such as the more than 100% that can be achieved by organic methods in traditional smallholder systems. Secondly, this sector is largely focused on the commodity supply chain. The large food surpluses produced in the sector have not lowered the number of people who are hungry. Logically, increasing the yields in the rainfed drylands areas is the key to ending hunger and achieving food security(Swaminathan, 2011a). Organic methods are the most suitable for rainfed drylands areas as the necessary methods and inputs that are needed to do this can be sourced locally at no or very little cost to the farmers(Sharma , 2001). CS have largely failed to provide consistent higher yields to the poorest farmers as the expensive synthetic chemical inputs have to be purchased. Most of these farmers do not have the income to do this. It is an inappropriate economic model for the India's most vulnerable farmers whereas organic agriculture is an appropriate one. This increase access to food in a variety of ways: by increasing yields, increasing total on-farm productivity, enabling farmers to use their higher earnings from sale to buy food, and, as a result of higher on farm yields, enabling the wider community to buy organic food at local markets. Further, OA is defamed as poor yielder and warned that promoting OA may lead to food scarcity. However, a comprehensive study summarized in the table 3 (Ramesh et al, 2010) disproves this hypothesis. The rice grain yield (4.0 t ha^{-1}) obtained

Table 3: Productivity of crops (t ha^{-1}) in organic versus conventional farming (Ramesh et.al.2010)

State	Crop	Organic farming	Conventional farming	Percent increase (+)/ decrease (-) in organic farming
Maharashtra	Vegetables	11.0	13.0	-15.3
	Fruits crops	11.4	13.6	-16.1
	Rice	2.0	2.5	-20.0
	Wheat	1.2	1.5	-20.0
Karnataka	Soybean	0.9	1.1	-18.2
	Chickpea	0.8	0.8	0.0
	Fruit crops	8.0	9.0	-11.1
	Groundnut	1.2	1.4	-14.2
	Sugarcane	120	140	-14.3
Tamil Nadu and Puducherry	Cotton	0.6	0.8	-25.0
	Cashew	1.3	1.0	+30.0
	Banana	25.0	30.0	-16.6
	Mango	8.0	6.0	+33.3
	Guava	20.0	23.0	-13.0
	Coconut	28,250 nuts	28,750	-1.7
	Rice	5.0	6.0	-16.6
Kerala	Pepper	1.38	1.40	-1.4
	Banana	23.6	27.2	-13.2
	Coconut	31,000 nuts	30,500	+1.6
	Coffee	1.23	1.31	-6.1
	Turmeric	22.5	25.0	-10.0
Uttarakhand	Rice	3.77	3.82	-1.3
	Wheat	3.12	3.92	-20.4
	Potato	12.0	15.0	-20.0
Mean				-9.2

under combined application of four organic amendments was at par with the yield recorded under recommended dose of chemical fertilizer application. An interesting observation recorded was that there was no serious attack of any insect pest or disease in organically grown crop (Singh et.al, 2007). In OA in low rainfall areas the yield of four high value crops (sesame, cluster bean, cumin, psyllium) was found comparable with the yield under CS (Sharma,2013). Area allocation to cash crops and biofuel crops need to be done cautiously so that sufficient area is maintained for food crops.

4. Maintaining soil health : Organic system improves soil physical, chemical and biological properties in long term that helps to maintain productivity. A comprehensive analysis (Ramesh et al,2010) strongly supports this development with OA(table 4). In Rice – wheat system, soil microbial population (Actinomycetes, Bacteria, Fungi and BGA) enhanced due to the application of organic amendments in comparison to recommended fertilizer application. Soil organic carbon and available phosphorus contents were also found to be significantly increased due to organic farming practice over chemical fertilizer application (Singh et al 2007). Increasing trend of soil organic carbon content was observed with OA (Sharma ,2013) in low rainfall areas.

5. Conservation of water : Water will be the most limiting factor for agriculture production in the coming years because of severe depletion in ground water and uncertainty in rainfall due to climate change effects. Also, over use of water (due to fertilizers application) can be categorized as one of the main factor that deteriorate the soil health. Soils under OA are able to absorb large amounts of water from heavy precipitation without water logging or erosion. They also store the available/irrgation water better, thus hedging against water scarcity and droughts and reducing irrigation needs. Successful sugarcane cultivation was done with 21 irrigation under OA as compared to 26 irrigation under conventional system(Kshirsagar, 2008). The favorable effects of OA on water use is more visible in drylands (Sharma, 2011).

6. Conservation of biodiversity : Maintaining biodiversity of both fauna & flora helps a lot in resource recycling, pollination, pest management etc. Therefore this is great and incomparable service of nature for our food production system. This was almost destroyed by the monoculture and use of pesticides. However, Most studies clearly demonstrated that species abundance and richness across a wide range of texa was higher in organic farms than on conventional farm in the same locality (Pratap, 2011) and helped in pollination and pest management (Altieri et al, 2006).

7. Conservation of energy : OA uses less fossil fuel based inputs and has a better carbon footprint than standard CS. Typically, organic agriculture uses 30 to 50 percent less energy in production than comparable non-organic agriculture. Organic operations provide promising possibilities for further energy reductions throughout the food system (Ziesemer, 2007).

Therefore, OA has potential to meet all the challenges that are going to be limiting factor for agriculture in future.

India's Readiness For Organic Production

India has done tremendous growth in the area of OA. The momentum developed during last 2-3 decades shows that OA will be the major production system in the coming decades. Presently three level of OA are exist in India-

I. Default organic in mainly in drylands (70% of total organic area) : Can be called below ground OA as small produce are mostly consumed locally, good for food security.

II. Improved organic(25%) : Higher production but low quality control, can be called ground OA as produce are used within the country.

III. Certified organic (5%) : Higher production and high quality control, can be called above ground OA

Now the need is to make balance in all the three categories for wider recognition of OA and its produce.

This preparedness is being visible in all four front i.e. production, research, market and policy level. However, sincere efforts by all stakeholders to maintain this momentum and a stronger policy support is required for maximizing OA at soil and at market.

***A. Production*:** At production level strong support of traditional technologies and sufficient input availability are the major factors for successful OA.

1. **Strong back up of traditional technologies/ systems:** Traditional agriculture system in India is

highly diversified in nature that includes crops, trees, animals, grasses etc. This system is scientifically efficient in nutrient recycling and restoration of soil fertility. In these systems 10-30 trees/ha are available and 2-5 animals are reared by a farm family. This integrated agriculture system minimizes pest incidence as well as favors organic agriculture (Altieri, 2006). This type of systems still exist in large part of India and mainly thriving best in rainfed conditions known as default organic. Our country has a vast treasure of tribal diversity and traditional knowledge. Locally adapted breeds and crop varieties coupled with their social structures to manage and conserve common resources, can support strengthen stability in agriculture. A balanced use of indigenous knowledge with integration of modern eco-technologies would drive sustainable agricultural to enrich itself. Some of the traditional preparation e.g.panchgavya has been found very effective in OA (Rupela et.al,2006). While some other technologies revalidated/invented by farmers groups/innovative farmers e.g Jeevamruit, Beejamrut, Dashiparni extract, cropping system.etc and reaching to millions of farmers through demonstration by farmer's themselves or by devoted workers (Yadav, 2011). Organic Farmers associations almost in every state becoming hub for mobilizing farmers for OA(Alvares, 2009). This also shows eagerness of farmers to shift on OA.

2. **Input availability and quality:** Availability of organic inputs is questioned most of the time at various platforms. To get answer of this question and to know the possibilities for further enhancement of quantity as well as quality, a survey was conducted by CAZRI during 2006-08(Sharma,2011) in low rainfall (below 500 mm) areas.

From the survey following information was generated.

- Availability at farm level was influenced by several factors like rainfall, cropping pattern, size of holding, availability of labor etc. In general most of the places farmers used raw cow dung, kept under sunlight for months and this caused heavy loss in nutrient availability that of the nitrogen. Further this increases weed population and termite infestation and farmers use chemicals to control both of them. On an average 1.5-4.5 t/ha organic manure was available at farm level in the form of crop residues and animal dung.
- Availability increased at village level by 1.5-2.0 folds mainly because of some farmers kept animals for dairy purpose. Also there are unproductive and old animals available at village level in large numbers. These animals may not give milk but provide manure in substantial quantity. Cattle provided 4.6 to 11 kg/ha/yr Nitrogen through urine (total agriculture land/total number of animals in the village).Trees are the integral part of farming system of low rainfall areas and contribute equivalent to 0.04t manure/tree. Trees available in common land, protected areas, waste land etc. also contribute to organic input availability at village level. Availability further increased at district level as intensive dairy farming was observed in peri-urban areas. After addition of organic input availability from all the sources the figure reached to 4.5-5.0 t/ha. This amount of organic input is sufficient for organic farming in low rainfall areas and increase in proportion of rainfall, and the technologies like use of microbs, green manuring, agroforestry are also used in integration. The availability of nutrient can be further increased by adopting following management practices-
  - Crop rotation with leguminous crops like cluster bean, moth bean, moong bean etc (Sharma, 2013).
  - Avoiding heaping of dung under sun and use of improved methods of composting through vermicomposting or pit composting methods.
  - Tree leaf litter, animal urine, bones of dead animals, non palatable weed biomass are some of the other rich and underutilized sources of nutrients that can suffice the nutrient requirements of the organic production system.

In several estimates it has been found that about 600 million ton organic material available in India and if it is speeded on 140 million ha cultivated land this will around 4.5 t/ha. Further, in a organic system once the cycle of organic matter starts, the system itself starts conserving/ recycling the applied organic matter and therefore, the external demand of organic matter reduces as the system become older.

Further, according to a survey conducted by National Sample Survey Organization (NSSO, 2005), organic manure was used by 56% farmer households during the kharif and 38% during the rabi season. It was available within the village for 68% households during the kharif and 75% households during the rabi season (it would have been 100% if part of it not burnt for energy). While, he has to

travel upto 10 km for getting fertilizers, pesticides and seeds.

Therefore, organic inputs are available in sufficient quantity and if it is not burnt for energy (cooking food, generating electricity, heat to kilns etc.) or cleaning the field (as being done in Punjab & Haryana), there is least possibility of scarcity of organic inputs for OA, the only need is their efficient utilization.

Quality of external inputs e.g. biofertilisers, biopesticides etc. is a major issue that affect output of OA to a great extent. Fortunately, Government of India established National Center of Organic Farming (NCOF), Gaziabad in 2004, that regularly monitor, making guidelines and capacity building for maintain quality of organic inputs.

B. Research : Research related to OA started in 1950's and continued till date on the name of eco-friendly farming technologies/conservation of natural resources . The issue of technology fatigue in agriculture is well known now. There is a need to shift away from individual crop-oriented research focused essentially on irrigated areas towards research on crops and ecofriendly cropping systems in the dry lands, hills, tribal and other marginal areas (Swaminathan, 2007). Most of the research institutions, work is being done on integrated use of eco-technologies with chemicals. In 2004, Indian Council of Agriculture Research (ICAR) started a network project on organic farming at 13 centers all over the country. Almost all the agriculture universities started course of farming system in their curriculum in which OA is a topic. Some pioneer universities (e.g Amity, Noida) have a full time management course or part time course (IGNOU, New Delhi) on OA. Recently, two agriculture universities namely Himachal Pradesh Ag. Univ. in north and University of Agri. Sciences in south India, opened department of OA.

In India research is in progress can be kept into three major groups i.e. 1. Revalidation of traditional technologies/ system, 2. Development of ecofreindly inputs, and 3. Organic system research.

1. Revalidation and standardize of traditional technologies/system: Under this group all the traditional knowledge/technologies developed in the millenniums are being revalidated and documented at various research organizations. Tamilnadu Agri. Unversity, University of agriculture sciences are the leading institute working on this aspect. They standardize technique of Panchgavya, a product of cows(indigenous breed) five products i.e. dung, urine, milk, curd and butter. Panchgavya is an elixir or promoter of soil health and plant growth. At ICRISAT,Hyderabad (a CGIAR institute) experiment was conducted for 8 years with panchgavya observed significant increase in the population of beneficial soil fauna(Rupela et al,2006). Several other preparation form botanicals as plant growth promoter or as biopesticides have been revalidated and standardized. The beauty of these traditional technologies is the cost effective, locally available and socially acceptable.

2. Development of ecofriendly organic inputs:This is the most liking aspect of research at various organizations because it does not require gestation period for system development, has some basic science/ biotechnology, easy funding availability and can be commercialized. Several such products has been developed by universities as well as private entrepreneurs. Some of the examples are enriched compost (with natural minerals and microbes), neem/ botanical based biopesticides, isolation of local effective fauna for biofertilisers/biopesticides etc.

3. Organic system research : This is the most difficult and time consuming aspect therefore at a few locations this type of research is going on. One interesting work of survey of productivity, soil health, economics of selected organic farms was done by Ramesh et al. (2010). Some of the NGOs like OFAI, CSA, Green foundation, Navdhanya etc. have documented the Organic systems available at various places (Alvares, 2009). Organized research after development of organic system is going on at limited places. One such system has been developed for the low rainfall areas at Central Arid Zone Research Institute, Jodhpur and research is going on all possible aspect (Sharma, 2013).

Crop based organic protocol has been developed for basmati rice, cotton, tea, and spices and continue on some other high value crops.

Fortunately at national level an increasing awareness about soil health may further support organic farming research one or the other.

C. Market: Several initiatives taken at government, corporate and individual level for promoting marketing of organic produce.

1. APEDA made a separate cell for organic import and export, regulating certification process and organizes meetings on OA issues under National Programme of

Organic Production(NPOP). Export-import bank, NABARD, KVIC are also funding for OA projects. Big programmes e.g National Horticulture Mission, Rasrtiya Krishi Vikas Yojana of Ministry of agriculture provides huge funds to organic inputs and soil health. Almost in every part of country, National Accreditation Board for Testing and Calibration Laboratories (NABL), Gurgaon, gives license and monitor the laboratories working for food quality testing.

2. Corporate associations e.g. ASSOCHAM, FICCI etc. are frequently organize workshops, business meets on organic marketing. ICCOA, Bangalore annually organizes international organic trade fair "Biofach-India".

3. Big corporate houses and many exclusive corporate are entering in contract farming, value addition and export of organic produce. Even, at most of the supermarkets, malls, organic products are displayed for sell.

4. The most important is the increasing number of small organic farmers groups, associations (e.g. Maharasthra organic farmers forum, Organic farming association of India,Goa etc.)and NGOs e.g Navdhanya, DDS,CSA, Jatan, ICRA etc. are facilitating marketing networks to sell organic produce at farm on profitable price to direct consumers and that is making strong linkages between producer and consumers, the ultimate need of fair marketing. It also saves energy by following "grow seasonally- eat locally" and several other advantages.

5. Media is playing a great role for awareness about pesticide residues in food and organic produce as safe substitute.

Programming For Action and Adoption

Although Considerable development has been done in India for enhancing production to marketing of organic produce. The most interesting aspect of leaving CS (NSO, 2005) by farmers despite of high financial and technical support and shift to OA with little support, is showing OA system viability. In 1999 only 40000 ha agriculture area was recorded as certified organic that increased upto 240000 ha in 2011 (six times) within a decade(APEDA,2013), if the non certified organic areas(mainly drylands) is also be added this will be much high figure. Therefore, it is the need of the hour that a multi-direction action plan has to be prepared for wider adoption and marketing of organic produce. The programming can be done to get active participation of all stakeholders in policy making, research, marketing and production. A target of 50% forest area (35 million ha)+ 80% drylands (60 million ha) + 10% irrigated area(5.0 million ha) can be realistic target of 100 million ha to be converted into OA by 2020, if the programming and execution is to be done efficiently.

A. Policy support

Considering the increasing awareness within the country and export demand of organic produce; it is need of the hour to do integrated efforts for higher quantity and quality organic production. These efforts are needed to be done at four level i.e. policy, research, market and production of spices. At market and production level the intensity of efforts is more as compared to research and policy support. Integration of technologies and programmes and coordination among various agencies is the prime requirement. Policy plays major role in promotion of any programme. Policy in terms of supporting rules & regulations, subsidies, facilities, allocation of budget & personnel etc. can alone is sufficient if executed properly. The best example is Cuba(Latin America), where organic farming was made a national policy and now whole of the country is organic. Similarly South Korea developed good system for organic production that include direct subsidy to farmers. (Jeong,2011). Although in India, organic movement was started in early 80s but it got momentum only after 2001 when govt. of India lunched National Programme of Organic Production (NPOP). Later on many of govt. agencies have started to give priority to organic farming. Similarly some of the state like Uttranchal, Sikkim and other NEH states etc. has declared organic state and they are taking lead. Some other states e.g. Madhya Pradesh, Karnataka, Maharashtra, Bihar, Himachal Pradesh etc. declared policy for promotion of OA. However simply giving budget, subsidies etc. may not be sufficient to promote organic farming, as least development has been done in arid & semi arid areas even, they are kept at Priority I & II in NPOP. For better development of OA additional measures need to be taken. They are:

1. **Priority to OA in ongoing programmes:** OS need not to be promoted as a new program that may cause overburden as additional progam. It would be better if OA is given priority in all rural development programmes e.g. watershed, SGSY, MNREGA. Food security mission, horticulture mission etc. Government of India now focusing eastern India as place for second green revolution and OA need to be given priority in that mission

2. **Popularization of OA without compulsion of certification:** The non certified organic contributes a great part of total supply of organic produce (FAO,2002). In rainfed/drylands areas farmers are very poor and unable to afford the cost of certification. Promoting organic farming with the compulsion of certification has made negative impact on adoption. Instead, at initial stage OA should be promoted for improving soil fertility, reducing cost of production and other environmental advantages and additional economic benefit to use organic farm as a place for ecotourism.

3. **Dissemination of OA in holistic manner:** Most of the agencies promoting organic farming in piecemeal approach e.g. .only vermi-compost, only IPM, only INM, only marketing etc. this makes confusion among the farmers. While organic farming is an integrated approach for nutrient recycling, conservation of natural resources, water conservation, crop rotation / diversification etc. So it must be inclusion of all these aspects which can make a sustainable OA in real term.

4. **Integrated efforts of supporting agencies:** Individual agency may not work efficiently for promotion of organic farming; For example KVIC have a scheme of margin money to establish vermi-compost unit but they are unable to ensure the use of produce of such unit. Similarly ICAR/SAUs have wealth of information but unable to provide financial support. Thus there is need of integrated programs by all related agencies. Even several ministries e.g agriculture, commerce, water resource, human resource, consumer affairs ,science & technology, tourism and culture (for eco-tourism) etc. need to be join hand for OA. Further agriculture is a subject that mainly governed by the policies of state governments and funding receives mainly from Central government, therefore all the states need to be involved while making policies for OA at national level.

5. **Encouragement of decentralized input supply :** Encouragement may be given to produce all inputs for organic farming in a decentralized manner at local level so that not only local resources can be utilized but also employment at village level can be generated. Self help groups sponsored by NABARD may be mobilized for this venture.

6. **Adoption of improved methods of composting and ban on burning of agro-waste**: Majority of the farmers apply animal and crop waste in undecomposed form to the soil, as a result the availability of nutrients to the plants decreases and also invites several pests. It would be better to apply these materials after composting them with any of the suitable methods. These methods can be popularized and financially. supported under the "Clean Village Scheme (Nirmal Gram Yojana)" of the central governments. Subsidy provision need to be done for mechanized systems for compost preparation and application. Ban on burning of agro-waste(straw, dung) for energy and promotion of biogas plants, solar energy use need to be done.

7. **Increase availability of responsive verities/ breeds to OA**: This is a very crucial input that need urgent attention as the verities /breed for CS may not perform well in OA. For example organic cotton is a high demanding crop but in a survey, scarcity of seeds for OA was observed. (Suchitra,2013). Similarly high milk yielding indigenous breads of cow (Sahiwal, harparkar, geer etc.) they are more responsive to OA, are not available easily.

8. **Awareness and capacity building:** OA is just not one technologies rather a group of technologies and ideology. Moreover it is a knowledge intensive system. Therefore, demonstrations, training, conferences, seminars, farmers fair etc. may be organized to make better understanding and a general consensus about organic farming and good organic management. Establishing a model organic farm (may be at PPP mode) at every tahseel/block level need to be done for successful capacity building.

9. **Subsidy and tax exemption on organic inputs :** Since fertilizer use in rainfed areas is very less as compared to irrigated areas therefore, partly diversion of fertilizer subsidy to organic inputs for OA in rainfed areas is needed. Financial support is also needed during conversion period for OA. Presently there is provision 4-5% VAT tax on organic inputs that need to be exempted and rather provision of subsidy may be made for organic inputs to make organic produce more competitive.

10. **Promotion of high value enterprises:** The demand of spices and medicinal plant is increasing when grown organically, so it must be promoted organically in the various rainfall zone of the country(Table 4). This will help to increase profitability of OA on one side and reduce pest load as most of these plants having pest repelling cpacity .Medicinal plant board, New Delhi and spice board, Cochin have taken some good initiatives that need to be executed in wider area.

Table 4: Potential high-value primary enterprises for OA in different rainfall regions

Rainfall zone	Rainfall Average(mm)	Suitable species and medicinal crop
Low rainfall	100-500	cumin, senna, psyllium, cluserbean (gum), fennel, asvagandha, fenugreek, lucorice, sesame, aonla, animal husbandary etc.
Medium rainfall	500-1000	coriander, turmeric, zinger, garlic, chili, safed moosli (indian ginseng), fruits and vegetables, cotton, dry fruits, honey and animal husbandry, poultry etc.
High rainfall	More than 1000	black paper, cardamom, coffee, tea, fruits and vegetables, cashew, rice+fish etc.
Temperate hills	750 and above	Apple, dry fruits, honey etc.

10. **Development of organic clusters of villages:** Available clusters of villages of watershed programs (mainly in drylands) may be converted into organic cluster of villages by providing technical support. This will help a lot for technical feasibility of OA, making cost effective and also make easier the group certification process. The cluster may also be promoted for ecotourism.
11. **Incentives to OA**: Farmers may be given incentive for carbon sequestration and environmental improvement services under OA.
12. **Separate Government personnel for OA:** In every cluster of OA separate trained personnel (Agriculture supervisor, extension officer etc.) need to be deputed exclusive for development of OA system. One personnel for both OA and CS may not deliver properly to both the systems.

B. Research

Research has been under taken on various components of organic farming by ICAR/SAUs, yet the research is needed to integrate the efforts and assess their effects. Besides, application, weed control etc. to reduce labor requirement.

C. Market

Market environment plays major role to motivate producer for opting an enterprise and same is true for farmers. After emerging demand of organic produce from western countries and to some extent from domestic market many initiatives have been taken by Government of India. Still a large part of produce from default organic area are yet to be recognized as to get market premium. Certification still need many modification to make it easier for producer and credible for consumers. Some of possible measures need to be taken for better market environment and for proper remuneration to farmer are-

1. Development of cooperative organic marketing facility.
2. Encouragement to exporters for bearing expenditure of certification.
3. Promotion of alternative low cost certification system for domestic market e.g. participatory guarantee system.

for long term sustenance of soil fertility and farmer's livelihood, basic understanding and principals of OA should be applied in the production system. Main emphasis need to be given on efficient use and recycling of limited natural resources. Therefore for production and marketing point of view an strategy with following component need to be adopted.

1. Production of inputs (compost, vermicompost, biopesticides etc.) as much as possible at local level.
2. Efficient use of inputs (time, method & quantity).
3. Effective integration of perennials, animals and beneficial organisms in farming system.
4. Adoption of system based production rather than crop based.
5. Improvement in traditional (default) organic system.
6. Continuous experimentation at farm level to understand natural production system and interactions.
7. Doing farming and getting certification as a group effort.
8. Giving importance to quality production rather than quantity only.
9. Harvesting at proper time and cleaning & grading at farm level.
10. Grading and packaging at farm level as much as possible (to get more price and least contamination).

E. Consortium efforts for promotion of OA

Although several agencies and individuals are working for promotion of organic farming however there is need of coordination, cooperation and complimentary action of all the agencies specially at three levels-

1. Inter and intra ministry level and between central and state governments , ministry of commerce is already in action that need further momentum.
2. Industrial /Marketing federations and NGOs/civil societies
3. Farmers of all over the region and country as whole.

Finally a consortium of all these three groups may do programming, mid-course correction and lobbying for promotion of OA from producer to consumer.

F. Maintaining balance between sustainability and profitability

Although market is target of any production is done and same is true for primary sector too, yet caution has to be taken while deciding long term balance between sustainability and profitability of OA so that it may not convert into exploitive system.

1. Strict rules and regulations and monitoring mainly for external inputs used in OA system. Any compromise in quality may contaminate produce with heavy metals, harmful pathogens(mainly from manure of city waste), or disturb the beneficial flora & fauna life with improper/ excessive use of biofertilisers/biopesticides.
2. Export oriented commodity based (Cotton, plantation etc.) system need to be discouraged they may sometimes lead to exploitive system.
3. Organic animal husbandry for dairy products is ecofriendly however for meat purpose should be done cautiously as it is neither ecofriendly nor good for human health.
4. Certification system needs continuous improvement for benefit of both producer and consumer.
5. The ecofriendly aspects need to be considered for processing, packaging and transportation to a long distance of organic produce.

G. Stepping towards organic

After more than two decades India's experience in OA it is now time to make perfect planning for promotion of OA without losing the food security and maintaining quality of inputs and output of organic produce. This planning need to be done separately for irrigated and rainfed/drylands (Table 5) and can be divided in phases. Each phase can be of two years and at last food grain can be included assuming that by that time OA will reach to perfection.

The phases can be as follows

I. Dry lands, pasturelands, inland fisheries, poultry and animal husbandry.

II. Cotton, sugarcane and groundnut growing areas – A non food item that has high indigenous and export demand and used 68 % part of total pesticides consumption in India, also this area prone to farmers' suicide.

III. All non food grain items e.g. spices, tea, coffee , fruits, vegetables etc. growing areas – Not affects food security but high value and export demanding crops

IV. Pulses and oil seeds : Grown manly in drylands

V. Food grain growing areas

With this approach a successful OA will be developed in the country to provide quality and quantity of all food items along with environment improvement and meeting the future challenges of primary industry.

Table 5: Proposed approach for gradual conversion into OA in irrigated and dryland areas

Irrigated areas	Dryland/Rainfed areas
1. Use of slow release Nitrogenous fertilizers + Phosphate and potash fertilizers at proper time and place and gradual decrease in dose every year till reaches to nil.	1. Promotion of composting and ban on burning of agro waste.
2. Strict rules and regulations for marketing and use of avoid, fake pesticides, unnecessary and excessive use of pesticides.	2. Encouragement to Exchange of inputs for OA at village level
3. Use of increasing dose of composted manure every year (to fulfill nutrients requirement)+ Phosphorus, potassium, zinc, sulphur solubilizing microbial cultures+ biofertilisers+ Azola (rice fields).	3. Promotion of rainwater harvesting/efficient use at village and farm level
4. Restrictions on the use of pesticides and weedicides in soil application, vegetables and fruits . Cultural and manual control of weeds and to follow integrated pest management at initial phase.	4. Development of OA responsive improved varieties from traditional/conventional varieties
5. Ban on burning of agro-waste(straw, dung and promotion of biogas plants, solar energy use)	5. Starting of organic cultivation of corps in different phases (mentioned above)
6. Making crop rotation/ intercropping with legumes and fodder crops + animal husbandry with indigenous breed mandatory	6. Planting complimentary fruit/ multipurpose trees/shrubs on farm boundaries for round year flowers/fodder/fruit
7. Planting complimentary fruit/ multipurpose trees/shrubs on farm boundaries for round year flowers/fodder/fruit.	7. Improvement in traditional eco-technologies and capacity building
8. Promoting manure responsive composite varieties of crops.	8. Development of model organic farms at farmers field in every tahseel/block for easy adoption.
9. At initial phase starting of fruits, vegetables, cotton and spices under OA.	9 Development of cluster of farmers of a village for OA system that makes a system for area basis to reduce cost and better success
10. After 4-5 years when system reaches on perfection organic cultivation of food crops may be started	
11. Development of model organic farms at farmers field in every tahseel/block for easy adoption.	

BOX-1

Drylands: No constraint but opportunity for organic agriculture

Drylands with nearly 58% of the cultivated area contributes 40% of the country's food production. Much of the acreage under coarse cereals (85%), pulses (83%) and oilseeds (70%), substantial area under rice (42%) and nearly 65% of cotton area is rainfed. Improving the efficiency of rainfed/drylands agricultural systems through organic practices is the most appropriate, cost effective, environmentally sustainable and practical solution to ensure reliable food production in the increasing productivity. In drylands where shortage of rainfall light soils are constrains for intensive chemical input based CS while these constrains become opportunities for organic agriculture. Hence organic agriculture not only suitable due to climatic uncertainties but also feasible due to availability of support system of the following favorable conditions(Sharma, 2005). This system includes (i) Low fertilizer use therefore early conversion into OA is possible (ii) Natural Availability of inputs : Plants like neem, pongamia, calotropis etc. the best sources of biopesticides , are abundantly available in these areas. Minerals like rock phosphate, gypsum and lime are available in large quantity. These minerals are good soil ameliorator as well as good nutrients supplier. Further the agriculture systems are dominated by animals. Waste and product of huge animal population can be a best source of balanced nutrient supply.(iii) Employment opportunities : High density as well as high growth of human resource remains underutilized throughout the year due to erratic rainfall and limited irrigation facilities. Migration of human resources during drought imbalances the development of these areas. Since the OA is an integrated system provides round the year work, input preparation is made at local level, there is ample opportunity for round the year employment and proper utilization of human resource. Now under MNREGA scheme this work of water harvesting structure, input preparation may get good support. On the basis of carrying capacity potential of rainfed/drylands has been explored for food security and climate change mitigation through integrated adoption of ecotechnologies (Venkateswarlu and Prasad, 2012).

Conclusion

Organic Agriculture is a holistic production system runs with the efficient use and recycling of locally available resources blending with modern scientific ecotechnologies, that will not only helpful to revive sustainability in irrigated area but also enhancing production in rainfed/drylands. OA is also helpful for meeting the challenges to farming due to changing climate and socio-econimic environment at global, national and regional level. India has done tremendous progress in enhancing area of OA as well as quantity & quality of organic produce that proves the capabilities of OA. However, to meet the future demand of indigenous as well as export market a programming need to be done for gradual paradigm shift towards OA to increase quantity and quality of organic produce with the maintaining balance between profitability and sustainability. Programming with the all round support with policy, research and market, and efficient execution will certainly able to meet the requirements of producers, consumers and the earth ecosystem as a whole.

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If you're using first-class land for biofuels, then you're competing with the growing of food. And so you're actually spiking food prices by moving energy production into agriculture.

— Bill Gates

Focus

Retail Sector Revolution in India and Agricultural Marketing: Issues and Concerns

DEEPAK SHAH

A paradigm shift in the retail sector of India is taking place owing to phenomenal growth in organized retailing over the past few years, which has emerged from the shadows of unorganized retailing and is contributing significantly to the overall growth of retail sector. The new format of agribusiness is expected to reduce inefficiency in agricultural marketing, which arise due to multi-layer intermediaries. Though the agricultural logistic management is expected to improve consequent upon reduction in market functionaries and higher participation of private sector players, long-term profitability and sustainability of retail sector can be achieved only if supply chain is realigned into efficient, agile and adaptable network. While extending scalability, such supply chain should have capability to handle larger volumes, expand reach, balance costs and address the demographic variations. Indian companies are now concentrating on logistic services to reduce costs. It is expected that liberalizing the retail sector will usher in investments into the developing and improving food supply chain. The entry of new companies in the retail space will also benefit the exchequer. It will result in greater employment and will offer the consumers greater choices and competitive prices.

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Despite having a population of a billion with a middle class population of over 400 million, India is yet to establish sound footing in organized retailing, which has of late transformed the economies of many developing countries. The slow progress of organized retailing in India is largely due to well managed food retailing system established by the traditional business stores that still continues to meet varied needs of consumers. However, this traditional highly fragmented food supply chain involving several market functionaries results in high costs with substantial loss in value of goods. The influence of traditional business stores encompassing lack of developed markets and processing industries has so far kept organized retail chains out of the market place due to their easy proximity to consumers. The inefficient supply chain involving number of intermediaries, therefore, requires corrective measures through introduction of organized retailing. The organized retailing is now gradually spreading in India over the past 3-4 years, especially in major metro cities. The large retail giants and corporate houses like Reliance Fresh, Vishal, AV Birla group, Bharati Walmart joint venture, and the existing Big Bajar, Spencer Daily, Food Mart, etc. have already made their presence felt in different parts of the country.

Indian urban consumers are now showing perceptible change in their consumption pattern due to rise in their per capita income and easy access to credit. Due to significant support from the capital market, the investments in shopping malls have been growing very fast. The space in shopping malls has also grown perceptibly in more recent times.[1] Since retail revolution involves significant capital investment, new technology and management practices, it has the potentiality of transforming the entire

[1]The space in shopping malls increased from 2.2 million sq. ft. in 2002 to 54 million sq. ft. in 2006 and further to about 100 million sq. ft. in 2007.

retail business through restructuring retail distribution system via higher asset turnover and better inventory management. It can also lead to better intermediary and logistic management, production management in the case of not only agriculture but also in manufacturing (Ahya and Sheth, 2006). In fact, due to inadequate infrastructure, involvement of large number of middlemen, complicated laws, indifferent attitude of traditional retailers and lack of access to good quality products have made traditional food supply chains inefficient in India. In order to overcome these deficiencies, the corporate houses are now intervening in the market by establishing their direct relationship with farmers, which has been helping both the farming community and the corporate in bringing high quality low cost products to the retail outlet without involving intermediaries. Since the emergence of organized retailing from the shadow of unorganized retailing has been contributing significantly to the overall growth of retail sector in India and as Indian retail industry has grown phenomenally over the past 6-7 years owing to change in consumer behaviour and lifestyle, increasing influence of western culture and rising per capita income, it is essential to ascertain and understand the implications of entry of corporate houses in retail business encompassing agricultural input and output markets, their likely impact on farmers as well as consumers, and various other issues relating to supplier-retailer relationship, government response function with respect to infrastructure investment and support, productivity growth and inflation, technology trends, innovation in transportation logistics, etc. This paper is an attempt in this direction and it chiefly focuses on various issues relating to retail sector revolution in India, which is already on the path of sound footing in recent times due to varied benefits extended to both producers as well as consumers.

Current Status of Retailing

At present, there is co-existence of two formats of food retail marketing system in India. While on one hand there exist Kirana Stores and Hawkers, viz. the road side hawkers, mobile retailers, kirana stores, including open format more organized outlets and small to medium food retail outlets, there has also been emergence of organized retailers like the discounters (Subhiksha, Apna Bajar, Margin Free, Reliance Fresh), the value-for-money store (Nilgiris, Big Bajar, Cooperative Stores), the experience shop (Food world, Trinetra), the home delivery (Fabmart), super stores and wide reach stores (Reliance Fresh, Spencer, Food Mart), etc. The traditional retail distribution system of India is highly fragmented and involves about 12 million players. About Rs.15 lakh crores worth food retail sector of India is spread across the country covering almost all the cities, towns as well as villages. The estimates reported by J M Morgan Stanley revealed that India's private final consumption expenditure (PFCE) was about US $ 221 billion (28 per cent of GDP) as of 2006 with organized retail sector accounting for just about 2.2 per cent share in PFCE. The past few years have registered 15-20 per cent annual rate of growth in organized retailing with food and beverages accounting for 38 per cent share in retail spending. The estimates also reveal that wholesale retail sector currently contributes to about 13 per cent share in GDP and employs about 40 million people (Ahya and Sheth, 2006). The estimates reported by Consumer analyst, Hozefa Topiwalla of Morgan Stanley Research indicate that India's organized retail market may grow from US $ 4 billion in 2005 to US $ 20 billion in 2010 and further to US $ 64 billion in 2015 (Table 1).

Table 1: Growth Estimates for India's Organized Retail Sector (in US $ Billion)

Year	Organized Retail	Unorganized Addressable PFCE	Un-Addresable PFCE
2005	4	188	228
2010	20	306	345
2015	64	527	552

Source: CEIC, CSO, AC Nielsen, Morgan Stanley Research Estimates

It has been reported that the top 40 retail chains in India may increase the share of organized retail from 3 per cent to 20 per cent in the next 4-5 years and over 50 per cent of investment of this organized retail business will directly reach agricultural sector due to significant share of food in retail business. The new format of retail business is gaining grounds owing to several factors like the change in lifestyle, tastes and higher disposable income, growing need for convenience, exposure to western culture, increase in number of working women and choice and value for money from food products. These factors have revolutionalized the food retail scenario in India. According to India Retail Report 2007, the size of the organized retail market, estimated to be about 12.4 US $ billion in 2007, would increase to in access of 45 US $ billion by the year 2010, implying about 15 per cent share in total retail business of India. As per the report, organised retail in India has the potential to generate some 2.5 million direct jobs through retail operation and over at least 10 million additional jobs in retain support activities including contract

Table 2: Total Retail and Organized Retail Market in India (at prevailing market prices)

Retail Segments	Indian retail Market (Rs. Crores)			Organized Retail (Rs. Crores)		
	2006	2007	Growth 2007 > 2006 (%)	2006	2007	Growth 2007 > 2006 (%)
a. Clothing, Textiles & Fashion Accessories	113500	131300	15.7	21400	29800	39.3
b. Jewellery	60200	69400	15.3	1680	2300	36.9
c. Watches	3950	4400	11.4	1800	2150	19.4
d. Footwear	13750	16000	16.4	5200	7750	49.0
e. Health & Beauty Care Services	3800	4600	21.1	400	660	65.0
f. Pharmaceuticals	42200	48800	15.6	1100	1540	40.0
g. Consumer Durables, Home Appliances/ equipments	48100	57500	19.5	5000	7100	42.0
h. Mobile Handsets, Accessories & Services	21650	27200	25.6	1740	2700	55.2
i. Furnishings, Utensils, Furniture- Home & Office	40650	45500	11.9	3700	5000	35.1
j. Food & Grocery	743900	792000	6.5	5800	9000	55.2
k. Out-of-Home Food (Catering) Services	57000	71300	25.1	3940	5700	44.7
l. Books, Music & Gifts	13300	16400	23.3	1680	2200	30.9
m. Entertainment	38000	45600	20.0	1560	2400	53.8
Total	1200000	1330000	10.8	55000	78300	42.4

Source: India Retail Report 2009 by IMAGES F&R Research

Table 3: Share of Organized Retail in Total Retail Market of India (in per cent)

Retail Segments	2004	2005	2006	2007
a. Clothing, Textiles & Fashion Accessories	13.6	15.8	18.9	22.7
b. Jewellery	2.0	2.3	2.8	3.3
c. Watches	39.6	43.5	45.6	48.9
d. Footwear	25.0	30.3	37.8	48.4
e. Health & Beauty Care Services	6.0	7.6	10.6	14.3
f. Pharmaceuticals	1.8	2.2	2.6	3.2
g. Consumer Durables, Home Appliances/equipments	7.8	8.8	10.4	12.3
h. Mobile Handsets, Accessories & Services	6.5	7.0	8.0	9.9
i. Furnishings, Utensils, Furniture- Home & Office	6.7	7.6	9.1	11.0
j. Food & Grocery	0.5	0.6	0.8	1.1
k. Out-of-Home Food (Catering) Services	5.7	5.8	6.9	8.0
l. Books, Music & Gifts	9.8	11.7	12.6	13.4
m. Entertainment	2.6	3.3	4.1	5.3
Total	3.0	3.6	4.6	5.9

Source: India Retail Report 2009 by IMAGES F&R Research

production and processing, supply chain and logistics, retail real estate development and management etc. Further, as per the Images F&R Research estimates for India Retail Report 2009, the India Retail market expanded from Rs.1,200,000 crores in 2006 to Rs.1,33,000 crores in 2007 registering 10.8 per cent annual growth (Table 2). In total retail business, organised retail accounted for Rs.55,000 crores in 2006 and Rs.78,300 crores in 2007, showing 42.4 per cent annual growth. The organised retailing would register faster growth over the next three years and it is expected to reach Rs.2,30,000 crores (at constant prices) by 2010, accounting for about 13 per cent of the total retail business (Roy and Kapila, 2009). The share of organised retail was estimated at 5.9 per cent in 2007 as against 3.6 per cent in 2005 (Table 3).

In total retail business worth Rs.13,30,000 crores of India, the food and grocery was the most predominant category, accounting for as much as 59.5 per cent share, followed by clothing and accessories (9.9 per cent share) and out-of-home food (catering) services (5.4 per cent share). This is a reflection of greater employment opportunities of young generation in services sector. However, the scenario was found to be different in the organized retail segment where clothing and fashion accessories accounted for largest share of 38.1 per cent in total organized retail business of Rs.78,300 crores in 2007, followed by food and grocery (11.5 per cent share), footwear (9.9 per cent share) and consumer durables (9.1 per cent share). Interestingly, while there was hardly 7 per cent rise in total food and grocery retail marketing in 2007 over 2006, the organized retailing in this category rose by as much as 55 per cent in 2007 as compared to 2006. This is again a reflection of importance of food and grocery in overall organized retail marketing of India. Out-of-home food (catering) services was another category, which registered substantial increase in organized retailing.

In fact, with the changing face of retail sector, the Indian consumers are rapidly transforming and India is becoming a strategic business hub for the investors across the world owing to dynamic retail landscape of the country. Despite current slow down in the Indian economy, the retail segment of India is expected to register faster growth due to involvement major Indian as well global players in retail business. Indian consumers are rapidly evolving and accepting modern retail formats. The key factors bringing about this change would be rise in disposable income of consumers, growth in Indian middle class, booming service sector and availability of hypermarkets, supermarkets, convenient stores and department stores that would find more and more acceptance from service class population of India.

Agriculture and Corporate Entry

Indian agriculture sector has enormous untapped potential. The entry of corporate in this sector would make the farmers happy who are prone to uncertain weather and market conditions. With enormous workforce at their disposal, corporate sector is capable of taking risks and withstand financial losses than small and marginal farmers. The government is supporting the entry of big corporate players into agricultural sector with a view to achieve higher growth prospects from this sector and also in the light of transforming standard of living of farming community (Kainth, 2007). The direct relationship established by corporate sector with the farmers is helping the producers in obtaining reasonable price for their produce, which was denied earlier due to involvement of numerous market functionaries in the marketing channel involving movement of agricultural goods from producers to consumers. In fact, the highly fragmented food supply chain is predominated by large number of market functionaries and this leads to inefficiency in marketing of produce. The marketing of agricultural produce was restrictive until recently due to control by the state specific Agricultural Produce Market Committee (APMC) Acts. The Act was amended by the central government and the New APMC Act came into force in 2003, which allows agribusiness marketing firms to source their raw material requirements directly from the farmers through contracts or other wise (Kainth, 2007).

The new agricultural policy of the Government of India encourages promotion of private sector participation through contract farming and land leasing agreements to stimulate faster growth in technology transfer, capital inflows and assured market for crop production, especially of oilseeds, cotton and horticultural crop. In view of this policy initiative, agribusiness corporate houses have come up and entered into collaborative partnership through vertical integration between farmers and consuming population. Some of the agribusiness models like Mahindra subh-labh services, Rallies Kisan Kendra, ITC e-Chaupal, and Kisan India are based on vertical coordination between Indian corporate and Indian farmer, which has been integrating and strengthening the supply chain management. The new format of agribusiness is expected to reduce inefficiency in agricultural marketing, which arise due to multi-layer intermediaries. Involvement of these intermediaries in the supply chain not only lead lower margin to the farmers but they hardly make any effort to

improve market infrastructure and technology. Market specific contracts[2], production management contracts[3] and resource providing contracts[4] are the three forms of vertical coordination emerging in the agricultural sector. It is expected that the initiatives undertaken by corporate houses with respect to agricultural sector will not only help in disseminating easy access to information regarding market forces but they will also strengthen bonds between farmers and corporate in input as well as output marketing.

Agricultural Supply Chain Efficiency

Unlike other sectors, agricultural sector is beset with several deficiencies due mainly to the wastage of products in the supply chain, which accounts for 9.8 per cent of agricultural component of GDP, valued at US $ 11 billion (Ahya and Sheth, 2006). The farmers are unable to improve the efficiency of the system owing to intervention of the government in both input and output pricing. Lack of adequate infrastructure has resulted in significant loss of produce from the point of production to the consumption point. This coupled with margin money taken away by various market functionaries has created disincentives to the farmers in agricultural production enterprise. However, the scenario obtaining until more recent times has been fast changing due to legislative reforms introduced by the state governments in APMC Act. The APMC Act amended in 2003 by 13 states and union territories is expected make agricultural sector more organized in retail business as farmers will have greater opportunity of incentives in the form of improved management techniques, which ultimately result in improved efficiency, better quality produce and availability of larger variety of products to meet consumer demand. The agricultural logistic management is expected to improve consequent upon reduction in market functionaries and higher participation of private sector players in agricultural business enterprise. A large business player like ITC has already introduced computers and Internet facilities in rural areas, which is able to provide more transparent mechanism of pricing and safe operating system to the farmers. This system has not only reduced cost of the products but it is able to generate higher realization to the farmers in disposal of his produce.

Retail Marketing in Agriculture

There has been sudden emergence of some of the corporate houses in rural market place. Some among them are Tata Kisan Kendra, Godrej's Aadhar, DSCL Hariyali, Mahindra's Subhlabh and ITC's Sagar Chaupal. These corporate houses are experimenting with the chief objective of finding solutions for the Indian agricultural sector. They are providing facilities in the form of credit facilitation, water management, supply of agricultural inputs, agricultural advisory services, and marketing of agricultural output as well as supply of consumer goods.[5] The experiments of these corporate houses will integrate Indian farmers with global players involved in processing activities, which in turn will improve their produce by improving soil and water testing facilities, quality of seeds, pest control management, crop rotation planning, output pricing and distribution network. The investments made by large food retailers in farm production may help the growers of fruits and vegetables to process the lot of produce that is wasted due to lack of processing facilities. Although small players may face competition from big corporate houses, they would still survive owing to their lower overheads, knowledge of local market conditions, and also due to their definite advantages in providing services like home delivery and sales on credit basis. However, since Indian population is highly heterogeneous, agricultural retailing in rural areas will be a challenging task, especially in the absence of adequate infrastructure facilities, which form the core of agricultural retailing.

Supply Chain Management

Although Indian retail is currently booming, the movement of raw materials, inventory, and finished goods from the

[2]It represents an agreement by a buyer to provide a market for the seller of the produce where the buyer may assume some risks and the right to take decision regarding the time of marketing of produce like ITC e-Chaupal.

[3]It entail more buyer contracts and allows the buyer to specify and or monitor production practices, input usage, etc. like services provided by Mahindra Subh labh.

[4]It represents greater level of control for buyer who not only provides market outlet but also supervise production practices and supply of major inputs. An example of this is PepsiCo's contract farming.

[5]The formats of these corporate houses provide a wide range of services to the farmers like good quality agricultural inputs like fertilizers, pesticides, seeds and animal feed, tractors and spare parts, irrigation equipment and farm fuels, and services such as equipment rentals and spraying. They will also offer multiple brands to farmers.

production point to consumption point will largely depend on the management of supply chain involving storage, transportation processing and handling of produce. Supply chain management, therefore, needs to be given top priority as under-developed supply chains are unlikely to help retail stores (Murali and Roy, 2008). Long term profitability and sustainability of retail sector can be achieved only if supply chain is realigned into efficient, agile and adaptable network. While extending scalability, such supply chain should have capability to handle larger volumes, expand reach, balance costs and address the demographic variations. Efficient supply chain management involves adequate planning, implementation and control of operations. The major hurdles to developing efficient supply chain are the inadequate road and warehousing infrastructure, unreliable power supply and insufficient investments in alternate modes of transport. The other hurdles to developing efficient supply chain can be traced in lack of technology usage, a fragmented supplier base and a multi-layered tax structure. These hurdles pose significant challenges to the evolution of a streamlined supply network (Murali and Roy, 2008). Indian companies are now concentrating on logistic services to reduce costs. Logistic services like transportation, storage, warehousing and inventory management have now acquired newer dimension in supply chain management.

Retailing and Technology

The success of efficient retailing depends on the kind of technology used in supply network. Since retailing is a technology intensive industry, retailers are now working closely with their venders to find ways to predict consumer demand, reduce inventory holding to save costs and also to shorten lead times. Wal-mart has already established a competitive edge in distribution and information network in retail industry through introduction of two innovative logistic techniques encompassing cross-docking and electronic data interchange. The retailing sector is now focusing on developing link with the consumers through establishment of the concept of 'Data Warehousing', which not only helps in compiling information relating to future shelf planning, discount offer or seasonal sales but it also helps in tracking potential customers, their pattern of shopping during festive seasons and their general demand.

Challenges for Indian Retailing

Several challenges are posed before Indian retailing. The most prominent ones among them are property and real estate issues, capital availability, legal framework, human resources, supply chain development and management, and logistics. Another most important challenge faced by the organized retail industry in India is the competition from the traditional players or unorganized sector. Traditional retailing in India took roots in India centuries ago, which of late involves 12 million outlets. Traditional retailing has cutting edge over organized retailing because of its low cost owner-operated structure, which involves negligible real estate, labour costs with little taxes to pay to the exchequer. Not only this, traditional retailing is more consumer friendly, which has developed from generation to generations. On the contrary, organized retailers not only have to incur substantial expenses but they are also supposed to keep prices low to compete with traditional sector. The organized sector incur higher cost of operation due to higher labour cost, comfort facilities, social security to employees, back-up power supply, taxes and much larger premises or real estate. In spite of these hurdles, investments of the organized sector in retail business are growing steadily. Since tariffs on imported items are now being aligned to meet prescribed WTO norms and as import restrictions are also curtailed, there will be significant rise in organized retailing in years to come. Indian retail sector would have brighter future for sustained growth owing to the depth of the Indian market and the variations of the consumer profile, which has of late developed greater exposure to overseas markets.

Retailing and FDI

The Indian retail market, currently valued at US $ 450 billion, is likely to grow further to reach USD 574 billion by 2015. It is the second largest sector after agriculture with an estimated employment of more than 35 million people. The sector accounts for 22 per cent of the GDP. The government has already considered allowing foreign direct investment (FDI) in multi-brand retailing as a measure to make India more attractive to overseas investors. The step initiated by the Government of India in September, 2012 to allow 100 per cent and 51 per cent FDI in single brand and multi-brand retail, respectively, is an attempt in this direction. The Global Retail Development Index (GRDI) finds India as the third most attractive retail market for global retailers among the 30 largest emerging markets. At a time when country is struggling with slow economic growth, decline in productivity, rising inflation and unemployment, etc., allowing 51 per cent FDI in multi-brand retail may be considered necessary for future growth prospect of the economy. The move will open opportunities for global retailers like WalMart, Carrefour and Metro AG, who until

now were operating cash-and-carry outlets in the country. It is believed that FDI will bring a wealth of experience, technical know-how, processes and patented structures that will result in the development of more streamlined and efficient supply chains and distribution networks. However, many domestic players may now face stiff competition from global retail giants and, therefore, may enter into strategic alliances with them in order to safeguard their interests and protect their business margins. This will help in establishing a stronger and more robust supply chains. It is to be noted that Indian household spending on food is one of the highest in the world with 48 per cent of income spent on food and grocery. With growing urbanization and consumerism and acceptance to modern retail, this sector still exhibits huge untapped potential.

The major argument against allowing FDI is that it will damage traditional business stores. But, those favoring FDI believe that there are obvious benefits of permitting FDI in retail as these investments will boost a key growth sector of the economy, create employment, benefit consumers with the increase in the retailer's efficiency and competitiveness, and importantly bring best management practices and access to world-class technologies. It is also believed that FDI will introduce new technology and investment in marketing of agricultural produce, and to make this happen, India must take full advantage of modern technology and operational and management experience of big supply chains in the food retail business.

In fact, due to the current scenario of inefficient supply chain, lack of proper and adequate storage facilities and presence of numerous intermediaries operating between farmers and consumers, the capital investment appears to be powerful catalyst to spur the investment climate in agricultural retailing. Since market infrastructure development requires huge investment that is unlikely to come from Government sector, the FDI driven modern retailing may bring about improvement in supply chain of agricultural commodities in India. The policy of allowing 100 per cent FDI in single brand retail may not only benefit the foreign players but also Indian partner where foreign players will get local market knowledge and Indian companies will access global best management practices, designs and technological know-how. Allowing healthy FDI in the retail sector will not only lead to a substantial surge in the country's GDP and overall economic development, but will *inter alia* also help in integrating the Indian agricultural retail market with that of the global retail market in addition to providing higher profit margin to Indian farmers which the unorganized sector has undoubtedly failed to provide (Roy and Kumar, 2012).

Conclusions

A paradigm shift is taking place in the retail sector of India owing to phenomenal growth in organized retailing over the past few years, which has emerged from the shadows of unorganized retailing and is contributing significantly to the overall growth of retail sector. The large retail giants and corporate houses have already made their presence felt in different parts of the country. The new format of retail business is gaining grounds owing to several factors like the change in lifestyle, tastes and higher disposable income, growing need for convenience, exposure to western culture, increase in number of working women and choice and value for money from food products. India is becoming a strategic business hub for the investors. The new agricultural policy of the Government of India encourages promotion of private sector participation through contract farming and land leasing agreements to stimulate faster growth in technology transfer, capital inflows and assured market for crop production. In view of this policy initiative, agribusiness corporate houses have come up and entered into collaborative partnership through vertical integration between farmers and consuming population. The new format of agribusiness is expected to reduce inefficiency in agricultural marketing.

Though the agricultural logistic management is expected to improve consequent upon reduction in market functionaries and higher participation of private sector players in agricultural business enterprise, long-term profitability and sustainability of retail sector can be achieved only if supply chain is realigned into efficient, agile and adaptable network. While extending scalability, such supply chain should have capability to handle larger volumes, expand reach, balance costs and address the demographic variations. Efficient supply chain management involves adequate planning, implementation and control of operations. Indian companies are now concentrating on logistic services to reduce costs. It is hoped that liberalizing the retail sector will usher in investments into the developing and improving food supply chain. The entry of new companies in the retail space will also benefit the exchequer. It will result in greater employment and will offer the consumers greater choices and competitive prices.

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Nothing improves an economy as efficiently as agriculture.

— Bill Gates

Focus

Productivity and Marketing Issues of Fisheries in Arunachal Pradesh: An Analytical Study

AMITAVA MITRA AND KAJU NATH

The economy of Arunachal Pradesh, the eastern most State of India, is predominantly agrarian with more than 60 per cent of workers engaged in agricultural and allied activities. Given the hilly topography (only around five per cent land is available for cultivation) and continuing dominance of low productivity under shifting cultivation, diversification of agriculture that raises the earnings of those dependent on agriculture remains one of the fundamental challenges. On the other hand, the State has untapped potential for fisheries in terms of many rivers, wetlands, ponds, lakes and area under rice-fish culture system. Hence, in this background the present paper makes an in-depth study of productivity and marketing structure of fisheries in the State of Arunachal Pradesh. The study was based on both secondary data and primary data which is collected from 300 sampled fish farmers of the State by applying multistage sampling technique. The study found that there are large variations of productivity of fishes in the surveyed districts in terms of pond size. The study also found that existing system of fish marketing was by and large inefficient.

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Agriculture is the main source of livelihood for the majority of the people of India despite concerted industrialization in the last six decades. In fact, a majority of the farmers of India are still following traditional practices of farming which are not at all remunerative. Therefore there is a need for diversification of agriculture and herein lies the importance of agricultural allied activities, including fishery, in rural areas of India. Fisheries, now recognized as a sunrise sector in India, recorded faster growth than any of the other agricultural and allied sectors during the last few decades. This rise in fish production was possible due to a quantum jump in inland fish production, especially pond culture, which is now growing at an average annual growth rate of around 13.87 per cent. The Twelfth Five Year Plan of India has emphasized to augment the production from fresh water aquaculture and make it a vibrant enterprise that can support rural livelihoods (Government of India, 2012). Arunachal Pradesh is richly endowed with water bodies, accounting nearly 56.48 per cent of water bodies of North East Region of India. Hence, there is great potential in the development of fishery sector of Arunachal Pradesh including the cold water fishery. In spite of large potential of inland water resources, only a minor part has been utilized by State fisheries due to a number of natural and anthropogenic factors. For example, most of the tribes of the State used to enjoy the social habits of open fishing and their fishing habits are just to meet the requirements of fish proteins at family level. However, with the growing individualization of agricultural land as well as water bodies, most of the owners of the water bodies are hold the potentiality to catch the commercial as well as ornamental market. The water bodies, as well as fishing resources, were owned by community and clan. There was no restriction on individual fishing of a particular community or a clan for the consumption purpose (Choudhary et al. 2008).

However, sometimes huge catches of fish were done by community during festival or recreational purpose from the water bodies owned by the community. This was the common practice a few decades ago when Arunachal economy was basically a mono-economy characterized by subsistence agriculture and a few cottage industries (Mitra, 2005). In fact, in many districts of the State, most of the ponds, tanks and beels are owned by individuals. For example, fish ponds and farms owned by the people consisted of around 9200.00 hectare, as against the Government fish firms of 35.69 hectare in 2010-11 (Government of Arunachal Pradesh, 2011). Many owners of these water bodies hold the potential to catch the ornamental as well as commercial market (both domestic and international) if their culture methods are developed (Das, 2005). So, it is high time to examine the productivity of fisheries, resource use efficiency as well as the marketing structure of the fisheries of Arunachal Pradesh. However, no study on economics of fishery in this direction is done till today in the State. Hence, the present study is an attempt to fill this gap in knowledge.

Section I

Fisheries in the North Eastern Region of India

The North Eastern Region of India has vast untapped potential for fisheries in terms of many rivers, streams, floodplain wetlands, lakes, ponds and large areas under rice fish culture system. The rivers Brahmaputra and Barak form the principal drainage of North East India with its numerous tributaries flowing through the different States. The region has 20,875 km of rivers, 5.63 lakh hectares of water bodies as well as 2,760 hectares of paddy-cum-fish culture area. The details are given in Table 1.

Table 1: Inland Water Resources of North Eastern Region of India

	North Eastern Region (NER)	India	NER's Contribution to India
Rivers and Canals *(in km)*	20875	195210	10.69 %
Reservoirs *(in lakh ha.)*	0.33	29.07	1.14 %
Tanks and Ponds *(in lakh ha.)*	3.71	24.14	15.37 %
Floodplain, Lakes and Derelict Water *(in lakh ha.)*	1.59	7.98	19.92 %
Total Water Bodies *(in lakh ha)*	5.63	73.59	7.65 %

Source: Annual Report 2011-12, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India

From Table 1 it is found that the region consists of only around 8 per cent of total geographical area of the country but it contains 9.58 per cent of rivers and canals, 19.92 per cent of flood plains lakes and derelict water and 15.37 per cent of tanks and ponds of the country. In fact, North East India is considered as one of the hot spots of freshwater fish biodiversity in the world. This water resource harbors 258 fish species belonging to 21 families and 76 genera (Mahanta, et al., 2010). Accordingly to preliminary evaluation, out of 186 fish species 62 (33.33 per cent) were considered as only food fish followed by 53 (28.44 per cent) as only ornamental. The rest were food as well as ornamental (12.90 per cent), sports as well as ornamental (9.67 per cent) etc. (NEDFi Data Bank, 2007). So far economic value is concerned, it is evaluated that out of the 186 species, 34 fish species have market demand better than Indian major crap whereas 19 species have similar economic values. This indicates that there is great potential for fresh water fisheries in the States of North East India through culture of indigenous fish species. In addition to it, in this region of the country, the fish is traditionally raised along with paddy or rain fed low lands (both shallow and deep water). In many areas, irrigation fed rice fields have also been adapted locally by the farmers to include fish farming (Das, 2002). The traditional rice-fish production systems have an important socio-economic impact in the life of the farmers and fisheries in the region. As a result, during the last two decades, there was a rapid increase of fish production in North Eastern Region from 112.35 thousand tonnes in 1990-91 to 313.94 thousand tonnes in 2010-11. That means on an average the fish production increased around 10.08 tonnes annually during the period. The details are given in Table 2.

Table 2 shows that there is variation of fish production among the States of North East India. The two relatively plain States like Assam and Tripura jointly contributed 88.06 per cent of total fish production of the region during 2010-11. In fact, Assam's lone contribution to total fish production of the region was 72.38 per cent during 2010-11. Among the hilly States, the largest contribution was by Manipur (6.44 per cent) during 2010-11.

The average growth rate of fisheries of North Eastern Region as a whole was estimated as follows:

$$\ln Y = 2.197 + 0.013\, t$$

$$R^2 = 0.791, \bar{R}^2 = 0.780, \text{ and } n = 21$$

Table 2: Fish Production in North Eastern Region of India during 1990-91 to 2010-11 *(in '000 tonnes)*

Year	1990-91	1995-96	2000-01	2005-06	2010-11
Arunachal Pradesh	1.25	1.85	2.60	2.75	3.04
Assam	76.00	155.06	158.62	188.00	227.24
Manipur	8.50	12.50	16.05	18.22	20.20
Meghalaya	1.52	3.58	4.97	4.12	4.56
Mizoram	2.95	2.50	3.15	3.75	2.90
Nagaland	0.83	3.00	5.20	5.50	6.59
Sikkim	0.10	0.15	0.14	0.15	0.18
Tripura	21.20	25.71	29.42	23.87	49.23
North Eastern Region (NER)	112.35	204.35	220.15	246.36	313.94
India	3835.89	4949.39	5655.34	6571.62	8294.68
NER's Contribution to India (%)	2.93	4.13	3.89	3.75	3.78

Sources: [1]Hand Book on Fisheries Statistics 2006, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India

[2]Annual Report 2011-12, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India

Thus, we find that in the region fish production increased at an annual average exponential rate of 1.3 per cent during the last two decades.

Status of Fisheries in Arunachal Pradesh

Arunachal Pradesh is located in the extreme north eastern corner of India. The State is well endowed for inland water fisheries. It is situated in the monsoon belt. It received an average annual rainfall of around 2721.80 mm (Government of Arunachal Pradesh, 2011). The State has extensive inland water resources in the form of rivers, hill streams, wetlands, lakes, ponds etc. The details are given in Table 3

Table 3 shows that Arunachal Pradesh consists of around 31.94 per cent of the total geographical area of the North Eastern Region of India but it contains 26.42 per cent of flood plain, lakes and derelict water, 74.39 per cent of tanks and ponds and 56.48 per cent of total water bodies of the region. Thus the State has enormous potential for development of fisheries in the region. In fact, fish, from time immemorial, has been an important dietary food of the people of the State. In addition, paddy-cum-fish cultivation is an important component of fisheries in general, and culture fisheries in particular, of the State.

Table 3: Inland Water Resources of Arunachal Pradesh

	Arunachal	North Eastern	Arunachal's Contribution

Trends of Production of Fishes in Arunachal Pradesh

The fisheries programme was first initiated in the year 1958-59 in a very modest scale. However, with the passage of time and expansion of fisheries development activities, pisciculture has taken a firm root in the State. The people are presently looking forward to fisheries as a means of additional income and seeking more and more Government intervention for this purpose. This is attributed by the fact that the people are basically farmers taking fishery as a subsidiary occupation and no 'fisherman' exists by caste in the State (NEDFi Data Bank, 2007). In fact, the problems of flash flood, underutilization of aquatic resources, unscientific methods of culture and low level of people's participation are some of the important factors in lowering the production up to a minimum level. However, there was a steady increase in production of fish since the nineties. The details are shown in Figure (Figure 1).

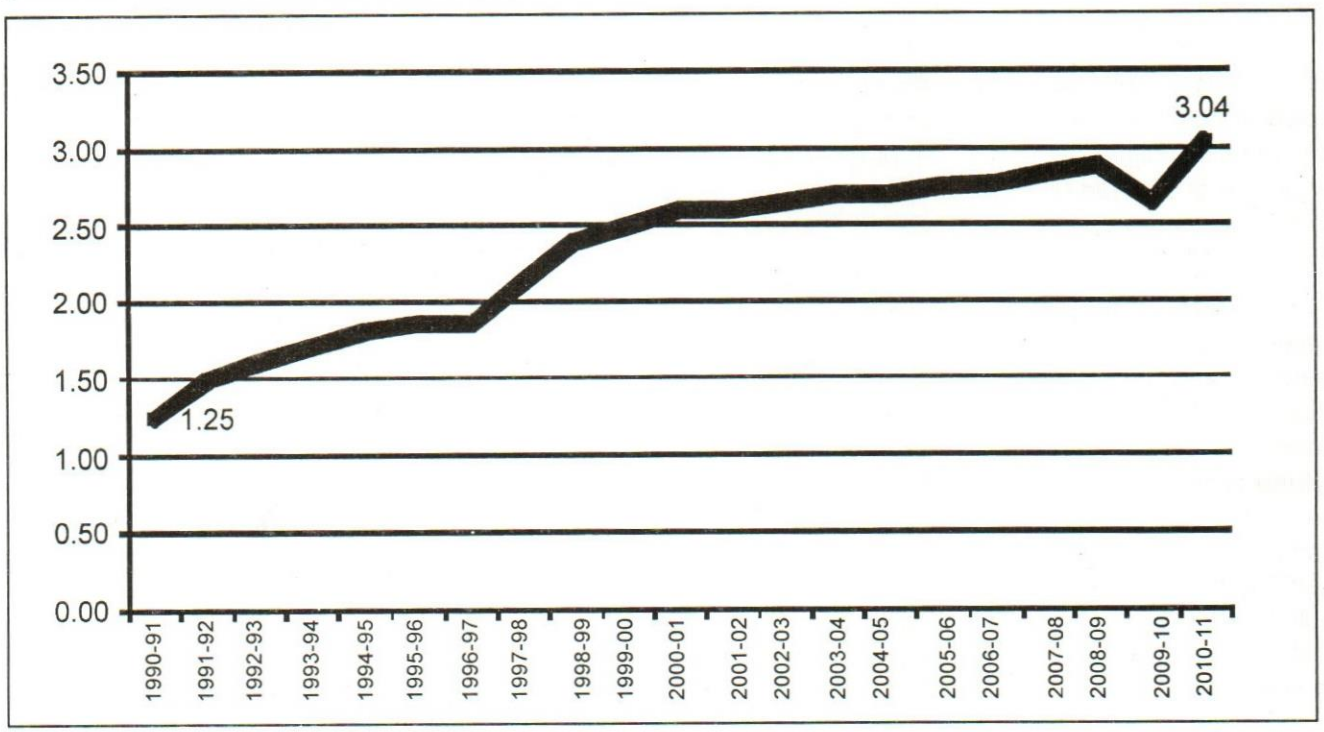
Figure 1 shows that fish production in Arunachal Pradesh increased from 1250 tonnes in 1990-91 to 3040 tonnes in 2010-11 (i.e., 2.4 times). An attempt was made to estimate the exponential growth of fish production during 1990-91 to 2010-11 as follows:

$$lnY = 3.171 + 0.017\,t$$

$$R^2 = 0.859,\ ^2 = 0.851 \text{ and } n = 21$$

Where Y is the total fish production of Arunachal Pradesh, t is the time measured in years, with origin at 1990-91 and the period covered is 1990-91 to 2010-11, with 21 observations (value of n). The average annual exponential growth rate was found to be 1.7 per cent which is significant at 0.01 per cent level. Thus, the production of fish in Arunachal Pradesh grew at an average rate of 1.7 per cent during 1990-91 to 2010-11 which is higher than that of the North Eastern Region as a whole (1.3 per cent).

Figure 1: Fish Production in Arunachal Pradesh during 1990-91 to 2010-11 *(in '000 tonnes)*



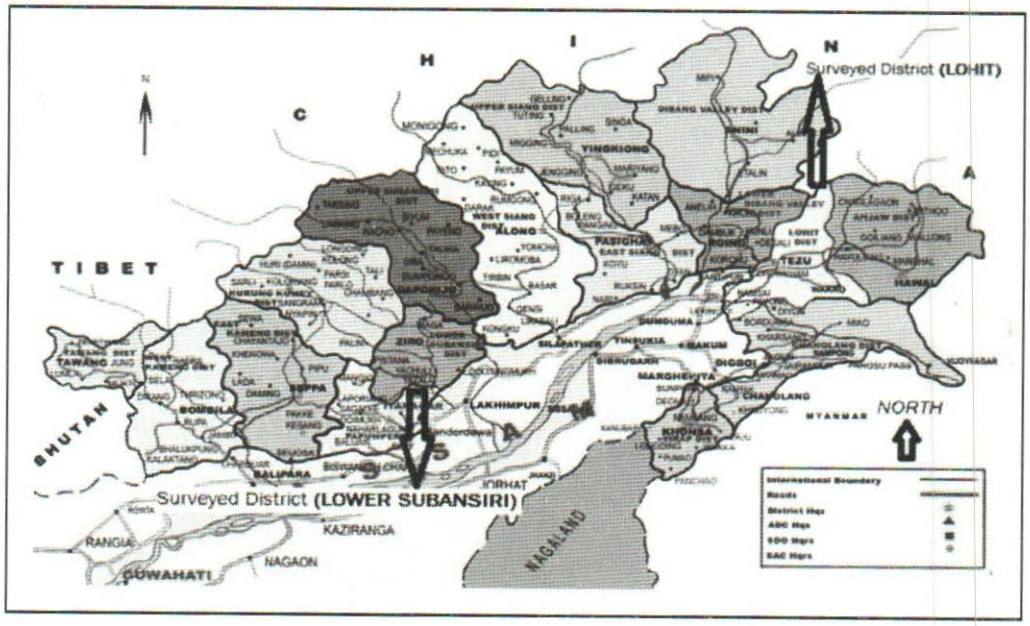
Source: Department of Fisheries, Government of Arunachal Pradesh, Itanagar.

Section II

Data Base and Methodology

The present paper is empirical in nature. The paper used both primary and secondary data. The collection of primary data was based on multistage sampling technique. In the first stage two districts namely Lohit and Lower Subansiri were selected by purposive sampling since almost 20 per cent of the total fish produced in Arunachal Pradesh comes from these two districts. In fact, Lohit is the largest producer of fish in the State and Lower Subansiri district is one of the largest producers of fish among the hilly

Map 1: Location Map of Arunachal Pradesh Showing the Surveyed Districts



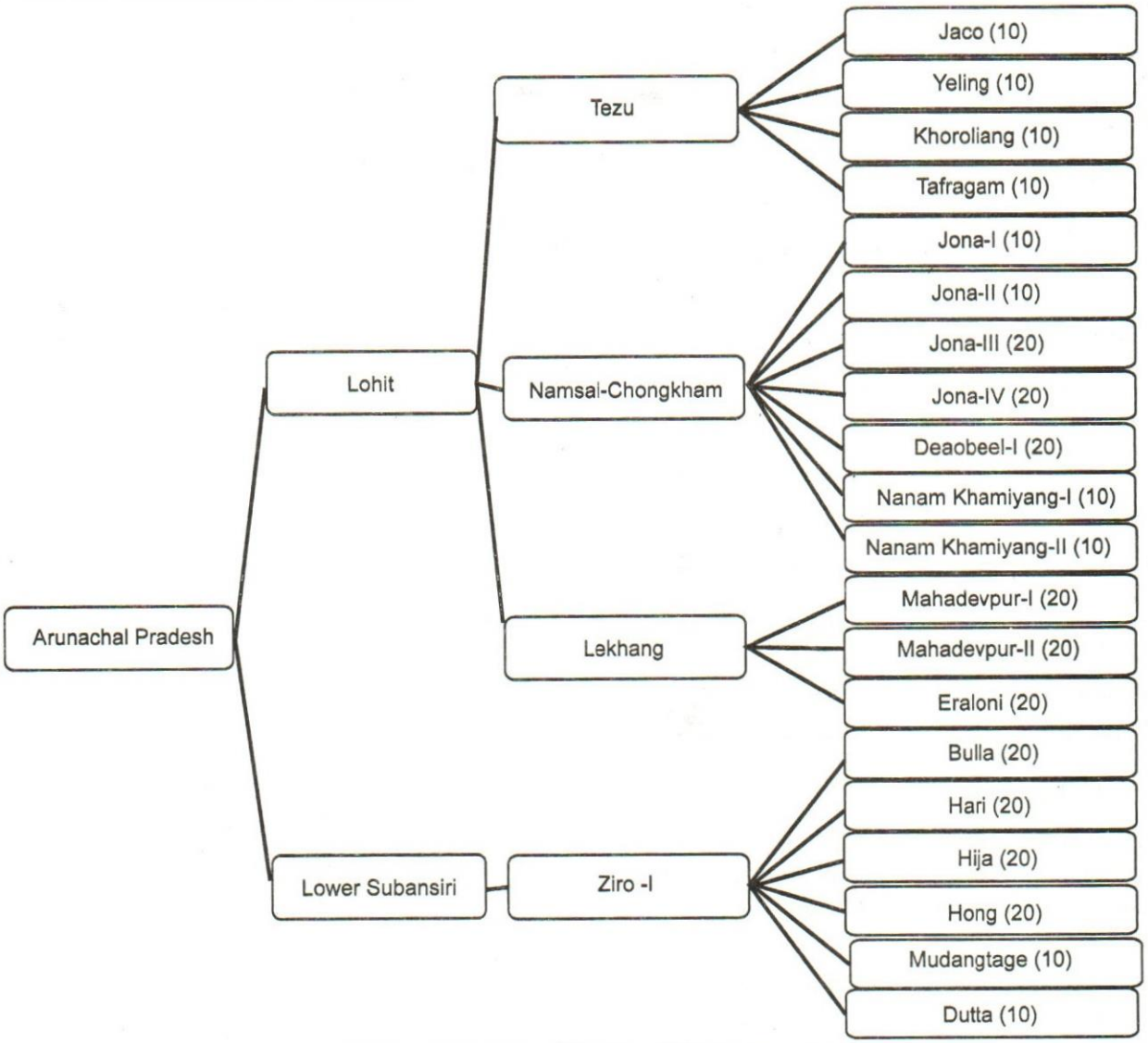
Source: http://arunachalpradesh.nic.in/images/state_map.jpg

districts of Arunachal Pradesh. Further, the *Apatani* plateau of Lower Subansiri district is a unique example of the paddy-cum-fish culture of the State. In order to have a clear picture of the study area, a location map of Lohit and Lower Subansiri districts of Arunachal Pradesh is shown in Map 1.

In addition, these two districts were selected as representative of three out of four agro-climatic zones existing in Arunachal Pradesh. Lohit district represented tropical zone (0-900 meters) and Lower Subansiri district represented sub-tropical zone (901-1800 meters) and temperate zone (1801-3500 meters). In the second stage, three blocks namely Tezu, Namsai-Chongkham and Lekhang from Lohit district and one block i.e., Ziro-I from Lower Subansiri district were selected by purposive sampling on the basis of extent of fish cultivation. In the third stage, four villages from Tezu block, seven villages from Namsai-Chongkham block, three villages from Lekhang block and six villages from Ziro-I block were selected purposively where fish farming was carried on a large scale. In the final stage, the fish farmers were selected randomly. The unit of observation is the fish farmer's household. Twenty fish farmer were selected from those villages where fish farming is carried out comparatively in large scale and ten fish farmer household were selected from those villages were fish farming is done comparatively in small scale. The details are shown in figure 2.

The secondary data were collected from various published and unpublished sources. The State and district level information were collected from Government offices like, Directorate of Fisheries, Government of Arunachal Pradesh, District Fishery Development Offices of Lohit and Lower Subansiri Districts, Directorate of Economics and Statistics, Government of Arunachal Pradesh, Department of Planning, Government of Arunachal Pradesh, various Government websites, etc. For National and international level data various publications and websites of Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India, Census of India, Government of India, Fisheries and Aquaculture Department, Food and Agriculture Organisation of the United Nations, etc., were used. In addition information was collected from relevant books and journals, various Government policy documents, report of various committee and publications of various organizations. Several officials of relevant departments were contacted and consulted for cross examining the information and for supplementing the data required for the present study.

Marketing structure and its efficiency of the fish products in the study area was also studied by finding



(State→Districts→Blocks→Villages/Locality)

Note: Figures in the parentheses indicates number of surveyed fish farmer households.

Figure 2: Design of Sample Survey

different marketing channels operating in the surveyed districts and marketing efficiency was also calculated with the help of the Shepherd's formula (Shepherd, G.S., 1965).

Section III

Productivity Analysis of Surveyed Fish Ponds

In this section, an attempt is made to estimate the productivity of fish pond on different size classes. Firstly, the surveyed ponds were divided into three different size classes i.e., small (up to 0.29 acres), medium (0.30 to 1.99 acres) and large (2.00 acres and above). Then the productivity was measured in terms of kg of fish catch per acre per year in the three different categories of ponds.

The productivity of small size pond was found to be 506.14 kg/acre/year followed by medium size (422.13 kg/acre/year) and large size (304.54 kg/acre/year). Thus, it was observed that there was inverse relationship between the size of pond and productivity. The inverse relationship was found to be more specific in the case of Lohit district where the productivity of the small size pond was found to 509.30 kg/acre/year whereas the productivity of medium size pond was 416.69 kg/acre/year and that of large size pond was 304.54 kg/acre/year. On the other hand, the

inverse relationship was not very specific in the case of hilly districts of Lower Subansiri where the productivity of small size pond was found to be 503.24 kg/acre/year and that of medium size pond was 490.16 kg/acre/year. The large size pond was not found in the surveyed area of Lower Subansiri district. The productivity of small size pond was much higher than that of the medium and large size pond because of the fact that the water bodies of smaller size enjoy the benefits of close supervision, intimate monitoring and sincere regulation by the family members themselves. The details are given in the Table 4 below:

It was observed that between the two surveyed districts, on an average the productivity of fish in Lohit district (420 kg/acre/year) was found to be much lower

Table 4: Distribution of Productivity by Size of Pond *(in kg/acre/year)*

Pond Size	Lohit	Lower Subansiri	Aggregate Productivity
Small	509.30	503.24	506.14
Medium	416.69	490.16	422.13
Large	304.54	—	304.54
All	420.00	502.24	444.76

Source: Field Survey, 2010-2012.

than that of Lower Subansiri district (502.24 kg/acre/year). However, in the case of small size ponds, the productivity of fish in Lohit district was marginally higher than that of Lower Subansiri district.

Another important observation of the surveyed pond was that there was a decline in productivity of pond as the number of shareholders increased. The productivity of sole owner pond was found to be 496.02 kg/acre/year, followed by two owners (364.97 kg/acre/year) and more than two owners (311.64 kg/acre/year). From Table 5.2 it is found that in the case of Lohit district the productivity of one owner, two owners and more than two owners pond were found to be as high as 496.32 kg/acre/year, 308.52 kg/acre/year and 254.39 kg/acre/year respectively. But it was interesting to observe that the trend is 'U'-shaped in the case of Lower Subansiri district where productivity of one owner, two owners and more than two owner ponds were found to be 502.24 kg/acre/year, 499.36 kg/acre/year and 507.26 kg/acre/year respectively. It showed that as the number of owners increased the productivity first declined in Lower Subansiri district and then it increased. However, there was a variation in the relationship of productivity and number of pond owner in the case of the surveyed districts. The details are given in Table. 5

This variation in the two districts may be due to two factors. Firstly, Lower Subansiri is basically a hilly district and Lohit is a comparatively plain district and both the

Table 5: Distribution of Productivity by Number of Owners of Pond *(in kg/acre/year)*

Number of Owner	Lohit	Lower Subansiri	Aggregate Productivity
One	496.32	502.24	496.02
Two	308.52	499.36	364.97
More than Two	254.39	507.26	311.64
All	420.00	502.24	444.76

Source: Field Survey, 2010-2012.

districts are from two different agro climatic zones of the State. Secondly, in Lower Subansiri district, paddy-cum-fish culture is practiced on a very large scale.

Marketing Structure in the Surveyed Districts

Marketing is one of the most important aspects in fish production as it is a highly perishable commodity. The marketing activity is restricted mainly to nearby markets like Tezu, Namsai, Mahadevpur and Sunpura in Lohit district and Hapoli in Lower Subansiri district. So, an attempt was also made to analyse the different marketing aspects like identification of important channels, cost and margins involved in fish marketing in the surveyed area. It was found that there are basically three channels through which fish is marketed in the surveyed area.

Channel-I: Producer→Retailer→Consumer
Channel-II: Producer→Vendor→Consumer
Channel-III: Producer→Consumer

From Table 6 it is observed that channel I (66 per cent) was the most popular channel followed by channel III (23 per cent) and channel II (11 per cent) respectively.

Table 6: Disposal of Fish through Different Marketing Channels

	Channel I	Channel II	Channel III	Total
Lohit	137 (68.50)	33 (16.50)	30 (15.00)	200
Lower Subansiri	61 (61.00)	00	39 (39.00)	100
Total	198 (66.00)	33 (11.00)	69 (23.00)	300

Note: Figures in parentheses indicate the respective percentages of total.
Source: Field Survey, 2010-12.

Table 7: Marketing Cost, Margin and Prices in the Study Area *(in ₹/kg)*

Districts	Particulars	Channel-I	Channel-II
Lohit	Producer's Price	80.00 (66.68)	80.00 (72.73)
	Marketing Cost	12.45 (10.36)	9.38 (8.53)
	Marketing Margin	27.55 (22.96)	20.62 (18.74)
	Price paid by Consumer	120.00 (100.00)	110.00 (100.00)
Lower Subansiri	Producer's Price	90.00 (64.29)	—
	Marketing Cost	17.25 (12.32)	—
	Marketing Margin	32.75 (23.39)	—
	Price paid by Consumer	140.00 (100.00)	—

Note: Figures in parentheses indicate the respective percentages of total i.e., price paid by the consumer.
Source: Field Survey, 2010-12.

The channel II existed only in one district i.e., In Lohit district among the two surveyed districts but it was the second important channel with 16.5 per cent share.

It was also observed from Table 7 that the producers share in consumer's rupee varied from 64.29 per cent to 72.73 per cent in the marketing of fish through identified channels. The details are provided in Table 7.

From Table 7 it was found that the marketing margin was quite high particularly in channel I. A comparatively lower producer's share in consumer's rupee in channel I and channel II was mainly because of the presence of agents who corner their margins by providing services in the fish marketing. Thus, though these two parameters, namely producer's share in consumer's rupee as well as quantum of costs and margins indicate that existing system of fish marketing in the study area was by and large inefficient. In fact, it was found that marketing system was quite unorganized to a great disadvantage to the fish pond owners.

Marketing Efficiency in the Study Area

In order to know the degree of the market performance, it is important to know the marketing efficiency. The efficiency of various identified marketing channels in the study area was calculated through the Shepherd's formula (Shepherd, G.S., 1965). The formula is given by following equation:

$$ME = \frac{V}{I} - 1$$

Where;

ME = Index of marketing efficiency
V = Value of goods sold (consumer's price)
I = Total marketing cost.

Table 8 represents that the estimates of marketing efficiency of fish through various channel through Shepherd's formula. It shows that the marketing efficiency is higher in channel-II in Lohit district (10.75) and lowest in the channel - I of lower susbansiri district (7,12)

Table 8: Estimates of Marketing Efficiency in Different Marketing Channels

Districts	Particulars	Channel-I	Channel-II
Lohit	Consumer's Price*(in ₹/kg)*	120	110
	Marketing Cost*(in ₹/kg)*	12.45	9.36
	Marketing Efficiency	8.64	10.75
Lower Subansiri	Consumer's Price*(in ₹/kg)*	140	—
	Marketing Cost*(in ₹/kg)*	17.25	—
	Marketing Efficiency	7.12	—

Source: Field Survey, 2010-12.

Conclusions

The success of any production process depends on economic feasibility. The process cannot continue in the long run if it lacks economic feasibility and incurs continuing losses due to high marketing cost and middle man's share. Fish farmers generally lack organization, leadership and political support. The success of fishery enhancement depends on the capacity of the community to coordinate and implement the practice. Fishery enhancement requires investments for producing fish seed or procuring seed from hatcheries, and fisher communities also need money to lease fishing rights and buy their gear. This will often require financial support.

On the background of the existing status, the fishery sector of the State appears to be in infant stage of development in spite of its enormous potential. As the State is the owner of the fishery waters of diversified zones,

the aquaculture packages of practices need to be refereed for adoption in the State in accordance with the available ecological zones for proper exclusion. For example, the hilly districts of the State hold the grounds from high altitude fishery development particularly in the trout production and sports fishery. On the other hand, the flood plain fisheries of the State encompass the natural water bodies and lakes situated in the relatively plain districts where composite carp production system may be incorporated. Therefore there is an immense scope for development of fish farming in the State to provide a source of income and employment to the people of the State. It was also found that fish farmers are not getting desired fish production in their pond due to lack of good quality of fish seed and fish feed. They have to purchase it from the market. It is imperative to popularise low cost fish farming system. Hence, the Government should encourage public private partnership for popularising as well as augmenting the production of fishes of the State.

The conventional fishing system is no longer able to address the grassroots level of reality. This calls for integrated approach of fishery with agriculture and other allied sector like piggery-cum-fish culture; duck-cum-fish culture; duck-cum-fish-cum-piggery culture. It may be noted that the role model of paddy-cum-fish culture was practised on a very large scale in Lower Subansiri district.

It was also observed that there is ample scope for improvement of fish production through appropriate input allocation. However, the parameters like producer's share in consumer's rupee as well as quantum of costs and margin indicate that existing system of fish marketing in the study area was by and large inefficient. Hence, in order to enhance producer's share and to reduce the role of middleman, it is suggested to encourage the formation of fish farmer's co-operatives.

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http://arunachalpradesh.nic.in/images/state_map.jpg

The discovery of agriculture was the first step towards a civilized life.

— Arthur Keith

Focus

Comparative Analysis of Organic and Modern Agriculture Systems: A Critical Assessment of Technical Efficiency

SIDDARAJU V.G AND M. INDIRA

Organic agriculture is not a new concept to India. Organic farming is one of the several approaches found to meet the objectives of sustainable agriculture. Many techniques used in organic farming like inter-cropping, mulching and integration of crops and livestock are not alien to various agriculture systems including the traditional agriculture practiced in India. Technical efficiency indicates the ratio between actual and potential output of any production unit. In this context, the present study estimates the technical efficiency of organic agriculture and modern agriculture systems and to study the factors influencing technical efficiency in organic farming. Technical efficiency shows that there is marginal difference in the technical efficiency under both farming systems in the case of Coconut and Areca nut. However, in the case of Paddy and Sugarcane more farmers practicing organic farming attained higher levels of efficiency. Training modules should include, technical aspects of organic farming, information about ecology, eco-systems, the relationship between production process and eco-systems and Cost of cultivation/budgeting.

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Sustainable development has caught the imagination and action all over the world for more than a decade. Sustainable agriculture is necessary to attain the goal of sustainable development. According to the Food and Agriculture Organization (FAO), sustainable agriculture "is the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of environment and conserving natural resources". All definitions of sustainable agriculture lay great emphasis on maintaining an agriculture growth rate, which can meet the demand for food of all living things without draining the basic resources.

Organic agriculture is not a new concept to India. Organic farming is one of the several approaches found to meet the objectives of sustainable agriculture. Many techniques used in organic farming like inter-cropping, mulching and integration of crops and livestock are not alien to various agriculture systems including the traditional agriculture practiced in old countries like India.

The introduction of Green Revolution agriculture technology in the 1960s reached the main production areas of the country, there were still certain (especially mountain areas) and communities (especially certain tribes) that did not adopt the use of agro-chemicals. Therefore, some areas can be classified as 'organic by default'. However, an increasing number of farmers have consciously abandoned agro-chemicals and now produce organically, as a viable alternative to Green Revolution. In the Indian context, organic farming can be significant in two different ways:

- **To increase the efficiency and sustainability of production:** Organic farming can help to reduce production costs (especially where labour is cheap compared to point costs) and to increase or stabilize

yields on marginal soils. This is especially relevant for smallholders on marginal area where Green Revolution agriculture has lead to a depletion of soil fertility and to high debts because of increase in input costs

- **To increase product value:** In areas where farmers have access to established organic markets within the country or abroad, products can achieve a higher price compare to the conventional market. Especially in the trend of decreasing prices for agricultural products, this can be an important way to stabilize or even increase incomes.

Status of Organic Agriculture in India

India is bestowed with lot of potential to produce all varieties of organic products due to its various agro climatic regions. An inherited tradition of organic farming in several states of the country is an added advantage. This holds the promise for organic producers to tap the market which is steadily growing (15 to 25 %) in the domestic market related to the export market. Farmers living in lands untainted by pollutants and away from the hassles of modernity and are rediscovering the benefits of traditional and holistic farming that maintains soil health and bio-diversity. Currently India ranks 33rd in terms of total land under organic cultivation and 88th in terms of the ratio of agricultural land under organic crops to total farming area. Presently the land under organic cultivation is 4.43 million Ha and its increasing at steady rate and rest are minor forest produce (wild collection) in an area about 3.65 million Ha. India exported more than 300 organic products under 19 categories for a volume of 69837 MT realizing value of USD 157 million (2010-11). The major products exported were cotton & textiles-17363 MT (25 %), basmati (5243 MT) and non basmati rice (1634 MT) (10%), Oil crops-17966 MT (26%) except sesame-2409 MT (3%), Process foods -8752 MT (13 %), tea-2928 MT & coffee (5%), honey-2408 MT (3%), dry fruits -1472 MT (2%), spices, medicinal plants and their processed products, miscellaneous (13%). The other products categories (5%) are cereals, spices, medicinal and herbal plants, coffee, vegetables, aromatic oil and pulses. 44 % of the organic products were exported to Europe followed by Canada (22%), USA (19%) and Asia (13%).

Agriculture Scenario in Karnataka

Agriculture is the main livelihood of people living in Karnataka for 65 % of the state population. Karnataka stands 9th with respect to total land area (191.8 lakhs Ha) and has 5.05 % of total population in the country. About 75.8 Lakhs Ha of land is suitable for agriculture and total cultivated land in the state is 123.8 lakhs Ha. Organic farming is more popular in the districts of Belgaum, Dharwad, Uttara kannada, Dakshina kannada, Kodagu, Chikkamagalur, Chamarajanagar, Mysore, Bidar, Bijapur etc. There are almost more than 35,000 certified organic farmers in the state with 60,000 Hectares of certified organic land. There are more than 60 organic outlets in the state mainly located in Bangalore. The major food produce from organic agriculture in the Karnataka state includes:

- **Cereals**: Rice, Ragi, Wheat, Maize, Jowar, Minor millets
- **Pulses**: Red gram dal, Green gram, Black gram and Bengal gram
- **Oil seed crops**: Ground nut, Sun flower, Sesame, Safflower, Soya bean
- **Commercial crops**: Sugar cane, Coffee
- **Plantation crops**: Cashew, Turmeric, Ginger, Black and white pepper, Cardamom
- **Vegetables**: Onion, Potato, Brinjal, Beans, Garlic, Gourds, Leafy vegetables etc

Technical Efficiency

Generally, Technical Efficiency (TE) is defined as the measure of the ability of a firm to obtain the best production from a given set of inputs (output increasing oriented), or as the measure of the ability to use the minimum feasible amount of inputs given a level of output (input-saving oriented) (Greene, 1980; Atkinson and Cornwell, 1994)[2]. Consequently, technical inefficiency is defined as the degree to which firms fail to reach the optimal production.

Understanding the relative efficiencies at the farm level is important so that the factors influencing the relative efficiency can be identified. This analysis helps in understanding the efficiency of the inputs used under different farming systems. Efficiency of any farm can be estimated in terms of allocative efficiency and technical efficiency.

Technical efficiency indicates the ratio between actual and potential output of any production unit. There are several studies by Kalirajan (1981), Mythili and Shanmugam (2000), Shanmugam and Venkataraman (2006), Sree Ram

Raju (2004) estimating the technical efficiency of particular crops in different states. In the present study, the procedure adopted by Battese and Coelli (1995) has been followed. In the first stage, Technical Efficiency of two perennial crops (Coconut and Arecanut) and two annual crops (Paddy and Sugarcane) has been estimated. In the second stage, the socio economic factors of the individual farmers were regressed against the frequencies of the technical efficiency to identify the factors influencing the technical efficiency. In this context, the present study has following two fold objectives

Objectives

1. To estimate the technical efficiency of organic agriculture and modern agriculture systems and compare them.
2. To study the factors influencing of technical efficiency in organic farming.

Methodology

Data Source and Area of the study

The study is largely based on primary data collected from the growers practicing modern farming system and organic farming system in selected districts of Southern Karnataka, India. Mysore and Mandya districts have been selected for the present study. A comprehensive questionnaire was prepared to collect data relating to the socio-economic background of the growers, cost of cultivation, perceptions of the growers regarding the organic agriculture etc.

Sample size

The study covered 50 farmers practicing Organic Farming System. In order to make a comparative study a control group of 50 farmers practicing modern agriculture were selected from the same villages. The criteria for selection of these farmers are that they represent the same characteristic of organic farmers in terms of socio-economic background, geographical location and crops grown.

Statistical tools

Technical Efficiency of individual farmers practicing organic agriculture and modern agriculture was calculated and average technical efficiency for different crops. In order to estimate the technical efficiency, Stochastic Frontier Production Approach was used.

Regression analysis was carried in order to identity if farming systems influence the technical efficiency apart from other farm specific factors like socio-economic background of the cultivators, knowledge levels, number of years of cultivation etc. Two-stage procedure adopted by Battese and Coelli (1995) is followed for the present analysis. Accordingly, Technical Efficiency of organic and modern farms producing two annual crops (Paddy and Sugarcane) and two perennial crops (Coconut and Arecanut) was calculated. In the second stage the technical efficiency of individual farms were regressed against some of the socio-economic factors at the farm level. This analysis was carried for individual crops produced under organic and modern farming systems.

Cobb-Douglas production function has been most widely used model in many empirical studies. Therefore, this functional farm is used in the present analysis. The following Stochastic Production Frontier is estimated.

$$\text{Ln } Y_{it} = \beta_{0t} + \beta_{1t} \text{Ln } X_{1it} + \beta_{2t} \text{Ln } X_{2it} + \beta_{3t} \text{Ln } X\,3_{it} + \beta_{4t} \text{Ln } X\,4_{it} + V_{it} + U_i$$

Where Yit is the total output

X_{1it} = is the value of farm power in rupees of i^{th} farm in the t^{th} period.

X_{2it} = is the value of organic nutrients in rupees of i^{th} farm in the t^{th} period.

X_{3it} = is the value of seed in rupees of i^{th} farm in the t^{th} period.

X_{4it} = is the irrigation charges in rupees of ith farm in the t^{th} period.

V_{it} = is a random variable and assumed to be independent and identically distributed (iid) as N $(0, \sigma_v^2)$ and independent of U_i random variables.

U_i = is firm-specific technical efficiency related variable and non-negative, defined by the truncation (at zero of N $(0, \sigma_u^2)$

Technical Efficiency is measured as the ratio of the actual output to the potential output that can be attained when the farm is fully technically efficient.

Technical Efficiency of the i^{th} farm is defined as

$$\text{Ln } (TE_i/(1\text{-}TE) = E(Y_{it}^*/U_i, x_{it}\ t = 1, 2 \ldots\ldots\ldots\ldots)$$
$$E(Y_{it}^*/U_i, = 0, x_{it}, t = 1, 2\ldots\ldots\ldots)$$

Where Y_{it}^* = Production in original units for the i^{th} farm in the t^{th} time period

Comparative Analysis of Technical Efficiency

Crop wise average technical efficiency of organic agriculture and modern agriculture were calculated and presented in tables. Z test was carried to estimate the statistics significant of differences in technical efficiency between organic and modern agriculture.

$$Z = \frac{(X_1 - X_2)}{\sqrt{\sigma_1^2 / n_1 + \sigma_2^2 / n_2}}$$

Where

X_1 = Mean technical efficiency of organic farms

X_2 = Mean technical efficiency of modern farms

σ_1^2 = Standard deviation of organic farms

σ_2^2 = Standard deviation of modern farms

n_1 = Number of organic farms

n_2 = Number of modern farms

Impact of Farm Specific Variable on Technical Efficiency

In order to determine the impact of farm specific variables on the technical efficiency scores generated by Frontier Production Function, multiple regression analysis was used.

The following regression model is specified.

$$TE = a + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4, e$$

Where

X_1 the age of the head of the family

X_2 Education background (dummy), if graduate 1, otherwise 0

X_3 Training (dummy), if trained 1, otherwise 0

X_4 Experience in cultivation more than 5 years 1, otherwise 0 b_1, b_2, b_3 and b_4 are respective regression coefficients

Analysis and Discussion

Social Background of the Sample Farmers

All the sample farmers of both Organic and modern agriculture are Hindus and more than 98 per cent belong to a single caste of Gowda, which is a dominant caste and upper caste in this part of Karnataka.

Age of Sample Farmers

Age of sample farmers is categorized into four groups viz., those below 30 years, between 31 to 40 years, 41 to 50 years and above 50 years. Distribution of sample farmers according to age group is presented in table 1. The data indicates that only in the case of Mandya district 5 farmers are below 30 years of age. In both farming systems, more farmers belong to the age group of above 40 years. This refutes the argument that more younger generations are adopting Organic agriculture. Concentration in higher age group in both farming systems shows that mainly the older group practices farming and younger generation is not practicing agriculture.

Table 1: Distribution of sample farmers according to age group

Sl No	Categories of Age Group	Mysore		Mandya	
		Organic Agri-culture	Modern Agri-culture	Organic Agri-culture	Modern Agri-culture
1	> 30	-	-	2 (8)	3 (12)
2	31 - 40	4 (16)	2 (8)	7 (28)	3 (12)
3	41 - 50	10 (40)	10 (40)	8 (32)	9 (36)
4	> 50	11 (44)	13 (52)	8 (32)	10 (40)
Total		25 (100)	25 (100)	25 (100)	25 (100)

Source: Survey Data

Note: Values within brackets represent percentage

Educational Status of Sample Farmers

Education background of the farmer is one of the important variables, which influence the awareness levels. Data on educational background of the sample farmers is presented in table 2. Data shows that 15 per cent of the farmers are illiterates and they are concentrated in Mandya district. Out of the total 15 illiterate farmers, 13 farmers are from Mandya district. One important observation is that majority of the illiterates are among the modern farming group. Graduates, postgraduates and professional could be observed in the Organic agriculture group. District wise observation indicates that in the case of Mysore, 24 per cent of the Organic farmers are professional, 12 per cent are postgraduates, and 48 per cent completed schooling. However, in the case of farmers

Table 2: Educational Status of the Sample Farmers

Sl No	Particulars	Mysore		Mandya		
		Organic Agriculture	Modern Agriculture	Organic Agriculture	Modern Agriculture	Total farmers
1	Illiterate	-	2 (8)	3 (12)	10 (40)	15(15.0)
2	School	12 (48)	14 (56)	8 (32)	13 (52)	47(47.0)
3	Graduation	4 (16)	8 (32)	13 (52)	2 (8)	27(27.0)
4	Post graduation	3 (12)	-	-	-	3(3.0)
5	Professional	6 (24)	1 (4)	1 (4)	-	8(8.0)
	Total	25 (100)	25 (100)	25 (100)	25 (100)	100(100)

Source: Survey Data

Note: Values within brackets represent percentage

practicing modern agriculture 68 per cent have completed schooling. In the case of Mandya, more illiterate farmers could be observed and they are practicing modern agriculture. Fourty per cent of the farmers practicing modern agriculture systems are illiterate and only 12 per cent practicing Organic agriculture system are illiterates. There are no postgraduates in Mandya district. The results clearly show the relationship between the education background and farming systems. The educated are switching over to Organic farming.

Technical efficiency of a farm depends on the management of the farm and the inputs used and the interaction among the inputs. Traditional average response function is associated problems of sampling, measurement problems and the influence of climate etc. In order to overcome these problems Aigner et al (1997) formulated Stochastic Frontier model. Jondrow et al (1982) improved this and developed a model to test efficiencies of individual observations.

Comparative Technical Efficiency Levels of Perennial Crops under Organic and Modern Agriculture

In the present study individual farm level technical efficiency were calculated for farms under organic and modern agriculture to make a comparative study, results relating to perennial crops are presented in table 3. Frequencies of technical efficiency for perennial crops show that there is not much difference in the organic and modern farms. Under both the farming systems, more than 60 per cent of the farms have attained more than 50 per cent of technical efficiency in the case of Coconut. It is the case with Arecanut but a marginal difference could be observed in the case of Arecanut. In the production of Arecanut only 58 per cent of the organic farms have attained technical efficiency of more than 70 per cent, under modern farming more than 66 per cent have attained this level. While 33 per cent are in the range of 50 per cent to 70 per cent, technical efficiency in the

Table 3: Comparative Technical Efficiency Levels of Perennial Crops under Organic and Modern Agriculture

	Coconut		Arecanut	
Efficiency Range	**Organic Agriculture**	**Modern Agriculture**	**Organic Agriculture**	**Modern Agriculture**
> 30	4(13.79)	3(10.34)	0(00)	0(00)
31 - 50	6(20.69)	5(17.24)	1(8.33)	1(8.33)
51 - 70	9(31.03)	10(34.48)	4(33.33)	3(25.00)
< 70	10(34.48)	11(37.93)	7(58.33)	8(66.67)
Total	29(100)	29(100)	12(100)	12(100)

Source: Survey Data

Note: Values within brackets represent percentage

case of organic farming, only 25 per cent are in this range in the case of modern farming.

Comparative Technical Efficiency Levels of Annual Crops under Organic and Modern Agriculture

Frequencies of technical efficiency of annual crops show a significant difference between organic agriculture and modern agriculture. Frequencies of technical efficiency of annual crops are presented in table 4. From the table 4 it can be observed that, while hundred per cent of the paddy farmers under organic agriculture have attained more than 95 per cent of efficiency, only 18 per cent of the farmers under modern agriculture have attained this level of efficiency. Majority of the farmers practicing modern agriculture are in the range of 75 to 85 per cent. 18 per cent of the farmers have attained less than 75 per cent efficiency. The analysis shows greater technical efficiency levels under organic farming compared to modern farming.

In the case of Sugarcane, also difference could be observed in technical efficiency levels between organic and modern farmers. Majority of the farmers in the case of sugarcane cultivation under organic agriculture have attained the technical efficiency ranging between 86 and 95 per cent. But only 17.86 per cent of the modern farmers are in this range. However, 28.57 per cent of the farmers practicing modern agriculture have attained technical

Table 4: Technical Efficiency Levels of Paddy and Sugarcane under Organic and Modern Agriculture

	Paddy		Sugarcane	
Efficiency Range	Organic Agriculture	Modern Agriculture	Organic Agriculture	Modern Agriculture
>75	0(000)	5(17.86)	0(000)	7(25.00)
75 -85	0(000)	10(35.17)	6(21.43)	8(28.57)
85 – 95	0(000)	8(28.57)	22(78.57)	5(17.86)
<95	28(100)	5(17.86)	0(000)	8(28.57)
Total	28(100)	28(100)	28(100)	28(100)

Source: Survey Data

Note: Values within brackets represent percentage

efficiency of above 96 per cent. None of the farmer under organic agriculture have attained efficiency levels above 96 per cent. Seventy eight per cent of the farmers under organic agriculture are in the range of 86-96 per cent.

Comparison of Average Technical Efficiency and Variation under Organic and Modern Agriculture

Average technical efficiency attained by farmers under organic agriculture and modern agriculture variation in the efficiency levels is presented in table 4 and Graph 5. Z statistics was calculated to test the significance of difference in average technical efficiency between organic and modern farms.

In the case of coconut, average technical efficiency under organic agriculture is greater than at under modern agriculture. However, higher technical efficiency is also associated with higher coefficient of variation indicating lower consistency. This shows that there is greater variation in the technical efficiency attained by farmers practicing organic agriculture in the production of coconut. Z test was conducted to observe the significance of difference in mean technical efficiency and it was found to be insignificant. In the case of Arecanut, very marginal difference in the average technical efficiency could be observed between the organic farmers and modern framers. The difference is statistically not significant. In terms of variation, modern farm appears to be more consistent with relatively lower coefficient of variation.

The same analysis was carried for farmers producing paddy and sugarcane, which are annual crops. Paddy production under organic farming appears to be more technically efficient compared to modern cultivation. Average technical efficiency under organic agriculture in the production of paddy is 97.64 per cent where as under modern cultivation is 84.86 per cent. The higher technical efficiency under organic agriculture is more consistent. Very low coefficient of variation (0.5 per cent) indicated that majority of the farmers producing paddy under organic farming system have attained 97 per cent technical efficiency. Difference is average technical efficiency of both the systems is statistically significant at 1 per cent level. This clearly shows that paddy production under organic

agriculture is technically more efficient compared to paddy production under modern farming system.

Similar tendency could be observed in the case of sugarcane. Average technical efficiency of sugarcane production under organic agriculture is more than that under modern agriculture and is more consistent among the sample farmers. Lower coefficient of variations (5.75 per cent) in the case of organic agriculture shows that majority of the farmers producing under organic agriculture have attained average technical efficiency. The difference in the average technical efficiency attained by modern farmers and organic farmers is significant at 5 per cent level. This shows that greater technical efficiency in the production of sugarcane can be achieved under organic farming system.

Factors Influencing Technical Efficiency under Organic Agriculture

Generally, Technical Efficiency is influenced by technology adopted. Apart from this various socio-economic factors which influence the use of technology will influence farm level technical efficiency. In the present study factors, influencing variation in technical efficiency of four crops produced under organic farming has been analyzed with multiple linear regression models. The variables included in this model are age of the farmers, education level of the farmers, experience in farming and training. The variables are selected based on the earlier literature suggesting a positive relationship between the technical efficiency and education (Reddy, 1997, Raju, 2004). The estimates are presented in table 5.

Table 5: Crop wise Average Technical Efficiency and Variation (In Per cent)

	Average Technical Efficiency		Coefficient of Variation (CV)		Z Values
Crops	Organic Agriculture	Modern Agriculture	Organic X Agriculture	Modern Agriculture	
Coconut	60.38	55.74	45.4	36.44	0.73
Arecanut	77.08	75.25	28.57	24.39	0.22
Paddy	97.64	84.86	0.5	12.05	6.62*
Sugarcane	88.93	83.86	5.75	15.37	1.94**

Source: Survey Data

Note: * indicate 1 percent level of significant

** indicate 10 percent level of significant

The result indicate that in the case of production of coconut under organic farming, out of all the variable considered, number of years of cultivation found to be significantly associated with variation in technical efficiency. Experience in cultivation is characterized with number of years in farming. The positive relationship indicates that those who are practicing organic farming for more than 5 years attained grater technical efficiency compared to those who have less years of farming experience. Education and Training in organic farming also have shown positive association and they are not found to be statistically significant. In the case of

Table 6: Crop wise estimation of factors influencing technical efficiency under organic agriculture

Variable	Coconut	Areca nut	Paddy	Sugarcane
Age	-.109(.219)	-.154(.426)	.045(.477)	-.015(.873)
Education	.296(.175)	.538**(.041)	.286*(.000)	.017(.872)
Experience	.706*(.000)	.458***(.088)	.211**(.034)	.699*(.000)
Training	.280(.782)	.108(.648)	.711*(.000)	.402(.000)

Source: Survey Data

Note: figures in parentheses are Prob. values

* indicates 1 per cent level of significance

** indicates 5 per cent level of significance

*** indicates 10 per cent level of significance

Arecanut, education and experience in cultivation have significant influence on technical efficiency. While education variable is more strongly associated, experience is weakly associated, but both are positively associated.

In the case of annual crops, the influence of these factors is stronger. In Paddy cultivation, technical efficiency is positively associated with the age of the cultivator, education background, number of years of experience in farming and the training. While the influence of age is not significant, the other three factors are significant at 1 per cent and 5 per cent confidence levels. In the cultivation of paddy under organic practice, education and training are the most influencing factors on technical efficiency. Technical efficiency of sugarcane under organic cultivation is influenced by experience and training. The coefficients of experience and training are significant at 1 per cent level of significance indicating that technical efficiency is directly related to the training and the experience of the farmers.

Experience in organic cultivation has been measured in terms of number of years that the farmer has been cultivating. The results show that with greater training opportunists and number of years of practice organic growers has standardized the methods of cultivation, which helped in attaining greater technical efficiency.

Summary and Conclusion

The present study involves a comparative analysis of organic and modern annual and perennial crops growing to evaluate their technical efficiency. Technical efficiency shows that there is marginal difference in the technical efficiency under both farming systems in the case of Coconut and Areca nut. However, in the case of Paddy and Sugarcane more farmers practicing organic farming attained the efficiency range of 85-95 per cent indicating that technical efficiency is higher under organic farming. Education, number of years of cultivation and training appear to be the factors influencing technical efficiency in all the crops under organic farming system. Factors influencing conversion from modern to organic agriculture have clearly shown that awareness about the environmental impact of modern farming is the main reason. This awareness is limited only to those who are educated. Efforts should be made to create awareness about two aspects of organic farming i.e., awareness about environmental consequences of organic farming and awareness about the economics of organic agriculture. Training is another important factor influencing farmers to attain technical efficiency in production and get higher income. It helps in optimal utilization of resources. Training modules should included, technical aspects of organic farming, information about ecology, eco-systems, the relationship between production process and eco-systems and Cost of cultivation/budgeting.

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When you concentrate on agriculture and industry and are friagal in expenditures, Heaven cannot impoverish your state.

— Xun Zi

Focus

An Overview of Dairy Industry in India

P. SARVESWARA RAO AND B. RAMACHANDRA REDDY

Since time immemorial, milk has been universally recognized as the nutritive food of excellence. Its protective food characteristics and goodness make it wholesome for those who can afford it. Proteins constitute 3.2 and 4.3 percent of cow and buffalo milk respectively. Dairying is an important contributor to the agriculture output of our nation and it sets right the imbalance in employment of rural agricultural labour. India is the largest producer of milk in the world with 121.8 million tons in 2010-2011. Five Year Plans and Operation Flood programs contributed a lot for this achievement. India is exporting dairy products to United Arab Emirates,Nepal,Singapore etc. Production of milk and per capita availability of milk in India have increased progressively. Dairy Cooperatives are handling 12% of country's marketable milk surplus. With economic liberalization from 1991 onwards private dairies are making a remarkable progress. India should be not only the largest producer of milk but also the best in dairy products in near future. In India the largest producer of milk is Uttar Pradesh with 21,031 thousand tons followed by Rajasthan and Andhra Pradesh with 13,234 and 11,203 thousand tons respectively.

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Since time immemorial, milk has been universally recognized as the nutritive food of excellence. Its protective food characteristic and goodness make it wholesome for those who can afford it. Proteins constitute 3.2 and 4.3 percent of cow and buffalo milk respectively. Besides protein, milk contains many other protective elements such as vitamins and minerals. According to the Nutrition advisory committee on the Indian council of Medical Research, a balanced diet for an adult should include 10 ounces of milk per day. It may seen surprising that while milk has high cultural prestige in India, many countries in the far East and South East Asia have till recently little access to milk or milk products in their diet. But in India milk is a preferred food and enjoys a special place in traditional diets.

Indian agriculture is an economic symbiosis of crop and cattle production. Small and marginal farmers own almost 80% of the total land holdings. About 67% of the workforce of 118 millions are engaged in agriculture either as cultivators or as farm labourers. In a normal year, crop production can generate employment for this workforce for only 90 to 120 days. For the remaining period, they are virtually unemployed. In this milieu, dairying sets right this imbalance in employment. The dairy sector today provides some 70 million farm families the triple benefit of nutritious food, supplementary income and productive employment for family labour, mainly for women. Indian dairying has been successful because it has evolved deliberately in a way that is complimentary and not in competition with agriculture.

Dairying is an important contributor to the agriculture output of our nation. Milk production is an important rural activity in India. Today, milk is India's largest 'Crop' in terms of its output value, surpassing even major cereals like rice and wheat. India at present is the largest producer of milk in the world and it is 121.8 million tons in the year 2010-11.

This happened because Indian dairy farmers have played a pivotal and pioneering role in enhancing the milk production in the country which has leapfrogged from a low of around 20 million tones of milk in the 1960's to the present 121.8 million tons of milk with a consistent growth rate of 4.5% which is substantially higher than the world average growth rate of 1.5%. It is very pertinent to note that Goldman and Sachs have predicted that India will be the 3rd largest economy in the world by the year 2035 after China and the USA in that order. The country has now achieved self reliance in milk production and is geared for substantial value of added milk products beyond its seashores. It has not only conserved the valuable foreign exchange by almost eliminating the import of milk and milk products but also has started exporting to African and middle-East countries. Now 60% of the rural households, 80% of the rural farmers and 36% of the rural landless class have already adopted dairying as their important and sustainable profession in rural India.

Dairying is a significant source of generating rural income and employment. To support it, seasonal agriculture income must be there. A regular alternative source of income is needed and the solution is "Income from milk". Dairying generates direct as well as indirect employment with its comprehensive potentiality. And for many it is the sole source of livelihood by bringing cash to their hands twice in a day in some places and weekly once in other places.

Significance of Indian Dairy

The Indian dairy industry has its first miracle when rural farmers joined together with professional managers to make the country self-sufficient in milk. Now it is ready for the second miracle. The emergence of india as the world's leading diary nation not merely becoming the biggest but also the best.

The production of milk in India is different from that of the developed countries, where the milk production is being carried out by the scientific integrated dairy farms with modern technology and hybrid cows. But in our country the milk production is done by the farmers with a little knowledge about milk production with small holdings of land and with the cross breed cows.

India has 52.98% of the world's buffaloes (77 million) and yield 60% of the total milk production of the nation. India has 19.41% of total cattle of the world (199.7 million) and yeild 40% of the nations milk production. Indian dairying has made rapid strides, but animal productivity, remains low. The animal productivity of dairy animals in India is estimated to be about 250 kg in local cows, 2500 kg is cross breed cows and 1,800 kg in buffaloes as against 4000-7000 kg per annum in advanced countries. The low productivity of animals in India is due to poor and improper feeding and lack of control and prevention of diseases.

The per capita milk consumption in India declined from 132 gm in 1973-74. However it has increased to 233 gm in 2000-01 which is due to the operation flood project and a better price policy. In advanced dairying countries, the per capita milk consumption is more than 500 gm, the world average being 285 gm. Out of the total milk production in India, 46% is consumed in fluid milk, 28% in the form of ghee, 8% in the form of milk powder, ice-cream and other milk products. But in advanced countries more than 80% of milk is consumed in the form of milk products.

Now our milk production has increased to 121.8 million tons from a total production of 20 million tons in 1960's. This means that even if the price of milk is calculated at just Rs. 10,000 per ton, an additional Rs.1,01,200 crores flow back into the rural economy in 2010-11. Fortunately, much of this directly benefits the poorest of India's farmers. Dairy development in India owes much to the Anand pattern of cooperative dairying. Its network covers over 10 million farmer members in more than 70,000 village societies in 170 milk-sheds spread over 270 districts of the country.

Table 1 shows the animal milk production and per capita availability in India from 1999-2000 to 2010-11.

Table 1: Annual milk production and per capita availability

Year	Milk production (in million tons)	Per capita availability gms. Per day.
1999-2000	78.3	217
2000-2001	80.6	220
2001-2002	84.4	225
2002-2003	86.2	230
2003-2004	88.1	231
2004-2005	92.5	233
2005-2006	97.1	241
2006-2007	102.6	251
2007-2008	107.9	260
2008-2009	112.2	266
2009-2010	116.4	273
2010-2011	121.8	281

Source: NDBB Annual Report, Annexure – V.

Table 1 reveals that the gradual increase in the production of milk and in the per capita availability of milk. The country's milk production is growing at an annual growth rate of 4.4% and its share in the world milk production is likely to reach 15.2% by 2014. This expectation has been crossed in this year only.

Table 2 shows the country wise production of milk by top 20 countries.

Table 2: Country wise production of milk

Rank	Country	Production (10^6 kg/y)
	World	696,554
1.	India	110,040
2.	United States	85,859
3.	China	40,553
4.	Pakistan	34,362
5.	Russia	32,562
6.	Germany	28,691
7.	Brazil	27,716
8.	France	24,218
9.	New Zealand	15,217
10.	United Kingdom	13,237
11.	Italy	12,836
12.	Turkey	12,542
13.	Poland	12,467
14.	Ukraine	11,610
15.	Netherlands	11,469
16.	Mexico	10,931
17.	Argentina	10,500
18.	Australia	9,388
19.	Canada	8,213
20.	Japan	7,909

Source : Dairy farming – Wikipedia, the free encyclopedia.

It is evident from Table 2 that India is the largest milk producer in the world with 110,040 (10^6 kg) per year followed by United States and China with 85,859 (10^6 kg) per year and 40,553 (10^6 kg) per year respectively.

Sri Lanka has entered into collaboration with the National Dairy Development Board of India to set up the Kiriya milk industries of Sri Lanka. The Kyrgyz Republic, a newly independent nation in Central Asia, has a new dairy plant built and commissioned by the NDDB.

History of Indian Dairy

When we trace back the history of dairying in India, we find that till the turn of nineteenth century, there had been very little effort to establish dairying officially. A few plantation owners imported various European breeds in an effort to augment the low yields derived from indigenous cattle, but did not seriously attempt cross-breeding European and Indian Stocks.

Dairy in pre-independence

The British authorities has established some large scale military dairy farms, the first of them being in Allahabad in 1891. Military dairy farms were started mostly in cantonment towns and they were meant to produce milk, butter and cream for British army units and their hospitals. These forms were the first to cross Indian cows with imported bulls. According to D.N. Khurody, before 1947, there were about 60 farms, with thousands of cross breed cows in them.

In 1914, the department of defence, on the advice of the BOA (Board of Agriculture) conducted a study on the productivity of Indian cows and buffaloes. Having seen impressed by the potentiality of dairying activity, it advised the Government, in 1916, to appoint an imperial Dairy expert.

Establishment of polson model dairy, the first butter making factory at Anand, in 1929 by the late M. Postonji E- Polson was a significant event in the modernization of the Indian dairy. The polson model dairy gave a fillip to the milk production in the Anand Region. It was polson who successfully demonstrated that pasteurized milk could be transported by rail to Bombay, a distance of 210 miles, in good condition.

In 1936, Dr. N.C. Wright, Director, Dairy Research Institute Scotland (DRIS) visited India to review the process of dairying in the country and made some important recommendations which formed the very basis for the development of dairy industry in the country. They recommended that (1) the milk industry has to be organized on proper lines in India (2) Ready and remunerative market should be made available (3) Inputs to diaries should be improved 4) India should develop its own technology to develop the industry 5) Being a country of villages inhabited by a number of small and marginal farmers and landless labourers, dairy development has to be dispersed and cover wide areas of rural pockets.

The first milk cooperative union was founded in Lucknow in 1937 and in 1941 the Bangalore Institute of Animal Husbandry was renamed as imperial Dairy Research

Institute on administrative grounds, which subsequently renamed as Indian Dairy Research Institute (IDRI).

In 1945, the Chief Executive Officer of the milk marketing board (MMB) of U.K. was appointed as the Milk Marketing advisor to the Government of India who recommended the establishment of "Milk Commission" in each state.

The Greater Bombay Milk scheme in 1945, followed by the setting up of the first farmers integrated Dairy Co-operative Unit AMUL at Anand in Kaira district of Gujarat in 1946, and the Greater Calcutta Milk Scheme, Bengal in 1947 were initiated.

Dairy Development in India – Post Independence Era

After independence, the attention of the Government was first drawn to the establishment of the milk colonies in cities to provide the consumers an adequate supply of cheap, hygienic and unadulterated milk. The Delhi milk scheme was set up on October 2, 1959 with a large dairy plant, supported by a network of rural milk chilling centres. By the end of 1960's, it was clear that the idea of the city milk scheme was unworkable.

Live stock

The sustainability, progress and development of dairy industry naturally depend upon the availability of healthy bovine population. As on today India possess more than 20% of the world bovine population and more than 14% of the cattle population.

Table 3 shows the live stock during 2003 and 2007 and their growth rate.

Table 3: Live stock populations

(in million no's)

S. No	Species	Live stock census		Growth rate	
		2003	2007	2007 over 2003	Annual
1.	Cattle	185.2	199.1	7.50	1.83
2.	Buffalo	97.9	105.3	7.58	1.84
3.	Yaks	0.1	0.1	27.95	6.36
4.	Mithuns	0.3	0.3	-4.92	-1.25
	Total bovines	283.4	304.8	7.52	1.83
5.	Sheep	61.5	71.6	16.41	3.87
6.	Goat	124.4	140.5	13.01	3.10
7.	Pigs	13.5	11.1	-17.65	-4.74
8.	Other animals	2.2	1.7	-22.93	-6.30
	Total live stock	485.0	529.7	9.27	2.23
9.	Poultry	489.0	648.9	32.69	7.33

Source : NDDB Annual Report 2011-2012.

Table 3 shows that there is an increase in the cattle and buffalo population in 2007 when compared to that of the population of cattle and buffaloes in 2003. The annual growth rate in their population is 1.83 and 1.84 respectively.

The table 4 shows state wise distribution of livestock and poultry.

It is evident from the table that Madhya Pradesh ranked I in the cattle population followed by West Bengal with 21,915 millions and 19,188 millons respectively. The buffalo population is highest in Uttar Pradesh followed by Andhra Pradesh with 23,812 millions and 13,272 millions respectively.

DAIRYING IN 5-YEAR PLANS

Systematic development of dairy and cattle industry started in India only after the launching of the country's five-year plans

First Five Year plan (1951-56)

In the 1st Five year plan no specific provision was made for developing dairying because of lack of trained personnel. However in states, which had the required personnel, there were seizable programmes like Bombay milk scheme, the Aarey Milk colony, the Anand Milk Union Ltd and the Greater Calcutta Milk Scheme. This Five year plan devoted considerable attention to controlled breeding disease control and segregation of old and infirm cattle through schemes like the Gosadan and the Gosala and Key village schemes. Efforts were also made for fodder development.

The total outlay for Animal Husbandry and Dairying during the plan was Rs. 220 millions. Out of Rs. 220 millions Rs. 141.9 millions were spent on Animal Husbandry and Rs.78.1 millions on dairying as shown in Table 5.

Second five year plan (1956-61)

The second five year plan continued to concentrate on Schematic cattle development programmes. The plan intended to expand the key village scheme and the Gosala and Gosadan schemes and 197 new key village blocks were established covering a population of 10,000 cows and buffaloes. Dairy development on an organized basis began to take shape during this plan. A number of states created separate Dairy Development Departments to give exclusive attention for the development of dairying. Two Regional Dairy Research stations were established at Bombay and Calcutta. It was during this plan the gift of road and rail tankers from New Zealand was received by

Table 4: Shows that the total number of livestock and poultry

States / UTs	Cattle	Buffaloes	Sheep	Goats	Pigs	Horses and ponies	Mules	Donkeys	Camel	Yaks m	Mithun	Total live stock	Total poultry
Andhra Pradesh	1123	13272	25539	9626	439	26	0	50	0		0	60175	123981
Arunachal Pradesh	503	3	20	292	356	6	0	0	0	14	219	1413	1348
Assam	10041	500	354	4320	2000	11	0	0	0		0	17227	29060
Bihar	12559	6690	218	10167	632	51	0	24	0		0	30342	11420
Chhatisgarh	9491	1604	140	2768	413	1	0	0	0		0	14418	14246
Goa	71	37	0	11	58	0	0	0	0		0	177	505
Gujarat	7976	8774	2002	4640	22	14	0	50	38		0	23515	13352
Haryana	1552	5953	601	538	134	26	11	5	39		0	8859	28785
Himachal Pradesh	2269	762	901	1241	2	13	19	7	0	2	0	5217	810
Jammu & Kashmir	3443	1050	4127	2068	1	167	42	24	2	62	0	10987	6683
Jharkhand	8781	1506	483	6592	732	5	0	1	0			18100	11231
Karnataka	10503	4327	9558	6153	281	11	0	26	0			30859	42068
Kerala	1740	58	1	1729	59	0	0	0	0			3587	64756
Madhya Pradesh	21915	9129	390	9014	193	27	3	20	4			40696	7384
Maharashtra	16184	6073	2909	10391	327	38	0	32	0		0	789	2403
Manipur	342	62	9	51	314	1	0	0	0		10	1823	3093
Meghalaya	887	23	21	365	524	2	0	0	0		0	328	1239
Mizoram	35	6	1	16	267	1	0	0	0		2	1419	3156
Nagaland	470	35	4	178	698	1	0	0	0		33	23057	20600
Orissa	12310	1190	1818	7127	612	0	0	0	0		0	7408	10685
Punjab	1777	5062	208	290	26	33	6	5	2		0	7408	10685
Rajasthan	12120	11092	11190	21503	209	25	1	102	422		0	56663	4946
Sikkim	135	0	3	92	35	0	0	0	0	5	0	270	157
Tamilnadu	11189	2009	7991	9275	284	7	0	5	0		0	30759	128108
Tripura	954	14	4	633	264	0	0	0	0		0	1869	3701
Uttar Pradesh	18883	23812	1188	14793	1350	122	31	84	9		0	60272	8754
Uttaranchal	2235	1220	290	1335	20	15	24	1	0	0	0	5141	2602
West Bengal	19188	2009	7991	9275	284	7	0	5	0	0	0	37419	86210
A & Nicobar	49	10	0	67	48	0		0	0		0	174	979
Chandigarh	7	20	0	1	0	0	0	0	0	0	0	28	129
Dadra & Nagar Haveli	57	4	0	25	0	0		0	0		0	87	170
Daman & Diu	3	1	0	3	0	0		0	0		0	7	26
Delhi	92	278	6	21	20	1	0	0	0		0	418	2
Lakshadweep	7	0	0	76	0	0		0	0		0	82	167
Pondicherry	84	3	4	69	1	0		0	0		0	162	387
All India	199075	105343	71558	140537	11134	611	137	438	517	83	264	529698	648830

'0 negligible with respect to thousands. $ Provisional results, derived from village level totals.

Source: NDBB Annual Report, Annexure IV.

Table 5: Plan wise outlay for animal husbandry and dairying under five year plans

Plan	Outlay		Total
	Animal Husbandry	Dairying	
First five year plan (1951-56)	141.9 (64.50)	78.1 (35.50)	220.00 (100)
Second five year plan (1956-61)	385.0 (68.82)	174.4 (31.18)	559.4 (100)
Third five year plan (1961-66)	544.4 (60.14)	360.8 (39.86)	905.2 (100)
Annual plans (1966-69)	413.3 (51.45)	390.0 (48.55)	803.3 (100)
Fourth five year plan (1969-74)	941.0 (40.36)	1390.0 (59.64)	2321.0 (100)
Fifth five year plan (1974-78)	3095.6 (70.75)	1279.8 (29.25)	4375.4 (100)
Annual plans (1978-90)	N.A.	N.A.	2460.6
Sixth five year plan (1980-85)	3896.4 (44.74)	4623.0 (54.26)	8519.4 (100)
Seventh Five year plan (1985-90)	6511.7 (56.50)	4934.7 (43.50)	11356.4 (100)
Eighth five year plan (1992-97)	4000 (30.76)	9000 (69.24)	13000 (100)
Ninth Five year plan (1997-2002)	N.A.	4695	NA
Tenth Five year plan (2002-07)	5500 (lakhs)	800 (lakhs)	6300 (lakhs)
Eleventh Five year plan (2007-12)	4800 (lakhs)	3200 (lakhs)	8000 (lakhs)
Twelth five year plan (2012-2017)	N.A.	N.A.	44800 lakhs

Note : (i) NA - Not available ii) figures in parenthesis represent percentages to total

Source : Government of India, planning commission, Annual report of Ministry of Agriculture, Department of Agriculture and Cooperation, New Delhi

the Bombay Milk Scheme for transportation of milk between Anand and Bombay.

This plan also gave importance to Animal Husbandry by allocating Rs. 385 millions out of Rs. 559.4 millions total outlay, only Rs. 147.4 millions were spent on dairying as shown in Table 5.

Third Five year plan (1961-66)

The important achievement of this plan was the establishment of National Dairy Development Board at Anand in 1965 with the objective of providing technical services and other inputs to the dairy plants on no profit no loss basis.

In this plan, 23 liquid milk plants and 27pilot schemes were operated, four milk product factories and 3 creameries were commissioned and Intensive Cattle Development Programme (ICDP) was formulated. Rs. 261.4 millions were spent on dairying.

Fourth five year plan (1969-1974)

The important land mark achieved during the plan was the launching of operation flood – I programme. It was conceived by the NDDB with these objectives. I) to increase the supply of milk, milk products, meat and eggs ii) to increase the output of certain animal products and iii) to diversify the economy of small farmers and landless labourers by enabling them to undertake animal husbandry activities. Out of Rs. 2,321 millions, allocated, 59.61% was spent on dairying.

Fifth Five Year Plan (1974-79)

In the fifth plan, it was intended to develop dairying in the interest of small and marginal farmers and agricultural labourers by extending necessary facilities. At the beginning of the plan, Annual session of the International Dairy Federation (IDF) and the XIX International Dairy Congress (IDC) were commenced. For buffalo development, central Buffalo Breeding Farm was established out of the total outlay to Animal Husbandry and Dairying Rs. 4375.4 milions Rs. 1279.8 millions was for dairying.

Sixth Five year Plan (1980-85)

Three integrated cattle-cum dairy development projects were started in Rajasthan, Madhya Pradesh and Karnataka. A large number of primary Dairy unions have been started on Anand pattern. By the end of the plan, it was proposed to collect 38 million tones of milk annually as against 30 million tones achieved by the end of the fifth plan. This recorded a growth rate of 4.8% per annum. The important milestone achieved in the sixth plan was the launching of operation Flood – II covering 155 districts with an outlay of Rs. 4,855 millions.

Seventh Five year plan (1985-90)

The Seventh plan aimed at achieving the target of 51 million tones of milk production by 1989-90. The objectives of the seventh plan were 1) to accelerate growth of livestock production, 2) To strive for increased productivity and 3) to provide more quality fooder seeds. Operation Flood III

was launched during this plan with an outlay of Rs. 6,812.90 millions.

Eighth Five Year plan (1992-97)

Total allocation for animal husbandry and dairying was Rs. 4000:9000 (Rs. 13,000 millions). A large number of dairy units and veterinary hospitals were envisaged at appropriate places. More funds were allocated to purchase vehicles and other inputs to supply the life saving vaccine to the animals.

Ninth five year plan (1997-2002)

Allocation for the dairying during ninth plan period was very low ie. Rs. 469.5 crores, which was 0.18% when compared to fourth plan 0.98% and when compared to the previous plan it was around 50% only. Most of the resources were eaten away by the wages and administrative costs of the government departments.

Tenth Five Year plan (2002-2007)

The constructive objectives of this plan were strengthening of the entire co-operative structure, rehabilitation of sick unions, strengthening the production, procurement, processing and marketing of milk, maintaining high quality milk and the like. The proposed outlay is Rs. 1,818 lakhs for the dairy development.

The intensive Dairy Development plan (IDDP) launched during the VIII plan period, is being continued during X plan with an outlay of Rs. 176 crores. So far 73 projects with an outlay of Rs.407.58 crores have been sanctioned in 25 states. The scheme has benefited about 9.6 lakh farm families and organized about 15,500 village level Dairy Cooperative Societies till March 2006.

Eleventh Five Year Plan (2007-11)

Under this plan Rs. 3200 lakhs was allocated for dairying. This amount is for cooperative strategy for dairy development as per the details given in table 1.5 besides that the plan is to 1) support private initiatives for dairy development ii) Enlargement of the venture capital fund iii) Encouragement for R & D. iv) Promote consumer awareness on safe milk and milk products v) Promote the role of women in dairying vi) Support professional development / HRD in dairying.

Support to cooperatives for dairy development under 11th five year plan.

It is very clear from Table 6 that the total 11th five year plan allocation is spent to support cooperatives for dairy development.

Table 6: Scheme 1: Support to cooperatives for dairy development under 11th five year plan

Particulars [at 2006 prices - in Rs. Crores]	2006-07 to 2011-12	Terms	Budgetary Support from GoI
Institution development soft skill primary level	72	100% grant	Rs. 30 crores p.a. = Rs. 150 crores
Institution developmental soft skill primary level	76		
Total – Village level ID	148		
Milk Pooling Equipment	103	Interest free loan	Interest subsidiary of Rs. 110 crores p.a. = Rs. 550 crores
Milk testing equipment	389		
Bulk milk coolers	589		
Total – milk proc. Equipment	1081		
Processing – New Capacities	1349	Loans at competitive rates	20% of investment = Rs. 350 crores
Processing – Refurbishment	545		
Marketing	96		
Total – Dairy infrastructure	1899		
Voluntary Retirement Scheme (VRS) in Milk Union /Federation	141	100% grant	Rs. 30 crores p.a. = Rs. 150 crores
Grand Total	**3269**		

Table 7: Financial proposal during 12th plan

(Rs. In lakhs)

S. No	Item	2012-13	2013-14	2014-15	2015-16	2016-17	Total
1	Milch Cattle Induction	1804.00	2078.00	2390.00	2750.00	3162.00	12184.00
2	Breed Improvement Programme & Heifer Rearing	2000.00	1955.00	2250.00	2588.00	2980.00	11773.00
3	Feed & Fodder Development.	700.00	805.00	925.00	1064.00	1224.00	4718.00
4	Input Distribution & Productivity Enhancement Programme	600.00	690.00	794.00	912.00	1050.00	4045.00
5	Training & Extension	745.00	860.00	990.00	1140.00	1315.00	5050.00
6	Consultancy Services	50.00	50.00	52.00	60.00	65.00	277.00
7	Milk Procurement, Processing & Marketing	800.00	920.00	1060.00	1220.00	1400.00	5400.00
8	Gokul Gram Vikas Yojna	200.00	230.00	265.00	302.00	345.00	1342.00
9	Khatal Rehabilitation Plan	1.00	2,00	3.00	2.00	2.00	10.00
	Total	6900.00	7590.00	8729.00	10038.00	11543.00	44800.00

It is evident from the Table 7 that 12th five year plan allocated Rs. 44,800 lakhs for the dairying and it is proposed to spend Rs. 6,900 lakhs, Rs. 7,590 lakhs, Rs.8729 lakhs, Rs.10038 lakhs, Rs.11,543 lakhs of amount during the year 2012-13, 2013-14, 2014-15, 2015-16 and 2016-17 respectively.

Dairy Development under cooperative sector

In the beginning of the plan era (1950-51) milk production was only 17 million tons. India was an importer of milk products then. During sixties, after a period of stagnation, annual growth in production of milk was so significant. The milk production in the country has reached the level of 121.8 million tons by 2010-2011. This was possible due to the dairy cooperative movement launched under the operation flood programme. With the onset of operation flood, the growth of vertically integrated 3-tier dairy co-operative structure in various states has played an important role increasing the production milk handled in the organized sector. This is nothing but a revolution that took place in the field of milk production – white revolution.

We have more than 1,25,000 dairy milk cooperative societies owned by around 13 million farmer members, of whom 3.2 millions were women and 198 milk unions in India spread over 346 districts. Annual growth rate in the production of milk is 6.5 percent.

Most of the dairy plants in the government, co-operative and private sector produce almost similar type of dairy products like butter, milk, ghee, skimmed milk powder and whole milk powder. There are 7 large scale cheese and 14 infant foods and malted milk manufacturers. The cheese market, presently valued at about Rs. 80 crores is growing at about 9% annually.

Government always looks towards co-operative as an instrument of socio-economic development of weaker sections. Therefore, co-operatives are never equated with other profit making and commercial organizations. Hence a different approach to deal with co-operatives is necessary.

Dairy cooperatives follow 3 tier structure at the village level primary diary cooperative societies at district level, milk processing unions and at the state level state co-operative marketing dairy federations. Village level primary co-operative societies form milk unions at district level, process their milk in a plant. Similarly, district level milk union federations are formed for efficient marketing of their produce.

During April to November 2011, the average milk procurement by Dairy Co-operatives was more than 262 lakh kg per day (provisional) compared to around 251 lakh kg per day during the same period in the previous year, registering an increase of 4.4 percent. The cooperatives marked an average above 229 lakh litres of milk per day (provisional) against the average of about 219 lakh litres per day during the corresponding period in the previous year, registering a rise of about 4.6 percent over.

Dairy cooperative societies are engaged in superior cattle breeding, product diversification, nutrition, animal health, high quality animal feed production besides milk procurement and marketing of milk. Of course, these

achievements are the result of the joint efforts of NDDB, operation flood, Government policy and support.

Despite dairy growth, cooperative sector faces several constraints related to: legislative and policy constraints, Resource constraints, institutional constraints, constraints relating to awareness, erosion of the democratic content in management, excessive bureaucratic and government control and unnecessary political interference in the operation of co-operatives.

Dairy cooperative presently handle 16 percent of country's marketable milk surplus and reach out to 15 percent of the milch animal house holds in about 20 percent of our village milk travels as far as 2200 km to deficit areas carried by innovative rail and road milk tankers serving a major source of fluid milk supply to cities and town across the country.

A substantial increase in the milk handled by the organized dairy industry – cooperative and private dairy from 30% of the marketable surplus handed by them today and it will increase to about 66% by 2021. New Generation Cooperatives (NGC) initiatives – Milk Producer Institutions (MPI's) were promoted in areas where cooperatives have little or no presence. By the end of November 2011, about 2,59,000 producers were organized into around 11,000 milk pooling points in 10 states namely Andhra Pradesh, Bihar, Punjab, Gujarat, Haryana, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh. Collectively, they procured an average of 13,87,000 kg of milk per day with a peak procurement of 20,62,000 kg.

Table 8 shows month / year wise average procurement by the dairy cooperatives during 2008-12.

It is evident from the table 8 that the average milk procured by dairy cooperatives has an increasing trend during 2008-12 it increased from 207.17 lakh per day in 2008 to 319.12 lakh kg per day in 2012 upto November only.

Establishment of Dairy cooperatives in India

The first dairy on co-operative basis was established at Allahabad in 1913 followed by the establishment of Calcutta milk supply societies union in 1919. Till 1938, 19 unions, 264 primary societies were recorded. However, dairy cooperatives did not make much progress during the pre-independence period.

The land mark in the history of dairy development is the formation of co-operatives milk producers union limited on the advice of Sri Sardar Patel under the leadership of Sri Thribhuvan Patel on 14 December 1946.

Dr. Virghese Kurian, the Chairman and GM of AMUL, has adopted an integrated approach to dairy development by linking all the major activities of dairying in the AMUL organization viz., Production, procurement, processing and marketing for achieving remarkable progress. Today AMUL is the largest dairy plant in the country handling on an average about 1225 district Co-operative societies with 24.58 lakh milk producers. It became model cooperative society and got world wide recognition.

Table 8: Month / year wise average procurement by the dairy cooperatives

S.no	Month	Average Milk procurement (Lakh kg. per day)				
		2008	2009	2010	2011	2012
1.	Jan	230.00	285.49	282.34	297.49	337.56
2.	Feb	207.00	276.78	284.96	301.04	347.73
3.	Mar	222.00	271.18	262.42	291.32	347.70
4.	Apr	202.54	272.24	258.76	269.96	316.32
5.	May	190.07	239.37	252.62	270.21	322.22
6.	June	188.89	234.34	238.94	255.92	299.12
7.	July	205.68	211.25	240.75	258.37	298.90
8.	Aug	189.48	208.87	199.54	254.24	294.95
9.	Sept.	195.73	210.09	197.49	262.50	299.58
10.	Oct	198.60	224.09	211.72	264.37	301.23
11.	Nov	206.00	270.11	271.03	313.18	345.06
12.	Dec	250.00	275.32	295.40	316.76	
Average per month		207.17	248.26	249.66	279.61	319.12

Source : National Accounts Statistics – 2012,CSO, GOI

Dairy cooperatives at Allahabad, Tamilnadu, Gujarat and Uttarpradesh have made some progress in organizing the dairy cooperatives during 1950's. The state level federations have been formed in the states of Punjab, Haryana, Rajasthan, Uttar pradesh, Bihar, West Bengal, Tamilnadu, Andhra Pradesh, Maharashtra and Gujarat.

In a long period of 10 years (1980) Operation Flood-1 could reach 9,199 villages or 3.21 percent as a matter of fact, artificial insemination facilities, which are supposed to increase milk production, were made available in 2,991 villages only out of 9,199 villages. Barring two states of Gujarat (covering 1,202 villages) and Tamilnadu (covering 1,440 villages), these facilities were extended only to 349 villages in the remaining 8 states of the country. It is a clear negligence.

In addition to Small Farmers Development Agency (SFDA), Marginal Tribal Development Agency (MTDA), and Integrated Rural Development Scheme (IRDS), which have a special task of providing incentives to the lending agencies and the co-operative credit structure have provided medium term loans for purchase of milk cattle.

Table 9 shows that the growth of dairy cooperative societies in terms of numbers over 2 ½ decades i.e. from 1980-81 onwards. It is very clear from the table that the growth of dairy industry under cooperative sector is much impressive because the number of societies established from year to year is (innumerable) significant.

The National Co-operative Development Corporation (NCDC) in liaison with the NDDB, IDC and Union Ministry of Agriculture and Irrigation, of late, started playing a significant role in the development of dairy industry through co-operatives for the purpose of organization of medium and small-sized dairy processing plants and milk chilling centres.

Many states like Andhra Pradesh, Karnataka, Maharashtra, Punjab, Uttar Pradesh, West Bengal and Rajasthan have already taken financial help from the NCDC for establishing milk processing plants on co-operative lines. The NCDC is providing training facilities and the dairy cooperatives were expected to take full advantage of this.

Table 9: Establishment of Dairy co-operative Societies in India

Year	Dairy cooperative societies (in numbers)
1980-81	13284
1990-91	63415
2001-02	100558
2002-03	103281
2003-04	108574
2004-05	113152
2005-06	117152
2006-07	116001

Production of milk

The share of dairying in the livestock sector is about 65 percent. This indicates the significant role of dairying in our country. The contribution of agriculture to GDP is less than 2 percent during the past one decade, where as the contribution of live stock sector to GDP has consistently shown a higher growth rate of between 4 and 5 percent.

India has occupied number one position in the world in the production of milk. This can be substanted in terms of physical units and the value of 97.1 million tones in 2005-06 to 121.8 million tones in 2010-11.

The major source of agriculture of income in India is from the production of milk. However in India 52 percent of milk is produced by buffaloes 45 percent by cows and only 3 percent of the milk is contributed by other species like goat, sheep and the like.

India contributes about 16% to the annual world milk production, the annual growth rate has been recorded as 3.9 percent between 1995-1996 and 2005-06.

India had the privilege to operate the most popular project 'operation flood' which has brought a remarkable multi-dimensional progress. The entire credit goes to the NDDB in particular and to the Central, State Governments, ICAR, dairies, R &D organizations and to the milk producers in general in the words of Dr. V. Kurien, Chairman, NDDB, Anand and the father of white revolution 'the dairy industry has now came of age' and India is now reckoned as a progressive dairy country in the world.

The country has now achieved self reliance in milk production and is geared for substantial export of value added products beyond its sea shores. It has not only conserved the valuable foreign exchange by almost eliminating the need for the import of milk and milk products, but also built up export to African and Middle East Countries.

Regional Disparities in the production of milk

Almost 80% of the milk produce in India is coming from 10 states viz., Uttar Pradesh, Punjab, Madhya Pradesh, Rajasthan, Andhra Pradesh, Tamil Nadu, Bihar, Maharashtra, Gujarat and Haryana. Milk production in these states is concentrated in about 140 districts. The Regional imbalances were handled by moving milk from surplus areas to deficit areas a National Milk Grid (NMG)

has been created by the National Dairy Development Board (NDDB) to meet the requirements of milk in the deficit towns and cities.

Herd size and season wise milk production in India

The milk producers have been classified on the basis of their hard sizes into 3 categories viz. small, medium and large. A small herd size is with one animal; medium size's with 2 or 3 animals while a large size has 4 or more animals.

It could be noticed from the table 10 that the small herd sizes house holds produce 5.14 litres of cow milk and 4.5 litres of buffalo milk per day per animal during the lean season. In the flush season the same producer produces 6.30 litres of cow milk and 6 litres of buffalo milk. This indicates an increase of 22.6 percent in the production of cow milk in the flush season over the lean season.

Table 10: Herd size and milk production during the lean and flush seasons in India

(Milk production in ltrs)

Herd size	Lean season		Flush season		Percentage of increase in milk production	
	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo
Small	5.14	4.50	6.30	6.00	22.60	33.30
Medium	5.10	2.60	6.00	3.30	17.60	27.00
Large	4.33	2.60	4.72	3.20	9.0	10.30
Average	4.86	3.30	5.67	4.17	16.67	26.26

Source: M. Siva Subramanian Indian Dairy man.

The cow milk production among the medium herd sized house holds is 5.10 litres per day per animal during lean season, and 6.00 litres during flush season, showing an increase of 17.6 percent from one season to another. The buffalo milk production among medium herd size house holds is 2.6 litres per day per animal in lean season and 3.30 litres in flush season recording an increase of 27 percent from one season to another. The relationship between the herd size and yield is inversely proportion to each other. The cow milk production by house holds with large herd size house holds is 4.33 litres in lean season and 4.72 litres in flush season, showing an increase of 9.00 percent from one season to another. The buffalo milk production households having large herd is 2.60 litres in the lean season and 3.20 litres in the flush seasons, showing an increase of 10.30 percent, 33.3 percent in the production of buffalo milk. If the herd sizes is small the yield is more proportionality and vice versa.

Table 11 Year wise milk production and per capital availability in India over a period i.e. from 1991-92 to 2010-11.

Table 11: Year wise milk production and per capital availability in India

Year	Production (in million tons)	Growth rate interms of percentage	Per capita availability gms/day	Growth rate interms of percentage
1991-92	55.7	-	178	-
1992-93	58.0	4.12	182	2.24
1993-94	60.6	4.48	188	3.30
1994-95	63.8	5.28	191	1.60
1995-96	66.2	3.76	197	3.14
1996-97	69.1	4.38	202	2.53
1997-98	72.1	4.34	207	2.41
1998-99	75.4	4.57	213	2.89
1999-2000	78.3	3.84	217	1.88
2000-01	80.6	2.93	220	1.38
2001-02	84.4	4.71	225	2.27
2002-03	86.2	2.13	230	2.22
2003-04	88.1	2.20	231	0.43
2004-05	92.5	4.99	233	0.87
2005-06	97.1	4.97	241	3.43
2006-07	102.6	5.66	251	4.15
2007-08	107.9	5.17	260	3.59
2008-09	112.2	3.99	266	2.31
2009-10	116.4	3.74	273	2.63
2010-11	121.8	4.64	281	1.10
Average Growth rate		4.21		2.34

Source : NDDB annual report 2011-12 Annexure – V

It is clear that the table 11 that the production of milk and per capita availability in India has increased progressively. But the growth in terms of percentage in both the cases is fluctuating and is not impressive.

Table 12 shows top 10 milk producing states in the country.

Table 12: Top 10 milk producing states in India by 2010-11

Rank	State	Milk production in 1000 tons	Percentages to total
1.	Uttar Pradesh	21031	21.16
2.	Rajasthan	13234	13.32
3.	Andhra Pradesh	11203	11.27
4.	Punjab	9423	9.48
5.	Gujarat	9321	9.38
6.	Maharashra	8044	8.09
7.	Madhya Pradesh	7514	7.56
8.	Tamil Nadu	6831	6.87
9.	Bihar	6517	6.56
10.	Haryana	6267	6.31
		99385	100

Source: Internet

Table 13: State / year wise per capita milk (Gms/day) availability in India over a period from 1991-92 to 2010-11

Last updated : Feb 29,2012																				
Per Capita Availability of Milk by States (gms / day)																				
State	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
All India	178	182	188	191	197	202	207	213	217	220	225	230	231	233	241	251	260	266	273	281
Andhra Pradesh	120	124	148	163	162	169	167	185	192	194	209	231	238	250	260	268	298	316	342	364
Arunachal Pradesh	22	64	62	64	119	115	109	119	119	102	105	112	109	114	113	114	73	55	59	63
Assam	77	78	78	79	95	79	78	79	71	69	70	71	71	72	72	71	70	70	69	71
Bihar	100	98	96	95	101	100	98	121	119	80	88	92	100	147	154	163	170	172	175	184
Goa	65	68	73	72	73	72	71	88	92	89	91	91	93	110	105	104	102	99	96	93
Gujarat	236	245	249	277	229	289	290	290	297	280	317	321	330	344	349	372	385	402	418	435
Haryana	586	597	605	625	618	617	630	623	631	614	645	647	643	631	628	624	621	644	662	679
Himachal Pradesh	313	314	330	324	329	316	314	347	349	335	341	339	337	378	373	393	420	424	397	446
Jammu & Kashmir	204	321	261	210	276	302	345	353	362	348	367	365	363	364	353	348	372	378	379	378
Karnataka	149	154	160	173	185	191	216	233	241	233	249	229	190	194	197	199	203	215	226	237
Kerala	167	174	181	190	198	199	204	221	227	219	234	203	173	169	171	174	183	197	201	210
Madhya Pradesh	197	196	195	199	199	192	194	262	261	211	240	236	233	233	262	260	264	271	278	287
Maharashtra	136	138	140	156	163	161	161	168	168	162	172	172	172	176	178	181	184	188	190	197
Manipur	122	119	118	88	80	75	74	87	88	81	86	85	85	90	92	91	91	90	88	88
Meghalaya	76	77	77	77	83	74	73	76	76	74	78	78	78	81	82	81	83	83	83	83
Mizoram	31	34	32	32	31	29	53	65	57	42	43	45	44	46	43	46	47	47	29	31
Nagaland	96	95	93	91	88	86	82	69	69	69	78	78	83	90	96	86	58	67	96	93
Orissa	43	46	47	47	49	54	53	58	66	64	69	68	71	92	95	100	113	110	112	113
Punjab	722	739	776	797	847	823	861	883	902	854	892	895	898	917	943	957	956	955	944	937
Rajasthan	275	276	292	280	294	322	348	356	367	353	376	368	371	376	387	449	486	501	509	538
Sikkim	194	191	186	192	204	190	188	186	185	173	187	222	231	221	232	231	195	194	200	194
Tamil Nadu	164	167	168	175	180	183	185	199	210	211	219	198	198	204	231	263	272	274	278	278
Tripura	31	33	33	35	35	36	45	69	69	64	77	66	68	70	70	71	72	74	77	80
Uttar Pradesh	199	204	207	209	216	215	221	238	243	223	241	245	250	254	262	267	274	278	283	289
West Bengal	120	118	119	123	130	123	123	125	123	116	120	120	120	124	126	127	129	131	133	137
A&N Islands	227	219	223	215	173	170	169	179	184	165	177	195	183	165	135	148	146	154	137	142
Chandigarh	141	147	145	142	143	148	147	139	134	129	131	127	127	115	116	112	106	101	95	87
Dadra & Nagar Hawali	59	196	129	144	87	89	86	106	13	97	100	97	95	45	53	50	94	91	86	83
Daman & Diu	0	25	26	25	25	16	17	26	144	17	17	17	16	10	11	12	15	15	15	14
Delhi	65	65	67	66	69	61	59	61	60	56	58	57	56	54	54	48	73	72	72	72
Lakshadweep	55	55	50	53	54	107	97	72	47	88	90	87	43	45	64	79	79	84	84	71
Pondicherry	90	89	103	98	90	44	43	109	106	102	104	101	107	108	108	110	108	101	96	94
Chattisgarh								-	-	100	105	103	102	103	103	102	103	106	110	117
Uttaranchal								-	-	323	344	339	365	364	361	357	354	351	387	383
Jharkhand								-	-	90	96	94	92	127	126	130	132	132	130	136

Source: Various issues of BAHS, Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, GOI.

It is clear from the table 12 that Uttar Pradesh occupies number one position in the country. Andhra Pradesh occupied third position after Rajasthan and the last position occupied by the state of Haryana.

Table 13 shows state / year wise per capital milk (gms/day) availability in India. It is clearly understood from the table that all India growth in terms of per capital availability of milk over a period of time is steady and most impressive.

In Karnataka, Kerala, Orissa and Punjab, the growth of per capita availability of milk is steady from 1991-92 to 2010-11. In otherwords, in other states, except the states stated above, the per capital availability of milk is fluctuating during the period 1991-92 to 2010-11.

Utilization pattern of milk in India

Table 14 shows the milk utilization pattern in India. The entire milk that is produced in the country has been utilized properly in various forms. 46 percent of the milk is utilized in the liquid form where as 54 percent of the milk is used in the form of milk products (both western / traditional milk products).

Table 14: Milk utilization pattern in India

Year	1943*	1956	2004
Milk production (million tons)	23.5	17.8	92
Milk utilization (percentage)	100%	100%	100%
Liquid milk	28%	39.2%	46%
Traditional products	72%	60.8%	50%
Ghee / Makhan (classified butter)	58.7%	46%	33%
Dahi (yogurt-like)	5.2%	8.8%	7%
Khoya (Partially desiccated milk)	5%	4.4%	7%
Chhana and paneer (unprocessed cottage cheese)	3.1%	1.6%	3%
Western products milk powder etc	Neg	Neg	4%
* includes Pakistan and Bangladesh			

Source : Handbook on technology of India milk products.

Table 15 depicts the milk consumption by urban and rural households. It is understood from the table that the household demand for milk products and the level of expenditure of both urban and rural house holds.

Table 15: Milk consumption by urban and rural house holds

Expenditure category	Urban			Rural		
	Monthly expenses (Rs.)	Percentage of household	Percentage of milk consumption	Monthly expenses (Rs.)	Percentage of household	Percentage of milk consumption
Bottom	0-425	13.21	3.34	0-300	14.21	2.16
Lower middle	425-665	24.91	13.18	300-420	24.34	9.98
Upper middle	665-1120	31.91	30.95	420-615	30.36	26.05
Top	Above 1,120	29.98	52.53	Above 615	31.09	61.80

Source: National sample survey organization (NSSO), CSO, GOI

Launching of operation flood project in India

The Government of India with the technical and financial assistance of NDDB and IDC. Commissioned the five year operation flood – I project, the brain child of padmabhushan Dr.Verghese Kurient on July 1, 1970. The operation flood-I was later extended by another 6 years upto March 1981. This was the largest project of its kind in the third world.

Operation flood aimed at setting up of modern dairy industry to meet India's rapidly increasing need for milk and milk products and making it capable of self-sustaining growth. The project took up the huge task of upgrading and modernizing production, processing and marketing of milk with the assistance provided by the World Food Programme (WFP). The aim was to create a "Food" of rurally produced milk (White revolution), assuring the farmer a remunerative price and ready market, and the urban consumer with wholesome milk at stable and reasonable prices.

Operation Flood – I (1970-81)

Operation Flood – I was launched in 1970 following an agreement with the WFP, which undertook to provide as aid 1,26,000 tons of Skim Milk Powder (SMP) and 42,000 tons of Butter oil (BO) for financing the programme.

The main thrust was to link up dairy co-operatives to the four metro cities viz. Mumbai, Kolkata, Delhi and Chennai, creating a commanding milk market. The overall objective of operation Flood-I was to lay the foundation of a modern dairy industry in India, which would adequately meet the country's need for milk and milk products.

By the end of operation Flood-I about 13,300 Dairy Co-operatives (DCs) and 39 milk sheds were organized enrolling 18 lakh farmer members. It achieved a peak milk procurement of 34 lakh litres per day and marketing of 28 lakh litres per day.

Operation Flood- II (1981-85)

Operation flood – II was designed to build on the foundation already laid by Operation Flood – I. The programme was approved for implementation during the 6th plan period,

with an outlay of Rs. 273 Crores. And about US $ 150 millions were provided by the World Bank and the balance was provided in the form of commodity assistance by the European Economic Community (EEC). The achievements under this programme are given in the table 16.

Operation Flood –III (1985-96)

The third phase was aimed at the consolidation of the gains of earlier phases. The main focus of the proramme was on achieving financial viability of the whole set up on 'Anand Pattern'. The Operation Flood – III programme was funded by the World Bank with US $ 365 millions, Rs. 22.6 Crores of Food-Aid (75,000 tons of milk powder and 75,000 tons of butter / butter oil) given by the European Economic Community and Rs. 207.7 Crores by National Dairy Development Board (NDDB). The programme covered some 170 milk sheds of the country by organizing 70,000 primary duty co-operative societies.

Table 16 shows the dairy development under operation flood programmes in India. All the developmental parameters like number of milk sheds, number of DCCS, number of farmer members, milk procurement, procuring capacity of the dairies, marketing of milk, number of Artificial Insemination centers, cattle feed capacity and the like have shown and impressive growth during the operation flood programmes in India.

Operation Flood – II helped to market the milk in about 148 cities and towns, covering a total population of 15 million through a National Milk Grid (NMG) linking them to 136 rural milk sheds. The project expanded the number of village Co-operative societies to 34,500, covering 36-lakh farmer members. The peak milk procurement increased to a level of 79 lakhs litres per day and milk marketing to 50 lakh litres per day.

Growth of Milk Co-operatives consequent to Operation Flood Programmes

Consequent on the launching of Operation Flood Programmes, there has been a spectacular progress in the number of co-operative societies, number of milk

Table 16: Dairy Development under Operation Flood Programmes in India

Parameters	Phase -I		Phase-II	Phase -III			
	1971	1981	1985	1990	1994	1995	1996
Number of milksheds	5	39	136	170	170	170	170
Number of DCS ('000)	1.6	13.3	34.5	60.8	67.32	69.0	72.74
Numbers of farmers members (in lakhs)	2.8	17.5	36.3	70.0	86.9	90.0	93.14
Average Milk Procurement (1 kgpd)	5.2	25.6	57.8	8.1	11.45	102	109.42
Peak Milk Procurement (1 kgpd)	6.5	34.0	79.0	120.0	130.0	116.0	140.0
Processing capacity							
Rural dairies (11pd)	6.8	35.9	87.8	140.3	167.5	172.0	193.7
Metro dairies(1 kgpd)	10.0	29.0	35.0	37.9	38.8	52.30	72.40
Milk marketing							
Metro dairies (1 kgpd)	N.A	21.8	29.5	30.6	32.34	35.0	38.0
Other cities and towns (1 kgpd)	0.9	6.1	20.6	41.9	53.90	59.0	61.38
Total marketing	N.A.	27.9	50.1	72.5	86.24	94.0	99.38
Milk drying capacity (t/d)	N.A	261.0	507.5	663.0	831.5	842.0	974.0
Milk powder production ('000 tons/year)	22.4	76.5	102.0	165.0	185.0	195.0	195.0
Technical inputs							
Number of AI centers('000)	N.A	4.9	7,5	10.9	15.12	16.28	16.50
Number of AIDone (in lakhs)	N.A	8.2	13.3	30.1	-	37.9	39.5
Cattle feed capacity ('000 tons /Day)	N.A	1.7	3.3	4.3	4.7	4.9	5.0
Investment Rs. Crores	N.A	116.54	277.17	411.59	690.6	896.21	1303.1

Note 1. Includes production by co-operative and other dairies.
2. 1 kgpd (lakh litres per day)
3. IIpd (lakh litres per day)
4. tpd (tons per day)

Sources: Gupta P.R. 1997.

producers and in milk procurement. The progress of co-operatives can be seen in table 16.

Table 17 shows the growth of DCS, member producers and annual milk procurement from Operation Flood I to III.

Table 17: Growth of DCS and procurement of milk during operation flood programmes in India

Year	Number of Dairy Co-operative Societies (DCS)	Member Producers (in'000)	Annual Milk Procurement (in '000 tons)
Operation Flood- I			
1970-71	1,588	278	189.8
1975-76	4,533	566	419.7
1980-81	13,270	1,747	934.4
Operation Flood-II			
1981-82	18,422	2,124	1,014.7
1982-83	23,496	2,620	1,613.3
1983-84	28,614	3,116	1,901.6
1984-85	34,523	3,632	2,109.7
Operation Flood-III			
1985-86	42,692	4,484	2,876.2
1986-87	49,077	5,097	2,865.2
1987-88	54,525	5,666	2,810.5
1988-89	5,883	6,250	2,909.0
1989-90	60,825	7,003	3,582.1
1990-91	63,415	7,482	3,541.3
1991-92	64,057	7,945	3,428.0
1992-93	65,469	8,371	3,856.8
1993-94	67,247	8,667	4,054.6
1994-95	69,600	9,000	3,723.0
Compound growth 1980-95	**11.48**	**12.40**	**10.00**
t- value	**8.58**	**14.55**	**7.88**
C.V	**39.22**	**43.51**	**35.70**

Source : Dairy India year book – 1997

During the Operation Flood – I period the number of milk co-operatives skyrocketed from 1,588 to 13,270 between 1970-71 and 1980-81. The number of member producers rose from 278 thousand in 1970-71 to 1,747 thousand in 1980-81 and the annual milk procurement rose from 189.8 thousand tones 1970-71 to 934.4 thousand tones in 1980-81.

During Operation Flood – II period (1981-82 to 1984-85) the milk co-operatives have nearly doubled from 18,422 in 1981-82 to 34,523 in 1984-85. Similarly, the annual milk procurement also doubled from 1,015 thousand tones in 1981-82 to 2110 thousand tones in 1984-85 even though the growth in number of milk producers was not that much during the period. During Operation Flood III period (1985-86 to 1994-95) the number of milk co-operatives has increased by more than 50% while the number of milk producers rose by more than 100% from 4,484 thousand in 1985-86 to 9,600 thousands in 1994-95.

National Dairy Development Board (NDDB)

The Ministry of food and agriculture established the NDDB in September 1965 with its headquarters at Anand. It is an autonomous body with the task of helping to set up milk producers' co-operatives on the Anand Pattern in all the milk sheds of the country.

The Board's programmes and activities were sought to strengthen the functioning of Dairy Co-operatives by providing them financial assistance and technical expertise, ensuring a better future for Indian farmers. NDDB employs over 700 people across 4 regions and 12 states and supports over 100 million farmers everyday through their district co-operative milk unions and state co-operative dairy federations.

Table 18: Year Wise Key Physical Targets During Operation Flood Programme - III

Item	Achievements as on March 1985 (by the End of VI Plan)	1985-86	1986-87	1987-88	1988-89	1989-9C
Number of Anand Patter DCS	34,525	36,000	41,000	46,000	49,000	50,000
Number of Anand Pattern DCS under AI	7,543	11,000	15,000	18,000	22,000	25,000
Milk Animals under co-op. Ambit (lakhs)	54.46	77.99	96.22	116.21	134.52	152.80
Milk procurement build-up (lakh lpd):Average	57.84	65.70	77.60	91.40	102.20	122.20
Peak	78.98	98.60	116.40	137.10	153.30	183.30
Urban milk marketing (lakh lpd)	50.11	53.55	63.72	78.50	96.50	124.20
Build- up of dairy capacity (Lakh lpd)	87.75	105.40	140.00	160.00	180.00	200.00

*Indicates the number of Dairy Co-operative (DCS) only for the milk sheds where operation flood implementation has been initiated / planed.

Sources: Gupta, PR., Operational flood., 1997.

Over the years, brands created by co-operatives have become synonymous with quality and value. Brands like AMUL (GCMMF), Vijaya (Andhra Pradesh), Verka (Punjab), Saras (Rajasthan), Nandini (Karnataka), Milma (Kerala) and Gokul (Kolhapur) are among those that have earned customer confidence.

Some of the major Dairy Co-operative Federations include:

1. Andhra Pradesh Dairy Development Co-operative Federation Ltd (APDDCF)
2. Bihar State Co-operative Milk Producers' Federation Ltd (COMPFED)
3. Gujarat Co-operative Milk Marketing Federation Ltd (GCMMF)
4. Haryana Dairy Development Co-operative Federation Ltd. (HDDCF)
5. Himachal Pradesh State Co-operative Milk Producers Federation Ltd (HPSCMPF)
6. Karnataka Co-operative Milk Producers' Federation Ltd (KMF)
7. Kerala State Co-operative Milk Marketing Federation Ltd (KCMMF)
8. Madhya Pradesh State Co-operative Dairy Federation Ltd (MPCDF)
9. Maharashtra Rajya Sahakari Maryadit Dudh Mahasangh (Mahasangh)
10. Orissa State Co-operative Milk Producers' Federation Ltd (OMFED)
11. Pradeshik Co-operative Dairy Federation Ltd (UP) (PCDF)
12. Punjab State Co-operative Milk Producers' Federation Ltd (MILKFED)
13. Rajasthan Co-operative Dairy Federation Ltd (RCDF)
14. Tamilnadu Co-operative Milk Producers' Federation Ltd (TCMPF)
15. West Bengal Co-operative Milk Producers' Federation Ltd. (WBCMPF)

The 30 years commitment of NDDB has been rewarded with achievements by co-operative dairies in milk production, employment generation, and per capita availability of milk, foreign exchange savings and increased farmer incomes. To ensure accelerated growth and better business performance wherever necessary, NDDB will render financial and technical assistance for setting up "New Generation Co-operatives".

During 2004-05, NDDB continued its institution building programmes by supporting more women milk producers in leadership roles. The organization aims at speeding up the overall development in milk production, processing and marketing. Firstly, it advises the state and central Governments on all matters concerning dairy development. Secondly it provides technical services and undertakes feasibility studies and offers consultancy for the erection of the plant and commencement of operation. Thirdly, it offers manpower development services by undertaking training programmes. Fourthly, it designs and manufactures dairy equipment with foreign collaboration Lastly, it acts as international laison.

The NDDB has a Research and Development wing at its complex in Anand. A new product was designed to provide cheap milk to the poor to make tea called "Chai Saathi". According to Dr.B.K.Chakravarthy, a survey in Baroda revealed that 90 percent of the milk is bought by the poor, 25 percent by the rich and 50 percent by the middle class groups only to make tea.

The NDDB managed Semen Stations produced 14 million semen doses. NDDB continued to assist dairy co-operatives with design and implementation of effective breeding, technical assistance, processing infrastructure, and feeding and health care programmes.

Role of NDDB in Indian Dairy

Through wide scale co-operative structure of dairying on 'Anand Pattern' in 22 states, the country with a membership of about 13 million milk producers in 1,25,000 milk co-operatives, has built up modern dairy sector responsible to meet the needs of rural milk producers as well as urban consumers with assured quality and reasonable price of milk and milk products by bringing new dynamism in the consumer market.

Consumers can now have a wide range of dairy products of different brands and also wide choices of flavors, packing and supply outlets. All dairy products available in the country are indigenously produced from Indian milk. All this has happened due to producers' productivity with the link up of technical management in co-operatives.

On milk marketing front, with wide network of co-operatives, they have increased supply of milk to urban centers with competitive spirit and that has helped to contain the rising price of milk. Now almost a commanding share of milk consumed in four metropolitan cities, and major cities comes from co-operatives due to comfortable quality and price.

Co-operative Milk. Marketing-National Dairy Development Board

Emphasis was placed on improved microbial quality of milk, distribution efficiency, and expanded coverage. NDDB continued to provide financial help to milk unions to strengthen marketing operations. NDDB launched www.milkmagic.com, a website that educates children, teenagers and housewives on the benefits of milk products, highlighting the co-operatives commitment to quality.

National Dairy Development Board, in addition to re-scheduling the loan repayments, assists the union in the preparation of its rehabilitation plan. Of 24 milk unions where the rehabilitation scheme is operational, eight have met their physical and financial targets; six have shown significant improvement but three are yet to achieve planned physical and financial targets; seven unions have shown only limited improvement. Rehabilitation activities have just begun in the 1-3 remaining three unions.

Rural milk procurement

Small farmers and landless labourers usually maintain 1 to 3 milk animals. Wide spread production of small quantities of milk makes the task of milk collection difficult. For organizing an efficient milk procurement system, the focus should be on good microbiological quality of raw milk. The farmers should know the way to safeguard milk against post-secretion contamination underall conditions. For continuous monitoring of milk quality at the farm, facilities like mobile kits, rapid microbiological testing must be available at farmer's door step. On the quality monitoring front, notable steps have been taken by the co-operative dairy sector under the NDDB.

For a systematic approach to rural milk collection, the first phase is to undertake extensive surveys in the milkshed area where a dairy plant is to be established. Availability of milk at various collection points is ascertained, based on the number of animals, future potential of milk availability, and the presence of competitors. The second phase involves "route planning" taking into milk availability, road access to collection points and their distance from the dairy plant. The third phase calls for planning the location of primary collection and chilling centres.

In India the following 4 systems of milk procurement are popular.

Directly from individual procedures

The producers bring milk directly to the dairy plant. This practice generally suits the large producers located near the processing plants.

Through contractors

The traditional middleman (contractor) acts as interface between the dairy plant and small milk producers. He operates cans and tankers for transportation of milk from rural areas to dairy plants. In this system the milk processor has little control on the equality of milk procured by the contractor.

Through co-operatives

A cooperative society collects milk twice a day and is tested and paid based on quality. The society supplies milk to its own district cooperative dairy plant. It transports milk to a chilling centre if possible. Societies also provides technical input services such as artificial insemination, veterinary aid, cattle feed and counseling to enhance milk production.

Through chilling centres

If the dairy plant is far away from the collection centre, then the collected milk is first brought to a centralized chilling center. Here milk is cooled to 4°c and stored in insulated storage tanks of 5,000-20,000 litre capacity. Subsequently, the chilled milk is transported once a day to the dairy plant.

Processing of milk and marketing system

The milk collection, storage, powder manufacturing, distribution system shift out of the main building so as to reduce the floor area of the main building and these activities would be conducted outdoor. Water being the key component in milk processing and due to its scarcity, several methods would come into use to reduce its use. The Soya products are already competing with the milk products. However, due to inherent strength potential of the milk products, it is maintaining itself.

The food market, in India, is growing at the rate of 15 percent per annum owing to the faster growth of urban population. Taking the population of India as 1,100 million, its urban segment constitutes about 340 millions. The

Indian market system consists of three major segments; subsistence level, basic level and premium level. While the subsistence level struggles for basic food like cereals and pulses and the like. The basic level looks for food which includes essential dairy foods and items like fish, meat, poultry products, and the like, growing at the subsistence level is growing at 14 percent, basic level 100 percent and premium level 150 percent. As income rise, food consumption patterns will change and the focus on greater protein intake and quality branded products will be more.

Only a small portion of the world milk production is traded internationally each year. Major trade items are bulk butter, cheese, milk powder and condensed milk. Indian dairying has several competitive advantages over others like large quantity of buffalo milk, strong, procurement infrastructure, large man power and the like. At the same time, it also suffers from several impediments like : low productivity per animal, seasonal imbalances, scattered production, quality aspects and the like.

Domestic Consumption and trade

Most of the demand supply gaps of liquid milk requirements for urban consumers earlier were met by importing milk powder. But with the onset of operation food programme, there was a total change resulting in stoppage of imports. Agricultural and Processed Food Products Export Development Authority (APEDA) regulated the exports and imports of dairy products till early 1990's. according to new EXIM policy, the Union Government has allowed free import and export of most of the dairy products. The major destinations for Indian dairy products are Bangladesh, UAE, US and Philippines.

Future prospects of Dairy industry

The dairy sectors was delicensed in 1991, as part of the economic reforms. These reforms opened up the industry to private entrepreneurs (including multinationals as the foreign companies were allowed to raise their equity holdings up to 51 percent). The basic philosophy underlying de-licensing was to encourage the competition in procurement and marketing of milk, thus enhancing value for both producers and consumers.

As private enterprises began operating, they were accused of poaching into co-operative territory. Moreover, the misconduct of private traders prompted need for some control over the market. Consequently, the government of India promulgated the Milk and Milk Products Orders (MMPO) in June 1992.

MMPO prescribed certain provisions for the orderly development of the dairy industry. Its key feature is that all plants handling milk quantity between 10,000 and 75,000 litres per day or producing milk products of the quantity between 500 and 3,750 tons per annum are required to be registered with state authorities, while those processing over 75,000 litres per day or more than 3,750 tons of milk solids per annum require registration with the central government.

This would lead the country to achieve a common goal of higher milk production and productivity, greater efficiency in milk handling, processing and marketing and an increased quantity and quality or milk to the public at reasonable prices.

Private Dairy – Consumers satisfaction

Satisfaction implies consistently getting his money's worth. Adherence to regulatory quality standards will ensure consumer's confidence and satisfaction or otherwise, survival becomes a problem. Again, with increasing awareness, consumers always ask for what they need and expect the processor to supply tailor-made produce to meet their demands satisfactorily.

Each milk product factory has to set up a quality assessment and control lab under ISO-9000 to assure the acceptable standard quality of milk products to gain consumer's confidence, to enhance product image and, thereby, its international competitiveness.

It is necessary to exercise a uniform strategy for quality control through a well-structured institutional network. Ideally, quality control should being at the production stage itself. However, setting up of high standards at the very beginning might result in the rejection of too great a volume of milk supplies. Hence, premium price has to be paid for richer milk that conformed to the quality standards over and above the minimum prescribed standards.

The organized dairy sector (both co-operative and private) has a common potential opponent, the innumerable small milk vendors, which not only supply un-hygienic and adulterated milk but also add adulterants to preserve the freshness of milk, which affects the quality of end products of milk as well. A major part of marketable surplus milk is still handled by them throughout the length and breadth of the country.

These vendors are the most formidable threat to the organized sector, which should be encountered by bringing

more and more milk into the organized sector; at the same time, consumers are to be educated about the dangers of un-hygenic and adulterated milk. The traditional traders who share more than 70 percent market should be in the long run, replaced. The product cost has to be controlled by minimizing the overheads. Again on the export front, strict quality control will have to be applied to every gram of dairy product exported from India. A single bad shipment can and will be used to tarnish the image of Indian dairy products.

Attractive packing should keep product fresh, without affecting quality for the full-length time. Product should be more than the money's worth. A single co-operative brand should be promoted to maintain the highest standard and quality of Indian products. Various options such as collaboration, sole selling agency agreements, forming subsidiary and joint venture companies would be available to co-operatives, but never at the cost of sacrificing interest of milk producers. However, producers-consumers interest can be inter-linked.

New markets for dairy industry should be constantly explored and tackled. India has yet to find out effective solutions to the sharp seasonal and cyclic fluctuations in milk production that make market for liquid milk a violate one. The Apex Agencies particularly will have to play a strong role in this direction.

Marketing

The dairy products are the largest selling and profitable segment after liquid milk and account for 50 percent of utilization. India's dairy market is multi-layered, shaped like a pyramid with the base made up of the vast market for low cost, liquid, raw milk. The narrow tip at the top is a small but affluent market for largely western-type and fresh packed dairy products.

The effective milk market is largely confirmed to about 285 million urban inhabitants. Over 50 percent of total milk production is consumed in urban population, which is projects to cross the 400 million mark by 2011. The expected rise in the purchasing power of growing urban population would give an added boost to the diary market. New emerging dairy markets will focus on Food service market, Defense market, ingredients market, and Parlor market.

In the new millennium, the Indian dairy industry is prepared to face new challenges and opportunities and this has given a thrust to the dairy industry to emerge as a full-fledged agro-business.

Marketing Strategies

Milk marketing involves packing, storage, transport and retailing of milk and milk products with quality to the satisfaction of consumers in the country. For export promotion, the industry has to gear up with dynamism and modernization to suit to the changing environment at the global level, by satisfying the international standards.

Factors favourable for milk marketing in India

India being a country with a huge population has over 300 million progressively affluent middle class consumers who always crave for diverse varieties of milk products with good purchasing power. In fact, the country is emerging as one of the largest and fastest growing consumer markets for milk and milk products in world Indian Diary industry sells different varieties of milk under co-operative sector. India has an export potential to reach greater heights in milk production and dairy development.

The traditional milk products occupy important position in the Indian dry industry in terms of consumer preference, being the largest market segment worth Rs. One lakh crore annually. The fluid milk continues to drive growth of organized sector of Indian dairy industry and is set to witness a dramatic change in market dynamics. Many companies such as Reliance, Bharathi, including MNC's in sectors such as retail and food processing, want to get into the milk business in India. Cola Majors, Coca-Cola and Pepsi, are keenly seeing the dairy business, especially with the increasing shift away from carbonated, soft drinks to healthier beverages.

Inspite of limited presence of organized sector in traditional products the organized sector has maintained its dominant position in this product category because of strong consumer preferences.

Availability of technologies to mechanize the process for large scale manufacture of traditional milk products is leading to convergence of two distinct segments of industry viz., Unorganised and Organized sector. The organized sector which remained restricted to fluid milk and western milk products, is fast gaining ground in traditional milk products.

Dairy Exports

It is a known fact than in most of the developed countries dairying activity is highly subsidized for taking up experts. Overall dairy exports constitute about less than one percent of total livestock products exported. Inspite of the fact that dairy production far exceeds the production and per capita availability of other animal products, the export of dairy products were of minor significance.

It has to be noted that much of the production goes to meet the heavily populated domestic market requirement which is a right trend. It also highlights the enormous scope lying ahead in dairying for export since South East Asia is dominated by India in dairying by its own characteristic production systems.

Milk and milk products constitute a major share in the value of output from the live stock sector accounting for about 67 percent. India was primarily an import dependent country for dairy products until 60. However, with the establishment of National Dairy Development Board (NDDB) and implementation of operation flood programme, the milk production in the country has increased from 22 million tons in 1970-71 to 121.8 million tons in 2010-11.

India has not entered the international market for the dairy products. The exports made during 2004-2005 and 2005-06 are 48,427 million tons valued at Rs. 389 crores, and 59,746 million tons valued at 500 crores respectively. Most of the developed countries provide heavy producer subsidies to increase their exports, which creates unhealthy competition in the domestic market of the importing countries. Table 19 shows the India's major export destinations of dairy products.

Table 19 is self explanatory that the major importer of Indian dairy products is United Arab Emirates followed by Nepal and Singapore.

Table 19: Dairy products India's major export destinations

Quantity In M.T. Tons
Value Million $

Country	2010-11		2011-12	
	Qty	Value million US $	Qty	Value million US $
United Arab Emirates	5,84,5.35	20.80	4036.08	19.53
Nepal	3058.70	9.68	12002.66	7.31
Singapore	2560.66	4.32	3062.65	5.42
Oman	748.00	2.98	872.52	3.71
Egypt Arab, Republic	3647.35	14.58	807.34	3.41
Australia	738.77	2.23	758.92	3.27
Saudi Arabia	1079.61	3.45	465.70	2.42
United States	354.45	2.35	524.79	2.32
Qatar	433.17	1.65	455.21	2.22
Kuwait	533.02	2.29	408.26	1.97

Source : DGCIS

The government does not finance product specific farm or export subsidies for dairy sector. To promote the dairy sector the Government of India has kept all dairy products exempted from excise duty in order to augment processing. The government has reduced customs duty on food processing machinery from 7.5 percent to 5 percent. The rates of Value Added Tax (VAT) currently applicable to dairy products are 4 percent for skim milk powder and 12.5 percent for other products such as butter, condensed milk and the like. Fresh milk and pasteurized milk are exempted from VAT.

Fast change in socio-economic environment will drive the requirements for traditional diary products to be processed and packaged in new forms projects domestic demand for major traditional products is 30,00,000 tons. Prospects for the export of traditional milk products confronting to the international quality and packaging standards present exciting opportunities for orchestrating further growth. Some 20 million Indians are living abroad and belong to upper income group it is a lucrative for the traditional dairy products.

Problems of Dairy Industry

Indian Dairy Industry have many challenges to face, among them the important are

i. Indian dairy sector comprises mainly of farmers with small land holding and low productivity milch animals.

ii. There are many milk producers clustered within villages, away from the urban consumption centres. The real challenge is to organize and weave a net work making the system work as an industry.

iii. Every small milk producer is dependent upon the dairy income, default in payment foils his family budget.

iv. Milch animal, an asset of the dairy farmer, is under continuous threat from local and infectious diseases causing morality and morbidity, poor farmers are unable to afford such calamities.

v. Lack of infrastructure facilities hinders the growth of the rural dairy farmers.

vi. In rural milk markets, there are many producers but only a few buyers, resulting in distress sales due to lack of proper marketing facility.

vii. In the Era of globalization and liberalization, those who produce quality items at cheaper cost gain market world–wide access. Though we produce milk

cost effectively, suffer from non-tariff barriers in international trade under Sanitary And Phytosanitary Measures Agreement (SPMA). The stringent food safety standards are beyond the reach of Indian Dairy industry.

Conclusion

Major Chunck of rural unemployed is diverted to the dairy industry to uplift themselves by generating additional income through dairying. The origin of dairy industry could be traced back to the end of 19th century. The milk production in the country has reached the level of 121.8 million tons. Dairy co-operatives presently handling 12% of countries marketable milk surplus. But in future they have to face a lot of competition from the private sector dairies. India has occupied number one position in the world in the production of milk. The production of milk and the per capita availability in India have increased progressively.

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What farmers gain most of all from the increase in agricultural productivity, of course, is choice.

—Jacqueline Novogratz

Focus

Identification of Success Factors for Business Incubation in Agribusiness for Achieving Higher Productivity

S.C. BOSE AND RAVI KIRAN

The present study identifies and assesses the key success factors for a business incubator involved in the area of agribusiness. The main objective of such BIs is to encourage entrepreneurship in the field of agribusiness so as to increase the productivity and profitability of the agriculture sector. With the help of exhaustive literature review, a model of feasible options for business incubator has been developed. The designed model is giving three feasible operation viz. Create, Maintain and Enhance. This model will help the business incubators to understand the stage they are operating and accordingly they can initiate the steps required to move over to the next stage of growth. It is expected that any business incubator can assess their current status and can formulate strategies which can help them to survive successfully.

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The agricultural sector continues to play a vital role in the Indian economy. As it is blessed with rich and diverse agriculture zone, vast fertile land for cultivation (about 160 million hectares), huge number of people involved in agriculture (about 2/3 of the population) and wide variety of crops grow. In spite of food grain surplus, thousands of poor suffers from malnutrition followed by death. Large numbers of farmers are poor and inept in spite of having reasonable marketable surplus. India has more than 100 million small farmers with an average farm size of less than 1.2 hectares.

Agriculture, in most developing economics including India, is providing livelihood to a large percentage of the population. Increasing the productive capacity of agriculture through higher productivity has been an important goal in developing countries (Mathur, Das, Sircar, 2006). It has been suggested that there is a need to increase yields to their technically highest levels through appropriate investment in basic infrastructure, human development and research and extension service (Chavas, 2006, Zepeda, 2006). In the last four decade the agricultural production has grown at 2.7% p.a. At least 5% p.a. growth rate is required to feed the growing population and fruitfully participate in the world trade.

In India, where subsistence agriculture is dominating practice, the agribusiness sector is small dealing mainly with limited volume of marketed food surplus. To increase the productivity and profitability of agriculture sector, the agribusiness sector needs to be expanded. The future growth and prosperity of India heavily depends on the future status of Indian agriculture and agri-business. Productivity

of agri-business is vital for economic development. To increase productivity of Indian Agriculture and competitiveness of our agri-business technology, innovation and entrepreneurship requires encouragement. Environment that facilitates technological innovation and enhancing entrepreneurship is the need of the hour. Business incubation program support diversity economics, commercialize technologies, create jobs and build wealth. In fact BIs encourages entrepreneurship. According to the National Business Incubation Association (NBIA, 2000), business incubators help entrepreneurs translate their ideas into workable and sustainable businesses by guiding them from the beginning to being able to achieve a growing and thriving business.

Business Incubators

Business incubators guide starting enterprises through their growth process and as such constitute a strong instrument to promote innovation and entrepreneurship. Business incubators provide entrepreneurs with a supportive environment to help establish and develop their projects. In other words " Business incubators are those organizations which supports newly formed business firm in their early phase when the risk of failure is very high and helps them to become "successful".(Stephanie, 2006).

The American National Business Incubation Association (NBIA) describes business incubation as a dynamic process of business enterprise development. It is an interactive development process where the aim is to encourage people to start their own business and to support start-up companies in the development of innovative products. A true incubator should offer services such as hand-on management, access to finance (mainly through links with seed capital finds or business angels), legal advice, operational know how and access to new market in addition to office space and common facilities (Aernoudt, 2004). Therefore, the concept of "incubator" is often used as an overall denomination for organizations that constitute or create a supportive environment that is conductive to the "hatching" and development of new firms (Chan and Lau, 2005).

According to Rudy Aernoudt (2002) the main goal of a business incubator is to produce successful firms that will leave the incubator financially viable and free standing within a reasonable time. Therefore a good incubator should do all those things which will enable newly formed business organization to grow and sustain outside the nurturing premises.

Any business incubator has certain relevant feature which includes:

- A well managed workplace providing shared facilities and conducive environment for tenant companies;
- Small and competent management team ;
- Advisory, training, marketing and financial services:
- Tenant companies

Types of business incubators

According to the National Incubation Association (NBIA) there are five basic classification of business incubation. According to this classification BIs could be in the category of:

- Mixed use
- Technology
- Manufacturing
- Service and
- Others.

The NBIA breakdown of incubation program (of these incubators the NBIA has researched) for these 5 types is the following:

- Mixed use – 47%
- Technology – 37%
- Manufacturing – 7%
- Service – 6%
- Other – 4% (NBIAs I)

Business incubations need a favorable eco-system for nurturing and growth of technology based entrepreneurship. In to successfully implementing innovative ideas technologist, entrepreneurs and venture capitalist should come together.

Goals of BIs

Any business incubator wants to achieve certain objectives:

- New venture creation: Produce successful firms which are financially viable and free standing.
- Job creation: To create new jobs for people living in those areas.

- Innovation and Technology Transfer: Incubation process is also used to develop innovation transfer technology and transport an entrepreneurial spirit (Mian, 1994 and 1997; Phillips, 2002; McAdan and McAdam, 2008; A1-Mubaraki, 2008)
- Interfacing and Networking: BIs helps in boosting the networking between SMEs, academic, R&D intuitions, industries and financial institutions.
- Economic Development: Incubators are used for enhancing regional economic development and establishing industry cluster (A1-Mubaraki, 2008)

Theoretical Framework:

BIs not only helps in establishing new ventures but also assist in survival of these ventures during early age when they are more vulnerable to failure. According to Ialkaka and Shaffer (1999) focused assistance to new firms increases their chance to survive, thus providing benefits to the entrepreneur, enterprise, community and to the state as well. According to Aernoudt (2004) the main goal of a business incubator is to produce successful firms that will leave the incubator financially viable and free standing within a reasonable time. He expanded on the concept and opined that a true incubator should offer hand-on management services, access to finance as well as legal advice, operational know how and access to new markets. Chan and Lau (2005) expressed that "incubator" is as an overall denomination for organizations that constitute or create a supportive environment for "hatching" and development of new firms. The goal of business incubator is to assist in the development of new entrepreneurial organization while they are in their initial phase (Stephanie, 2006). Adding the concept of Marketing Von Zedtwitz and Grimaldi (2006) portray incubators as those which help entrepreneur develop business and marketing. Kumar and Ravindran (2012) considered occupancy level, sustainability of the incubator, number of incubators in thousand sq. ft. and survival rate to gauge performance of the incubators. Sharma et al. (2011) highlighting the goal of agribusiness incubator, advocated that it specifically is related with developing and commercializing new products, technologies and services to improve productivity.

BI's have attracted the interest of a lot of researchers from all over the world. In India also it is gaining increased attention. The requirement of successful incubation is the matter of research for many scholars, each giving their own set of critical success factors. Based upon the above theoretical framework, the researchers identify the following are the critical success factors identified and established by different researchers.

i. The mission statement of the incubator should be clear and unambiguous
ii. Collaboration with a University
iii. Clear and transparent selection, entry and exit criteria
iv. Strong Networking as deliberate strategy
v. Keeping proper records and monitoring firms
vi. Services should be strategically selected
vii. Focus on services as opposed to infrastructure
viii. Strong, qualified and experienced manager

As shown through Author-BI Goal Matrix, the generally acceptable goals to many researchers are: BIs need to have a clear and unambiguous mission statement; need to strategically select services and have a Strong, qualified and experienced manager.

Agribusiness incubator can provide knowledge, experience, infrastructure means to rural produces and worker to become agribusiness entrepreneur. This can help in promoting modernization of primary production, industrialization, and marketing and development of rural areas. Agribusiness incubator develops a system which helps in identification, adaptation and commercialization of products from public and private agriculture research institution. The goal of agribusiness incubator is to develop and commercialize new products, technologies and services to improve productivity (Sharma et al. 2011)

This model of business incubation process was produced in October 2010 as the part of the World Bank info Dev (Information for development program) project on developing a policy framework and implementation strategy for BIs. This model categorized the whole process into three different sections. First as Preincubation i.e. before the potential entrepreneurs becomes a tenant. Second i.e. Incubation period (after selection) when a potential entrepreneur becomes a tenant and starts availing the facilities of the incubator. The third phase starts after graduation. During incubation period it considers the importance of Physical Space but limits its role. Intangible supports like training, financial support, business advice etc. are considered very vital and key to success. This model clearly states importance of different stages and emphasizes the role of networking between them in successful completion of business incubation process.

Table 1: Author-BI Goal Matrix

S No	Key Success Factors	Authors										
		Lalkaka and Rishop (1996)	Stephanie Pals (2006)	Akcomak (2009)	Hackett and Dilts (2008)	Totterman and Sten (2008)	Chan and lau (2005)	Allen and Rahman (1985)	Lalkaka (1986)	Knafp (2014)	Tamasay (2007)	A betti (2004)
1.	The mission statement of the incubator should be clear and unambiguous	√	√	√								
2	Collaboration with a University		√									
3	Clear and transparent selection, entry and exit criteria				√	√						
4	Strong Networking as deliberate strategy			√								
5	Keeping proper records and monitoring firms		√	√	√							√
6	Services should be strategically selected				√		√	√				
7	Focus on services as opposed to infrastructure			√								
8	Strong, qualified and experienced manager								√	√	√	

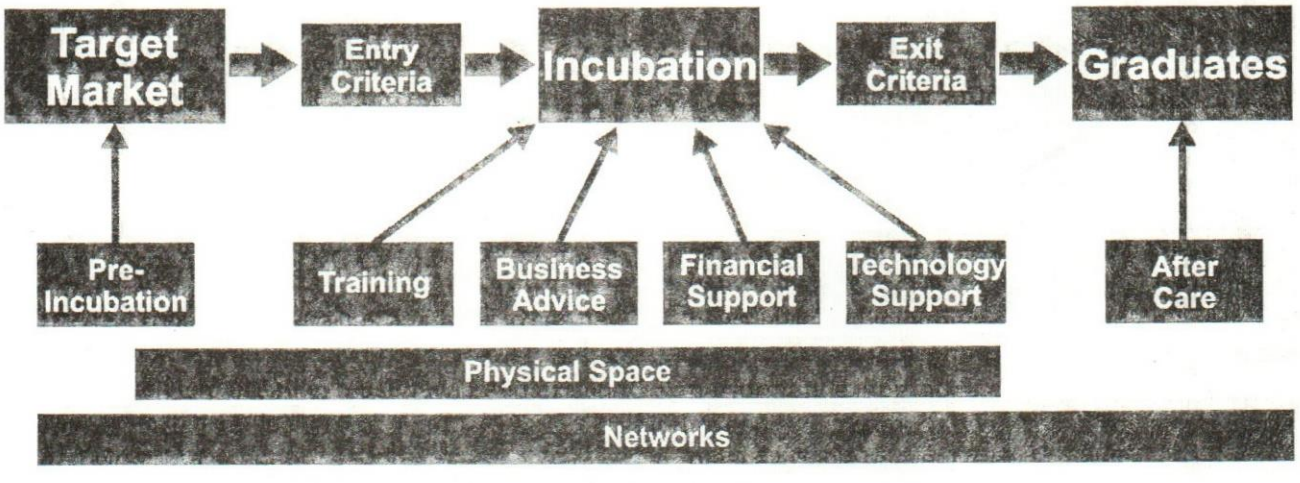

Figure: The Business Incubation Process

Success and failure of Business Incubation

Success and failure of Business incubation is dependents on three feasible operations:

Create:

i. A Strong, qualified and experienced team of managers
ii. ICT Technology Expertise
iii. Strong value chain
iv. Financial Resources
v. Marketing Team

Maintain

i. Strong ties with University
ii. Proper Monitoring of firms
iii. Financial Records
iv. Time Management
v. Corporate Governance & Transparency

Enhance

i. Networking
ii. Clear and transparent selection, entry and exit criteria: Tenant companies should give both an oral and written showcase of their company to the committee of whoever is making the decision within the particular business incubator.
iii. Competitor analysis.
iv. Strategic Selection of Services.
v. Training and Development.

Feasible Options of Business Incubation

1. Surviving and growing profitably If a BI is operating in two categories, i.e. Create, Maintain and Enhance —— Option 1
2. Surviving, growing, and on a path to productivity If a BI is operating in all three categories, i.e. Create, Maintain and Enhance —— Option 2
3. Surviving, but is not growing and is not profitable, or is only marginally profitable . Only operating in Create Category.
4. Operations were terminated while still in the business incubator, but losses were minimized. Not operational in enhance and maintain category.

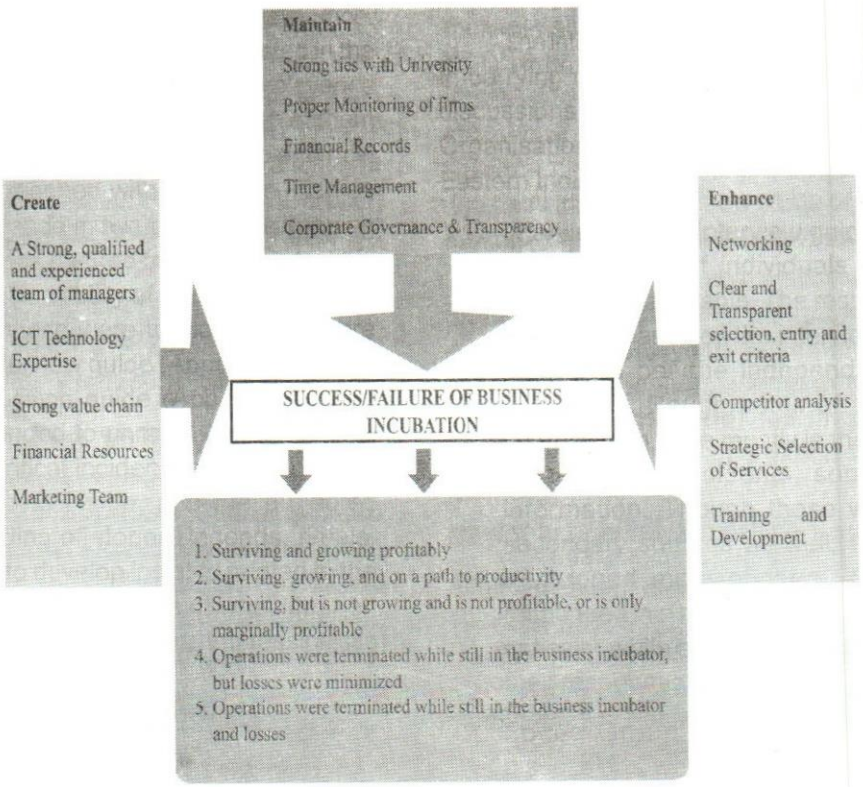

Figure 1: Feasible Options of Business Incubation

5. Operations were terminated while still in the business incubator and losses were large. Not operational in create, maintain & enhance category.

Conclusion

The study has tried to come out with key success and failure factors for business incubators and have designed a model depending upon the key success and failure factors. The designed model is giving three feasible operation viz. Create, Maintain and Enhance. This model will help the business incubators to understand the stage they are operating and accordingly they can initiate the steps required to move over to the next stage of growth.

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Agriculture, manufacturers, commerce and navigation, the four pillars of our prosperity, are the most thriving when left most free to individual enterprise.

— Thomas Jefferson

Focus

Dynamics of Resource Conservation under Watershed Approach: A State Level Analysis

RADHIKA RANI, CH , U. HEMANATHA KUMAR, AND S.S.P. SHARMA

Watershed development in rainfed agriculture is a policy response to the increasing environmental crisis and on sustainability of agriculture. Experience shows that the watershed development programmes brought out significant positive impact. However, studies reveal that sustainability of the investments undertaken by the different agencies has not been ensured. The involvement of hierarchy of administration and communities at the grassroots level in highly varying agro climatic and socioeconomic conditions invariably requires periodical assessment for achieving developmental objectives. The article is an attempt in this direction to assess the impact of watershed projects mainly on biophysical and socio economic conditions of watershed programmes across the states. Eight hundred and thirty seven watersheds have been assessed in nine states covering 121 districts. It is observed that community involvement in decision making, location specific structure, ensuring quality in structures corroborate each other to promote better soil and water conservation works. Institutional mechanism need to be established for sharing the resources generated through watershed for the impact to be visible and long lasting. Blanket budget allocations for unit area across different agro climatic regions also may not be feasible keeping in view of technical variations.

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Sustainable management of natural resources is the key for the progress of any developing country. The growing biotic pressure and overexploitation of natural resources are leading to the reduction in productivity levels and increase in poverty. It is estimated that for meeting the food demand of the growing population by 2025, an additional 2000 km^3 water will be required with the current practices of food production (falkenmark, 1986). Given the increasing pressures on water resources and the increasing demands for food and fibre, the world must succeed in producing more food with less water. Therefore, a conservation linked development of vital natural resources on a sustainable basis without impairing its productivity is the need of the hour. Watershed development in rainfed agriculture is a policy response to the increasing environmental crisis and on sustainability of agriculture. The programme has traversed through a fairly long way to its present status of a well-conceived integrated approach focusing on conservation and development of the three natural resources, i.e. land, water and vegetation (Shah, 2000).

The watershed development programmes involve the entire community and natural resources and influence so many factors such as productivity and production of crops, change in land use and cropping pattern, community participation, socio economic conditions of the people, development of institutions etc. It is a key to sustainable production of food , fodder, fuel wood and for meaningfully addressing the social, economical and cultural conditions of the rural community. The benefits of watershed programmes spread across both participating and non participating farmers. Experience shows that various watershed development programmes brought significant positive impact. There is an improvement in groundwater recharge (Kerr et al., 2000, kakade et al., 2001), increase in crop yields and substantial increase in cropped area

(Wanietal, 2002), rise in employment and reduction in migration of labour (Deshpande and Ratna Reddy et al., 1991). However, studies reveal that (Joshi et al., 2005) even though there are some visible gains from the various watershed development programmes, the sustainability of the investments undertaken by the different agencies has not been ensured mainly because of insufficient participation of the local communities. Time is an important element in NRM particularly watershed development projects where the investments on soil and moisture conservation works occur during one period and benefits occur during later period. Besides, the involvement of hierarchy of administration and communities at the grassroots level in highly varying agro climatic and socioeconomic conditions invariably requires periodical assessment for achieving developmental objectives. The paper is an attempt in this direction to assess the impact of watershed projects mainly on biophysical and socio economic conditions of watershed programmes across the states. The paper is part of the study[1] conducted by the NIRD during 2009-10.

Methodology

Watershed Development Projects (WDP) sanctioned by Department of Land Resources (DoLR), Ministry of Rural Development (MoRD) was taken up for the study. Eight hundred and thirty seven watersheds have been assessed in nine states covering 121 districts.These were sanctioned between April 1, 1998 and March 31, 2002.The states covered were AP, MP, HP, Tamilnadu, Orissa, UP, Karnataka, Jammu & Kashmir and Jharkhand.The watershed projects include DPAP DDP and IWDP watersheds.In each district, approximately six watersheds were selected.Selection of micro watersheds was done on a random basis, giving representation to different Project Implementing Agencies(PIAs) and geographical location with in the districts. The selection was done in discussion with DWDU in initial orientation visit. In each watershed 40 primary stakeholders were selected. The total sample size was therefore 33,480. About 1/3 rd of the beneficiaries was large holders while the rest are small holders. Information was obtained through Focus Group Discussions (FGD's) and household survey formats.The selected watersheds were sanctioned and initiated during different phases between 1998 to 2002. Therefore, there was no fixed base period. As there was no base line survey at the time of project initiation, the stakeholders were asked to recall the pre project status of their lands before the implementation of the project and compared with post watershed status. This qualitative assessment is the limitation of any watershed based study. The improvement was assessed in terms of percentage and accordingly the data was presented.

Impact of Watershed Programme

a) Biophysical Impact

The impact of watersheds on change on land use pattern, quality of water harvesting structures, groundwater status, soil erosion reduction, production systems, etc across different states is discussed here.

i) Change in Land use Pattern

The land use reflects the biophysical state of the earth's surface and immediate subsurface, embracing the soil

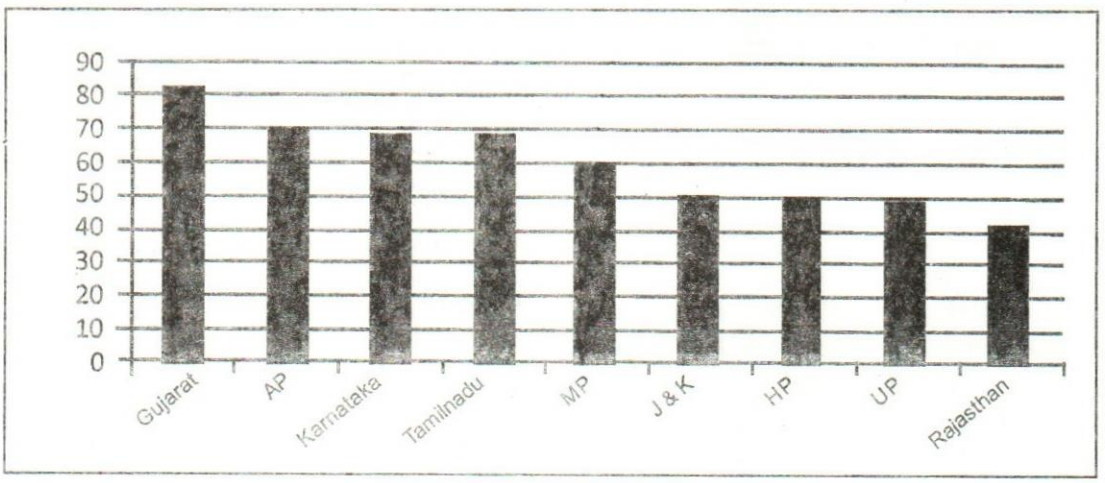

Figure 1: Change in Land use Pattern

[1]An Overview of Impact Assessment of Watershed Projects"(1998-2002)

material, vegetation, and water (Turner et al.1995). In the context of watersheds, land use pattern can be defined as taking up suitable interventions based on the slope percentage and soil type of the land. In principle, lands in ridge location need interventions such as plantation and afforestation, in the valley region agriculture related initiatives are required and in the middle region interventions like bushes and shrubs are needed. This will result in bringing down the extent of cultivable waste into cultivable. At the aggregate level the land use pattern was changed to the extent of 60.93 percent. Among the states, Gujarat scored high with 82.92 percent, followed by AP with 70.37 percent. It is observed that the projects in North Gujarat i.e the districts of Banaskhantha, Sabarkantha and Patan have a comparatively better performance. A strong agricultural community is visible in these watersheds. The state which scored least is UP with only 48.44 percent. Not only in this state, but in the districts of other states which have not performed well, more investment was observed in good class lands leaving marginal lands uncared.

ii) Quality of Water Harvesting Structure

The prime objective of any watershed programme is harvesting the run off water. Many structures of various types like check dam, nala bund, farm ponds, etc. needs to be constructed across the gullies of various orders. The impact of water harvesting structure in the post project scenario depends on the quality of the structure. The quality of the structure was defined based on various parameters such as community involvement in decision making, location specific (scope for percolation), use of locally available resources, existing resources such as wells, bore wells under the structure to recharge and users of the structure. Based on the above parameters Rajasthan and Gujarat fared better in terms of quality of structures with around 80 percent followed by Karnataka, AP and Tamil nadu with 79 percent, 70.56 percent and 69 percent respectively.The states which showed poor performance were UP and Jammu & Kashmir with around 44 percent respectively.

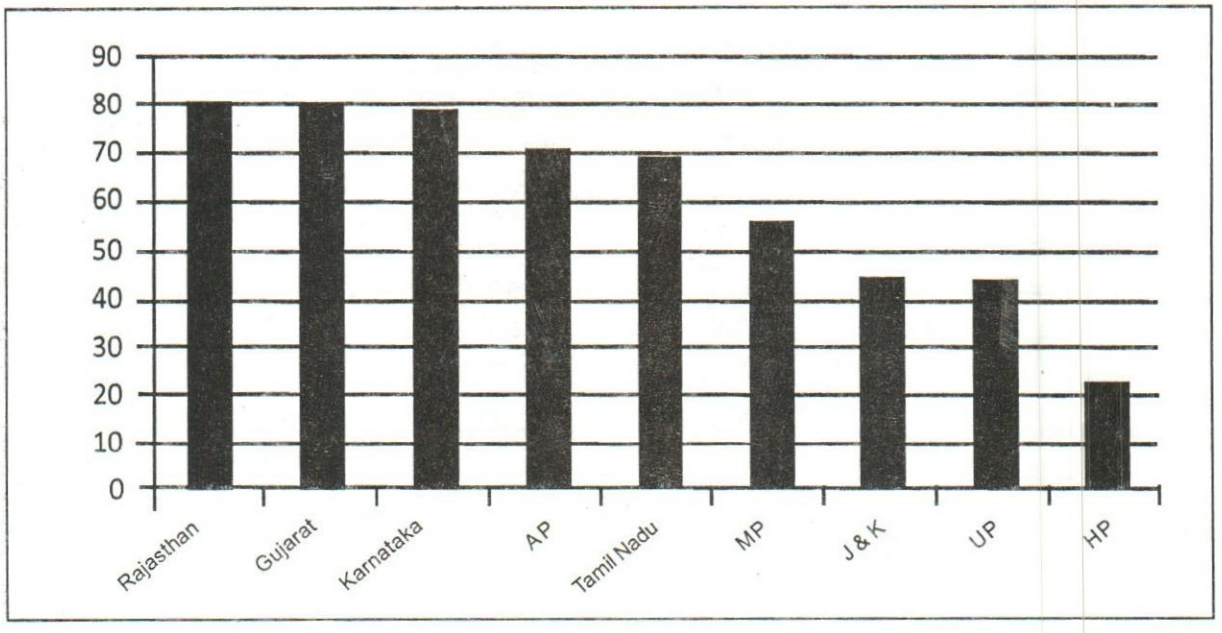

Figure 2 : Quality of WHS (%)

iii) Increase in Stream/Spring Flow Period (%)

The increase in stream flow happens only when there is sufficient rain, water is harvested adequately and also depends on the soil parameters. The increase in flow period was calculated based on the no. of days the water flows during different seasons in a year before and after watershed. The difference between before and after was converted into percentage of increase/ decrease. However, if there is drought for consecutively for two to three years, the impact of the water harvesting structures is not visible in the field. This was happened in case of UP which was in drought situation before the period of survey. The increase in spring flow was observed more in case of Gujarat and Karnataka with around 60 percent. UP, J&K and HP are the states which have witnessed a poor increase in stream flow compared to the other states.

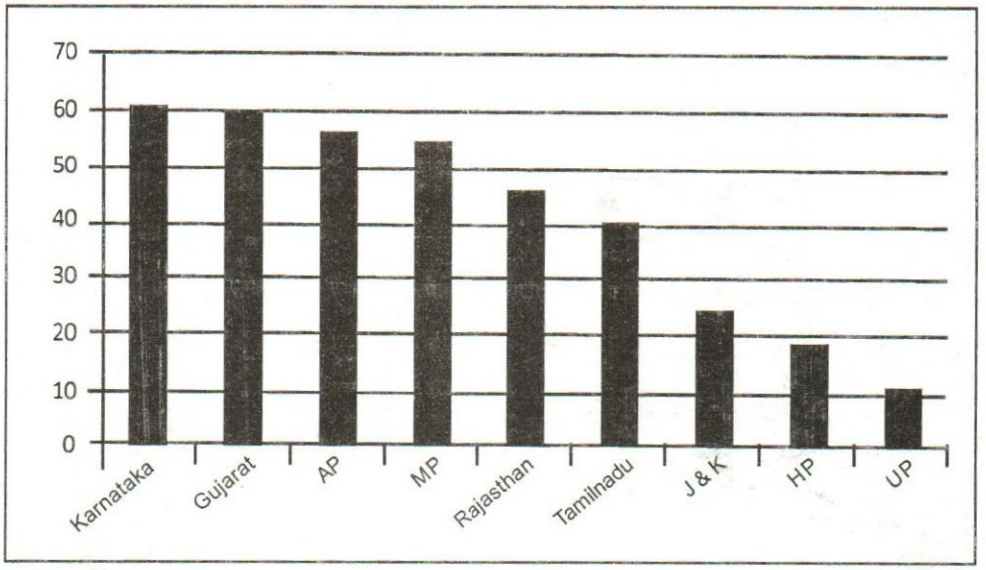

Figure 3: Increase in stream/spring flow period(%)

iv) Groundwater Increase

Groundwater is instrumental in managing risk and optimizing food production in the rainfed areas. An increase in the groundwater availability serves as an entry point for increasing agricultural production and improving rural livelihoods in watershed areas (Wani et al. 2003, 2009). The main contributors for the increase in groundwater are the water harvesting structures which stores water and allows sufficient time for water to percolate into the ground and also the land development activities such as contour bunding, land levelling and cultivation practices which helps in water percolation. Severe drought condition after the completion of watershed program was one of the major reason for poor performance in the state like UP. As there were no norms evolved to share the watershed benefits, several farmers have drilled new bore wells during and after the watershed program, which was another reason for the decrease in ground water level in UP. Whereas, the states like AP, Gujarat, and Karnataka have shown better performance in the increase in groundwater. Rajasthan, Tamilnadu and MP have shown moderate performance. In Rajasthan, better performance was observed in regions of moderate rainfall compared to the low rainfall regions. This is corroborated in other studies as well.(Despande and Reddy, 1991; Joshi, et. al, 2004; Reddy, 2005).

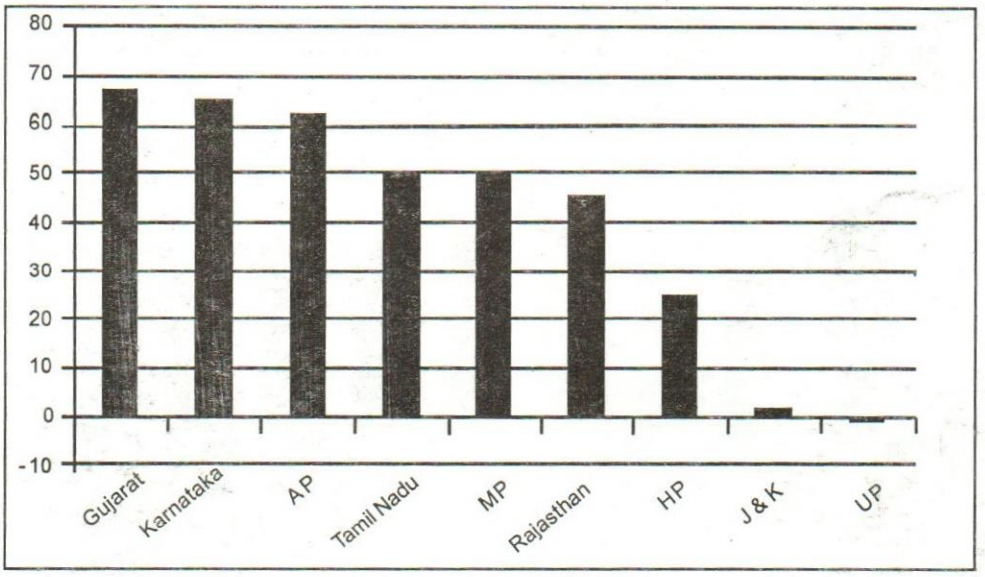

Figure 4: Groundwater Increase (%)

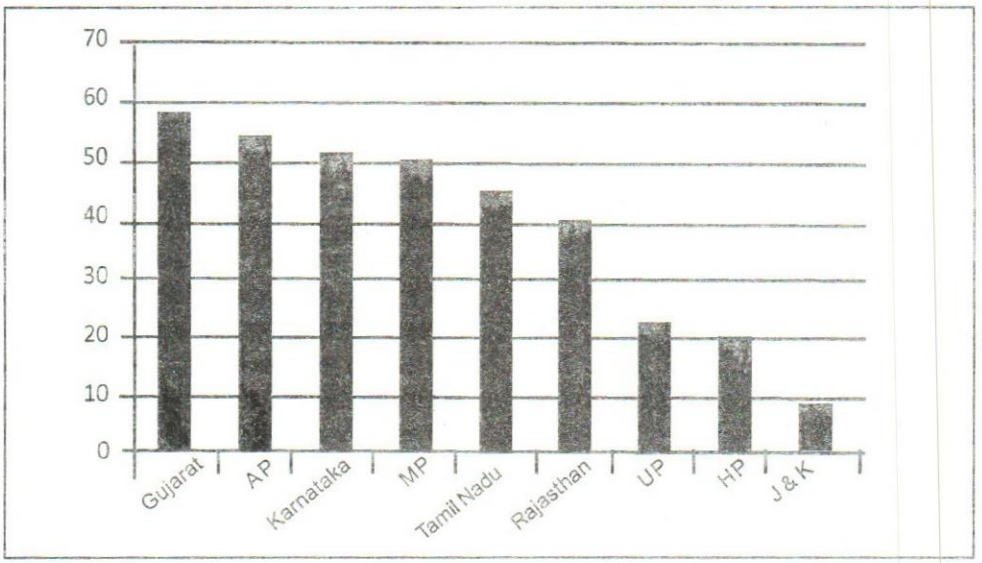

Figure 5: Surface water increase (%)

vi) Surface Water Increase

Increase in availability of surface water is another form of indicator for a successful watershed. The increase in availability of surface water helps for irrigation, drinking water for livestock, taking up short term fisheries activity and so on. When the run off water is arrested, there is a trend that the surface water will increase. This can be either in the constructed water harvesting structures or the traditional water bodies like ponds and tanks and also the springs. Among all the states, Gujarat fared better in terms of increase in surface water. Followed by Gujarat, AP and Karnataka have shown better performance with the increase in surface water to the extent of 53.41 percent and 50.44 percent. Not much impact was seen in the states J& K , UP and HP regarding the surface water increase.

Vii) Run off Reduction

Harvesting run off at a micro level for storage and recycling is necessary for better utilization of rainfall, control of erosion and providing life saving irrigation to crops during dry cycles. Run off reduction from the land is due to bunding, vegetative growth etc. In case of gullies it is due to construction of water harvesting structures. More the run off is reduced, the more can the water be harvested. The impact was assessed in terms of (i) no reduction (NIL)

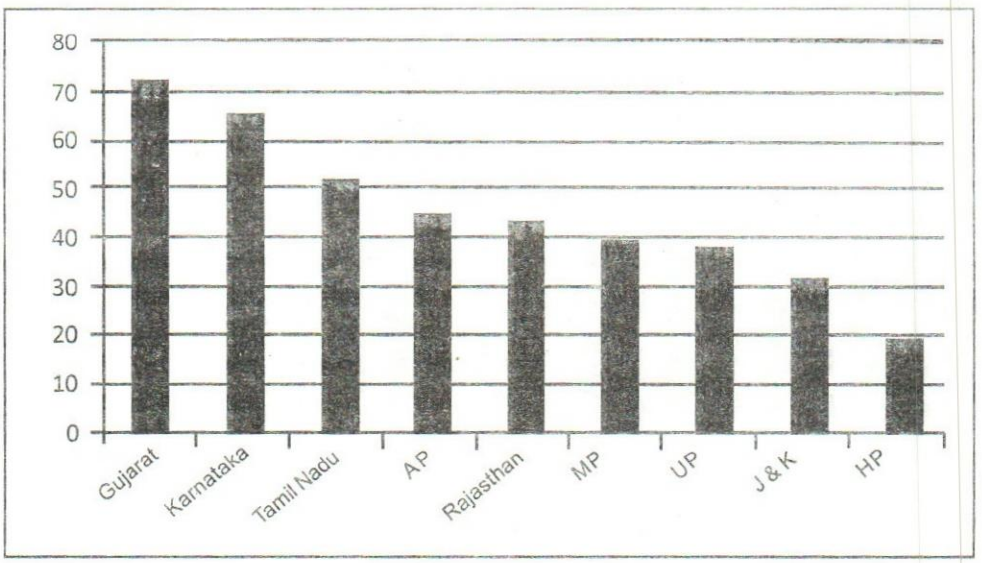

Figure 6: Run off Reduction (%)

and (ii) reduction to the extent of less than 40 percent, (iii) 40-80 percent and (iv) above 80 percent. It is observed that Gujarat have shown better performance in runoff reduction with 72.75 percent, followed by Karnataka with 65.78 percent. The states which showed poor performance in runoff reduction was HP with 19.33 percent. Rajasthan has shown moderate performance with 43.53 percent. In Rajasthan, the arid districts of Jaisalmer, Barmer and Bikaner reported less than 40 percent (including zero) reduction in runoff compared to the other districts. This indicates that arid climatic conditions are technically less responsive when compared to medium rainfall zones which arises the fundamental question of having common investment pattern for the watershed programme.

Viii) Soil Erosion Reduction

Checking soil erosion is one of the main objectives of the soil conservation technique. Most serious soil erosion problem in the country is in the form of sheet erosion which is a serious constraint particularly for red soils. Changes in soil erosion due to watershed development (WSD) is measured in terms of (i) increased erosion, (ii) no change and (iii) reduction in soil erosion to the extent of 25 percent; (iv) 25-50 percent and (v) above 50 percent. The best performing watersheds are those where soil erosion was reduced by more than 50 percent and the worst performing are the ones where there is an increase in soil erosion. The variation in the percentage of reduction basically depends on quality of soil and moisture conservation

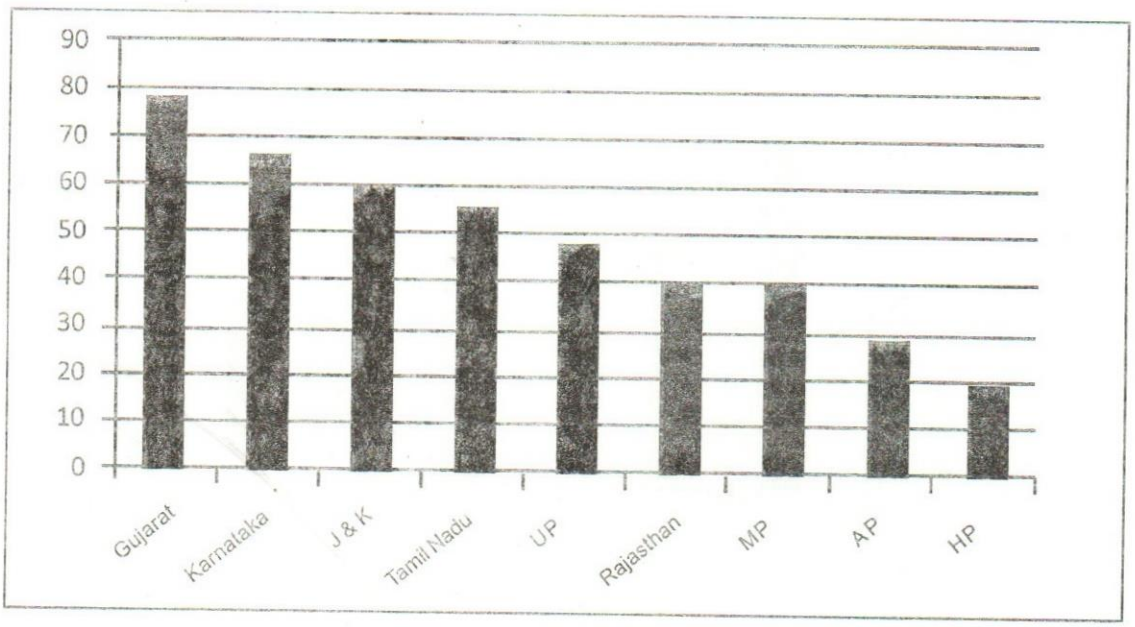

Figure 7: Soil Erosion Reduction (%)

activities and soil types. The reduction in soil erosion will trigger the improvement of productivity of the land. Among the states Gujarat fared better in terms of soil erosion reduction with 78.50 percent, followed by Karnataka with 66.20 and Jammu Kashmir with 60 percent respectively. IWDP programmes in J&K have fared better in terms of reduction in soil erosion. The performance was moderate in Rajasthan, MP and UP. Andhra Pradesh shown poor performance in terms of soil erosion reduction mainly due to some faulty methods selected for preventing so.

ix) Decrease in Waste Lands

Under Integrated Wasteland Development Program (IWDP) watershed programs were sanctioned to the villages where the extent of wasteland was more, with an intention to develop them on priority basis and convert into productive land. On the other hand Drought Prone Area Program (DPAP) aims at developing the wastelands to improve the overall productivity of the watershed area. The waste lands that were there before the watershed development programme, need to be put into cultivation after land development activities.

The decrease in waste lands was seen more in Karnataka with a decrease by 51.67 percent followed by AP with 48.74 percent and Gujarat with 42.50 percent. HP has fared moderately with a decrease by 36.30 percent. The performance was lowest in case of J&K with 2 percent followed by UP with 15.13 percent.

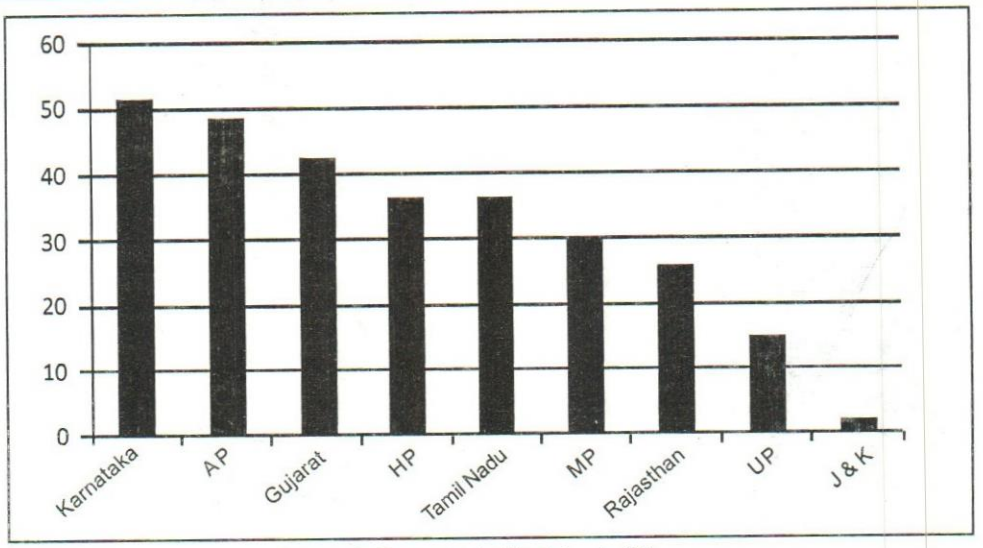

Figure 8: Decrease in Wastelands (%)

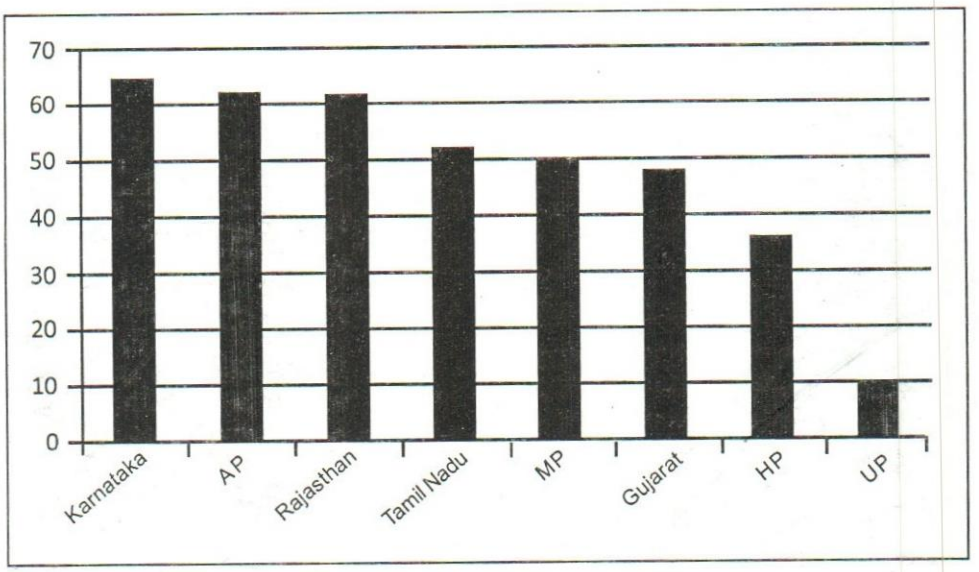

Figure 9: Increase in Vegetative Cover (%)

x) Increase in Vegetative Cover

Increase in vegetative cover is important not only in the context of improving soil and moisture conservation but also improving the land productivity. The vegetative cover has improved much in Karnataka state with 64.67 percent followed by AP with 62.16 and Rajasthan with 61.87 percent respectively. All the states except UP have fared better in terms of improvement in vegetative cover.

xi) Maintenance of Common Pool Resources (CPRs)

Common Pool Resources (CPRs) play an important role in the livelihoods of rain fed communities. Maintenance and management of CPRs also assumes an important role among these communities. CPRs mainly supplement the fodder and fuel wood needs of the communities. The health of the CPRs is often reflected in the vegetative cover. Among the different states, Karnataka performed well in terms of maintenance of CPR's with 43.38 percent followed by Rajasthan with 40.97 percent. The impact of vegetative cover is be translated into the impact on fodder, fuel wood and manure. It is heartening to note that fuel wood situation appears to be improved in the arid districts of Jaisalmer, Barmer, Jalore and Bikaner in Rajasthan when compared to other districts. High proportion of cultivable waste lands in districts of Jaisalmer and Bikaner is also another reason for this. Given that a large percentage of farmers depend on CPRs for their fuel wood requirements in most of the districts, especially arid, it is a clear sign of improvement in the conditions of CPRs. More than

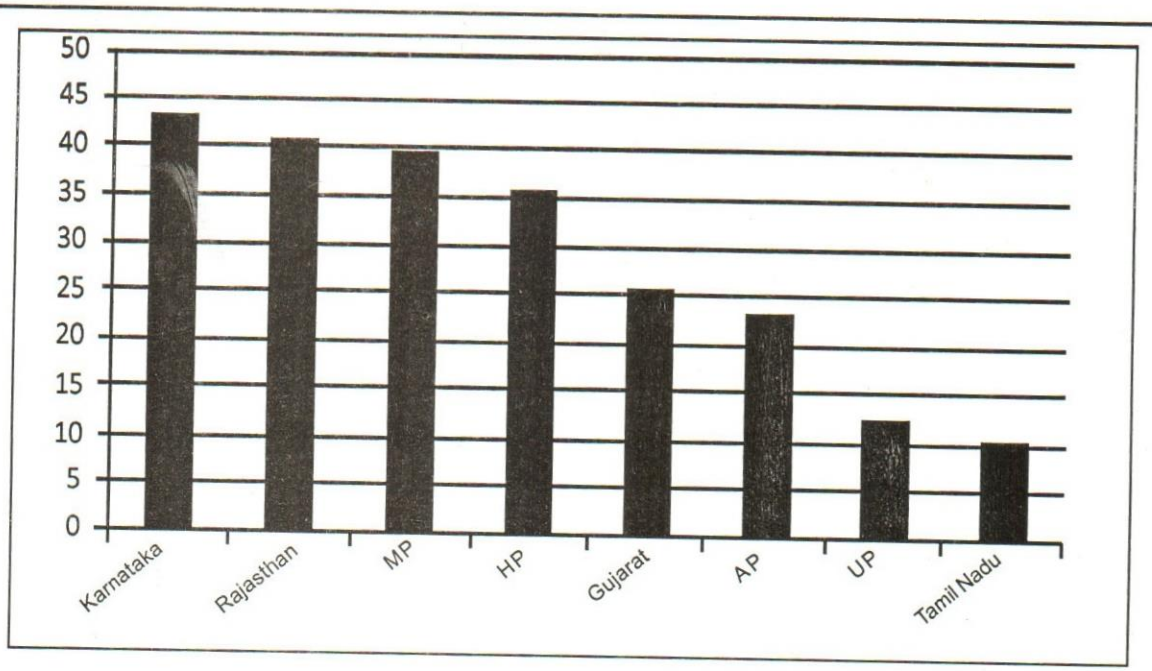

Figure 10: Maintenance of CPR's

75 percent of the farmers across all the districts in Rajasthan, Karnataka and Tamilnadu have reported adequate to excess availability of fodder.

B) Socio- Economic Impact

i)Community Based Organizations (%)

Community Based Organizations (CBO's) are widely recognized as the most importantactors of watershed management and are key players in scaling out and scaling up processes, which lead to involving more beneficiaries, in wider geographical areas, and in a quicker, more equitable, and long-lasting manner (Gonsalves, 2001).The CBO's within a watershed are user groups, self help groups, common interest groups, watershed committee, watershed association etc. As maintenance of CPR's is equally important in watersheds as that of private property, active people's participation through CBO's is, therefore, highly critical in the success of the watershed program (Kerr et al. 2002, Sreedevi et al. 2004; and Joshi et

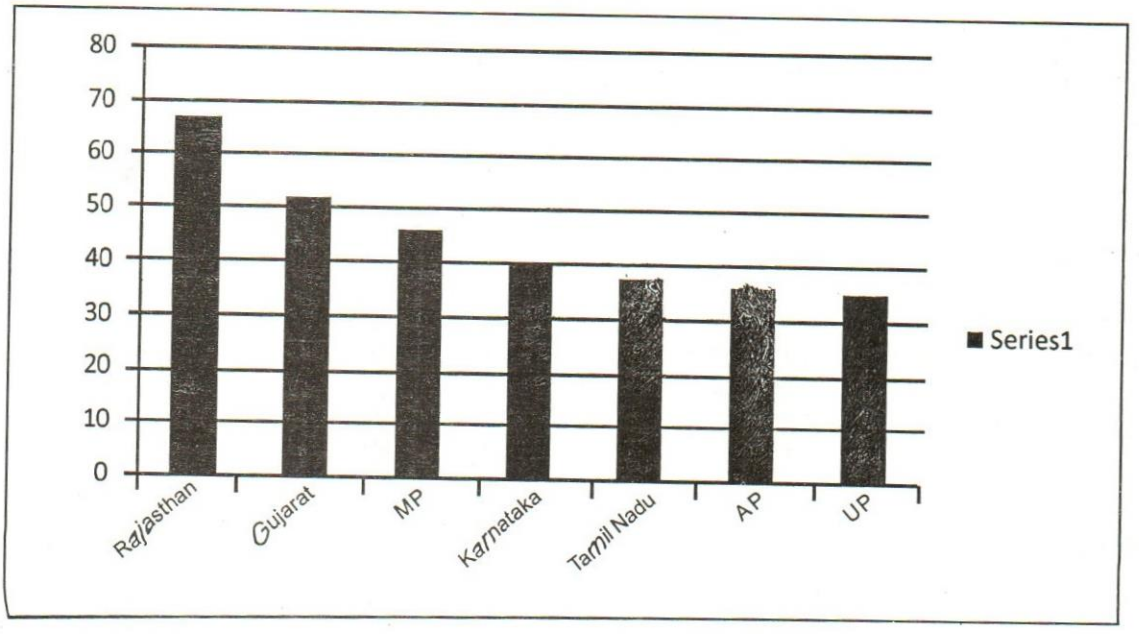

Figure 11: Increase in Functional CBO's(%)

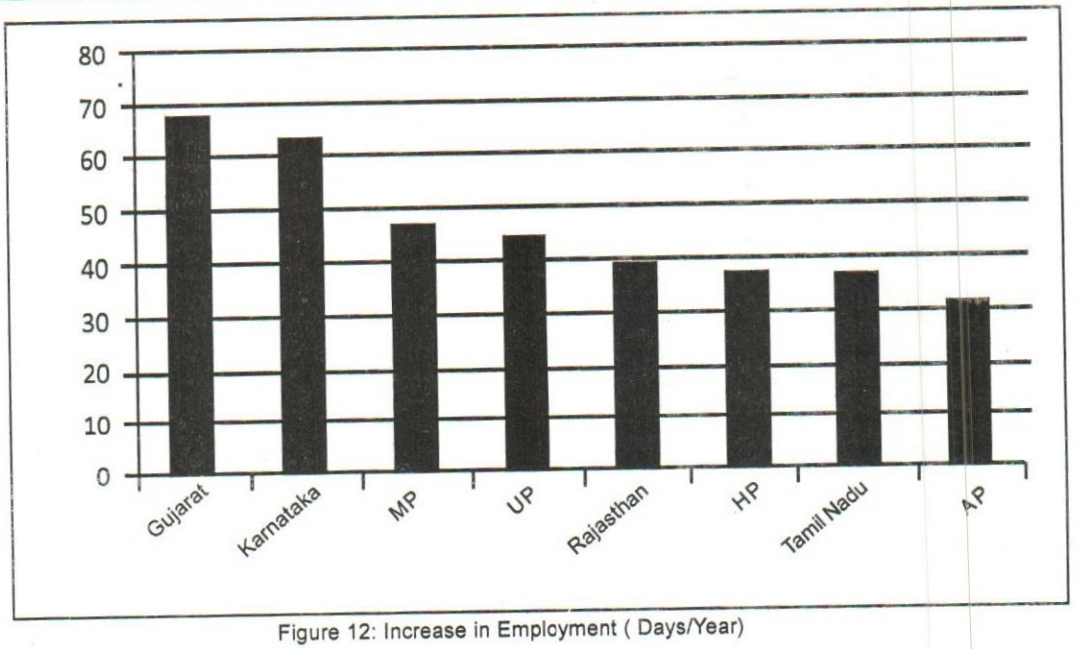

Figure 12: Increase in Employment (Days/Year)

al.2005).The results of this study also show that the impact among various indicators was more visible wherever, there were functional CBO's. The increase in percentage of number of functional CBO's in post project scenario was high in Rajasthan with 67 percent followed by Gujarat with 52 percent. The increase was moderate in other states ranging from 46 percent in MP to 35 percent in UP. Among these states, only J&k ranked poor in terms of increase in functional CBO's.

ii) Increase in Employment

Livelihood promotion is considered as one of the important outcome of a watershed project. Increase in employment as labor days in considered as a parameter for livelihood promotion.Though additional employment and debt reduction was reported, attributing the impact entirely to WSD could be difficult as the other employment programme such as MGNREGA was also operational in these areas. However, it could be assumed that wherever, biophysical impacts were visibly seen, in those areas, employment was also generated . It can be concluded that employment was generated in the range of 30 to 70 days among the watershed projects with Gujarat ranking high with 68 days and surprisingly AP ranking low with 32 days.

Conclusions

In the rainfed areas water scarcity and growing land degradation cannot be tackled through farm level interventions alone and community based management of natural resources for enhancing productivity and improving rural livelihoods are urgently needed(Wani et al., 2003, Rockstrom et al., 2009). An Integrated watershed Management Programme is therefore inevitable for natural resource conservation and their efficient use. Peoples participation is indispensable for the sustenance of any program. This is obvious from the above observations that community involvement in decision making, location specific structure, ensuring quality in structures corroborate each other to promote better soil and water conservation works. Institutional mechanism need to be established for sharing the resources generated through watershed for the impact to be visible and long lasting. Blanket budget allocations for unit area across different agroclimatic regions also may not be feasible keeping in view of technical variations. Despite development of CPR's in some of the project areas, there is no clarity about user rights which assume critical importance for the sustainability of the benefits. It is therefore, essential that a comprehensive policy is to be evolved at the national and the state level for devolving and decentralizing the governance and administration of natural resources with special focus on CPR's.

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Innovations that are guided by small holder farmers, adapted to local circumstances and sustainable for the economy and environment will be necessary to ensure food security in the future.

— Bill Gates

Feature

Studying Organisational Excellence Qualitatively

V.N. SRIVASTAVA

Lot of studies have been done and are done quantitatively, using acceptable quantitative techniques for carrying out social science research. The boundaries and parameters of quantitative analysis are well laid out. The qualitative methods for research have also evolved over a period of time to probe social realities; however, they are not as precise as quantitative techniques. Each piece of a scientific enquiry is addressed with some difference to bring out real realities and not dominate with projected and confessional tales. Studying excellence qualitatively has been exciting as it unearthed numerous aspects of realities, in a qualitative unquantified manner. This article takes through step by step methodology carried out for a qualitative exposition and also the rationale as to why it was done so. It discusses in details apart from introducing what was the research all about and moving from discussing the conceptual framework used in the study, to dependent and independent categories, the detailed methodology followed, including process of analyzing the data and the conclusions reached.

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The study of Organisational excellence has generally emphasized on both the symbolic aspects of excellence such as a company known for its leader, a company known for continuous high performance, a company regarded as an institution from which some learning could be acquired, a company on whom other companies in same line of operation look for attracting human resources, drawing upon their systems and processes and try to find out the strategic initiatives and also the attributes related to various Organisational processes. Studying in depth the phenomena underlying organizational excellence in public enterprises is done using a qualitative research methodology. In the study under reference, the researcher adopted a case study design using qualitative methods of research. It used an exploratory research design and the system, the process related to the groups and Organisations and the individual/person focused details has been studied using a qualitative research method and great insights obtained.

The Conceptual Framework

Bloomberg and Volpe (2008) point out that the conceptual framework plays an extremely central role in the research process, as well as in the final analysis. According to them, it is so central a concept in the dissertation and because its scope is far reaching, development of the conceptual framework requires careful, logical and thoughtful explication. Merriam (1998) argues that it affects every aspect of the study from determining how to frame the problem and purpose to how the data are collected. Miles and Huberman (1994) and Schram (2003) contend that without it there would be no way to make reasoned decisions in the research process. However, as Bloomberg and Vope argue, there does not appear to be a uniform and consistent definition and discussion of the conceptual

framework in literature. They also report—based on a review of qualitative research literature (Miles and Huberman, 1994, Merriam, 1998, Robson, 2002, Rossman and Rallis, 2003, Schram, 2003, Maxwell, 2005)—that writers who attempt to explain the notion of conceptual frameworks do not do so conclusively and offer only vague and confusing explanations.

The independent and dependent conceptual categories in the conceptual framework explain the relationships between various conceptual categories (powerful leadership, performance culture and Organisational excellence) more logically when categorized into dependent and independent categories. The present study is based on the conceptual framework given in Figure 1.

It can be seen from figure 1, there are distinctly two independent categories —powerful leadership and performance culture—and one dependent category — Organisational excellence. The sub-categories under both the dependent and independent categories used in the research study under reference is discussed below, including their operational definitions and some aspects addressed in the study based on the conceptual framework.

Dependent Category: Organisational Excellence

Organisational excellence is studied in its three distinct forms—excellence in continuous growth as evidenced by both organic and non-organic growth, excellence achieved in the Organisations' human resources, and HR systems

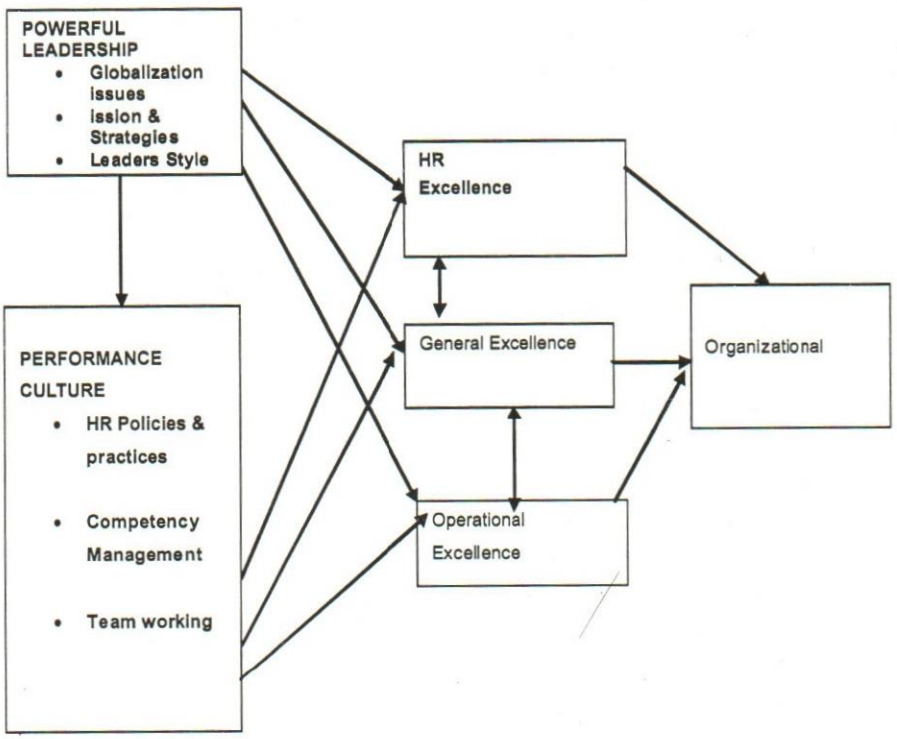

Figure 1: The Conceptual Framework

and excellence in operational and project parameters. The three sub-categories chosen are:

1. General Management Excellence: The degree to which there is a continuous organic and inorganic growth of the Organisation and the effectiveness with which the issues related to globalization, competitiveness, continuous growth, increased concerns for optimizing yields and outputs from better human asset and talent management, and continuous efforts to provide and develop leadership for driving change initiatives and programs for Organisational transformations in the sphere of general management.

2. Human Resource Management Excellence. The extent to which the human resource and HR systems have achieved excellence, as evidenced by better attrition control and employee engagement systems, more satisfaction, more discipline, higher openness and more trust.

3. Operational Management Excellence: The extent of people productivity, operational and maintenance productivity and projects productivity. It is related to three aspects: plant productivity, operational productivity and people productivity.

Independent Categories

The two independent categories in the study are powerful leadership and performance culture.

Powerful Leadership

In this study, powerful leadership has been studied with regard to the components of leadership which help in high effectiveness in terms of achieving higher and increasing organic growth, helping Organisations remain high performing and excellent. Under this categories, three sub-concepts have been taken—globalization issues; vision, mission and strategies; and leadership dynamisms. These sub-concepts and their operational definitions are given below:

1. Globalization Issues: The extent to which the Organisation has developed responsiveness to the globalization challenges for a competitive edge. It has explored initiatives towards this end and the Organisation's preparedness to meet such challenges.
2. Vision, Missions and Strategies: The extent to which the mission and strategies are leadership driven. It has sought to study the extent of contributions to various forms of Organisational excellence.
3. Leadership Dynamisms: The extent to which the efforts are towards enabling line personnel developing the right leadership skills to enable them to manage their subordinates well, take work effectively from difficult employees, effectively manage problem employees, and make every employee a leader to transform the Organisation to become the best among navaratan companies.

Performance Culture

Performance culture—one of the subsets of 'Organisational Culture'—is a great contributor to achieving Organisational excellence. It is performance management system dependent and supported by HR policies and practices, competency and talent management, and team working processes. These are operationally defined as:

1. HR Policies and Practices: The degree to which the Organisation's HR policies and initiatives are oriented towards achieving HR excellence aimed at high retention, satisfied employees, fully engaged and strengthening the human resource systems.
2. Competency/Talent Management: The degree to which the Organisation's efforts are driven towards performance management processes to make performance appraisal free from traditional biases and prejudices and oriented and linked to performance management systems, i.e., 'key performance area' for achieving HR excellence. The study has tried to seek replies to investigate the effectiveness of the performance and potential appraisal systems and processes, performance review feedback and discussions oriented to talent utilization, management and whether or not focusing on the optimization of human asset management for total human productivity, including competency mapping for competency and talent management.
3. Team Management: The degree to which there is effective/true team working as indicated by effective team processes in O&M, functional and cross-functional departments and projects.

Objectives

The study is proposed to be undertaken with the following objectives:

1. To study and critically examine organizational excellence in the context of powerful leadership and performance culture of the organization under study.
2. To study the impact of factors of powerful leadership on Organisational excellence.
3. To study the impact of factors of performance culture on Organisational Excellence in the organisation.

Methodological Details

Qualitative methodology is widely open with unlimited boundaries but having strong logical and philosophical foundations, accepted by majority of qualitative researchers (Gibbs, 2007). It is intended to approach the world 'out there' and to understand, describe and explain social phenomena 'as it exists from inside'. The qualitative methodology is continuously evolving and every new researcher may have something new to offer in terms of collecting rich data, analyzing and drawing conclusions. The research objectives can be fruitfully achieved as it lays minimum boundations in carrying out the research. The following specific methodology was adopted:

- Gathering the experiences of individuals or groups identified keeping in view diverseness of the group. This involved identifying individuals and groups for in-depth individual interviews and focus group discussions for getting insights related to critical incidents in respect of various categories, including biographical life histories as relevant to the study and practices narrated by individuals in both personal interview and focus group settings.
- Gathering specific and relevant data related to the study based on interviews, focus group discussions and observations, making rough notes during the interviews and Focus Group Discussions and writing detailed observations the same day so as to capture all essential and relevant aspects of the generated data.
- Analyzing documents (reports, write ups of various departments, published brochures, reports,) or similar traces of experiences available in the articles of the Organisation under study.

Study Population

Choosing the study population demands following a series of important steps that will help bring out important issues and aspects that is needed to be precisely brought out from the study. This was given a careful though and the specific steps chosen in carrying out the study under reference was:

1. To go in depth with some acceptable amount of width to be able to clearly achieve the set research objectives warranted choosing a single enterprise.
2. The next most important thing was choosing an enterprise from either the public sector or the private sector enterprises. The main criteria for choosing an enterprise from among these two sectors were largely the ease with which the sharing of the type of information needed for carrying out the research qualitatively would be possible and also the interest and time given by the individuals and groups of the Organisation chosen.
3. The next important criteria has also been to see how long the Organisations have been in existence as any chosen Organisation must have been existing from at least three decades or more.

Looking at the wider utility of the undertaken research, the study of a PSE was felt to be more appropriate as the created knowledge could help in not only developing or reformulating growth plans of the public sectors, but also help in revisiting and reengineering the central drivers of the HRM&D for creating high performing PSEs in India. Having so chosen to study an Organisation in the public sector, the next choice was a specific enterprise from among different industry sectors for studying 'Organisational Excellence'.

Identifying a Public Sector Enterprise for the Purpose of the Study

While identifying a public sector enterprise for the purpose of the study, few considerations were there: (i) it is a high performing PSE i.e., an enterprise which has either achieved excellence, or is striving to achieve excellence; (ii) it is also an Organisation that is manageable for carrying out an in-depth study; and (iii) it is an Organisation that will not only give permission for carrying out a research study, but would also be interested in it. Thereby full cooperation and support is achieved from the various target groups which is required to be studied.

Applying these criterias, ABCL, an organization in the public sector was chosen which had severe developmental constraints and high government dominance on the affairs of its management. Having identified ABCL as an Organisation in the public sector for studying excellence in-depth, the next step was to see fulfillment of the third criteria i.e., permission to carry out an in-depth study on 'organisational excellence', which it gladly granted, subject to certain conditions. The conditions were agreed to by the researcher and with that began the second step of the methodology. The agreed conditions were adhered to by the researcher.

Collecting Data for Qualitative Analysis

Step 1: Preliminary Studies

Data for qualitative analysis has been collected from both primary and secondary sources. The process of collecting secondary data began immediately after identifying the Organisation for the study. The main secondary source has been the Organisation's brochure, in-house journal/ news bulletins, information displayed on notice boards, details of training programmes, training calenders, performance appraisal forms, consultancy reports, research study reports done by the Organisation, etc. and other available relevant reading materials. This was done largely to develop focused questions to relevant target groups, that could be asked in the various sub-categories

and how the entire Organisation could be studied with minimum possible effort.

Step 2: Tool Construction

Open ended, unstructured questions were constructed for primary data collection. The following step-by-step methodology was adopted for the same:

The tool was constructed related to the various sub-categories of both the dependent and independent categories. No questionnaire was used in this study. An interview guide for carrying out individual interviews and a guide for focus group discussions were developed. The purpose was to trigger the interview and focus discussions around the major concerns of the categories of the study. Only those questions were asked which were likely to provide useful insights in the study. The important consideration given in designing of the unstructured questions was on what was actually going on, what specific strategies the organisation had undertaken, and the response of the employees who mattered for these. The tool retained only the most relevant questions to be enquired from only the applicable target group.

These questions were pre-tested by seeking opinions from few officers in the field of HRM in the Organisation and discussions with the researcher's guide and refining them after examining their appropriateness and relevance. These final tools so developed was again pre-tested in the Organisation by examining the appropriateness, relevance and answerability of each question and also which of them could be better answered by which target group and how better insights could be reached with their help. Earlier, the interview guide was made in two annexures keeping in view elaborate responses desired from various targets groups depending on the possibility of getting best quality response. However, as these were too long, they were shortened and a small interview guide (Appendix 1) and a small focus group discussion guide (Appendix 2) was developed. The tool intended to unravel various factual information, facts, and critical incidents so as to be able to make inroads related to inside, and the projected realities by way of unfolding of stories, legends, rituals, ceremonies, and taboos to develop insights related to the true Organisational processes, in terms of what Mannen (1988) referred as realist, confessional and impressionistic tales.

Step 3: Identifying Units of Study

The different relevant units or entities studied were:

i) The headquarters of the organization under study was studied.

ii) The Regional Headquarters of one of its region in Eastern India.

Step 4: Carrying out the Field Study

Data has been collected from both secondary and primary sources. Details of the method adopted for collecting data from the two sources are discussed below.

Data from Secondary Sources

The main sources of data from secondary sources are official documents provided by some of the respondents who were approached for a personal interview for the purpose of research.

Data from Primary Sources

An effort was made to send the interview guide in advance with a covering letter from the researcher's guide' to concerned target groups for serving the purpose of awareness, triggering some unstructured random thoughts into their minds, and thus preparing them for a productive interview. However, it did not work and therefore to prevent the population being targeted from becoming non-responsive, it was stopped.

The interview guide and focus group guide used helped in carrying out an in-depth interviews and focus group discussions, respectively in the corporate office of the Organisation in the NCR and in the Regional Office in Eastern India.

1. Interviews: The 'interview guide' was used to carry out interviews of individuals at various levels in different departments. The respondents were asked questions based on the interview guide, which were mostly as per the independent and dependent categories. Rough notes of the responses were taken, which were mostly in the form of narration of some critical incidents, some facts and some information. Though these were present in the secondary sources as well, the respondents still mentioned most of them. Some respondents responded in a highly positive way, some responded critically, while some were extremely critical in both their responses and approach.

2. Focus Group Discussions: The focus group discussions were also held using a 'Focus Group Guide' and were done in different departments, both

technical and non-technical, in both the corporate office in Northern India and in the regional office in Eastern India. To conduct the FGD, the focus group guide was given to each member of the focus group which ranged from 3-6 members. The purpose of giving the focus group guide was to keep them comfortable with the questions and concentrate on them so that they could go to depth from there.

The questions mentioned in both 'interview guide' and 'focus group guide' were mainly for the purpose of triggering initial response from the respondents or the FGD group. As the interview or the discussion proceeded, new questions were generated based on the response to the earlier question and more and more inner understandings were developed by a process known as 'iteration' in qualitative methodology. The responses received from them have been also converted into elaborate field notes without any classification or categorization. These field notes were later appropriately transcribed to roll the entire transcribed field notes from all sources into coding and thematic categorization process. These notes are categorized into:

i) Notes from interview responses

ii) Notes from focus group discussions

iii) Notes from fields based on observations and conversations

iv) Notes from the field, based on documents made available during interviews and FGDs..

The detailed break-up of the interviews held with different respondent categories according to the methods used are summarized below:

The percentage of male and female population studied was 87.8 and 12.2 percent ,respectively. The maximum coverage of the total population was at the Deputy Manager and Assistant Manager levels, together accounting for 40% of the total population. About 26.6% of the population belonged to the levels of Director, Executive Director, General Manager, Addl. General Manager, Joint General Manager and Dy. General Managers. About 17.7 percent of the population studied was from workers and supervisory levels. Together with officers, the middle management population (Asst. General Managers, Managers Deputy Managers, Assistant Managers) comprised 55.5 percent of the study population. The level-wise break-up of the population (top, senior, middle, supervisory and worker) are given in table 6.

Table 1: Total Study Population

Method Used	Corporate Office in NCR	Regional Office in Northern India	Total
i) Interviews	31	9	40
ii) Focus Group Discussions	8(30)	5(20)	13(50)
iii) Total	39 (61)	14(29)	53 (90)

Data Analysis

The voluminous data collected were processed through analytic procedures into a clear, understandable, insightful, trustworthy original analysis. Qualitative data analysis has been undertaken by different researchers in different ways. According to Miles and Huberman (1994), Maykut and Morehouse (2001), and Ritchie and Lewis (2003), sorting, retrieving, indexing, handling and processing of qualitative data must generate analytic ideas. Other researchers emphasise the idea that analysis involves interpretation and retelling and that it is imaginative and speculative (Mishler, 1986, Riesmann, 1993, Denzin, 1997, Giorgi and Giorgi, 2003). These approaches emphasize the idea that qualitative data are meaningful and need to be interpreted in analysis, not just to reveal the range of subject matter people are talking about but also to recognize and analyze the ways in which they frame and mould their communications. To that extent, observations were made an integrated part while carrying out in-depth interviews and focus group discussions also.

Graham Gibbs (2007) provides two core activities in qualitative analysis: (i) developing an awareness of the kinds of data that can be examined and how they can be described and explained; and (ii) a number of practical activities that assist with the kinds of data and the large amounts of it that need to be examined. As suggested by Gibbs (2007), the collection and analysis were merged and the volume of data was expanded, laying adequate attention to minute details while carrying out personal interviews and observations. This helped in raising new issues and new questions. The initial questions were used only as a guideline to carry out individual interviews and

Table 2: Personal Interview & FGD Respondents from Corporate Office in NCR

Level	Gender		Total
	Male	Female	
Directors	1	0	1
Executive Directors	2	0	2
General Managers	1	0	1
Addl. General Managers	5	1	6
Joint General Managers	3	0	3
Deputy General Managers	4	1	5
Manager	8	2	10
Dy. Managers	4	2	6
Asst. Managers	2	2	4
Total	25	6	31

focus group discussions, with new aspects being included as field work progressed making more sense in the study conducted.

Step 1: Data Preparation or Transcription

This was done by transcribing the interview contents, focus group contents and observations and field notes to produce a neat typed copy of respondents' responses and observations. Every care was taken to capture spoken aspects of the interview, so as not to miss out the setting, context, body language and general feel of the session. In the present research, therefore, the researcher used "handwritten notes" during interviews and field work. No tapes were used. Transcription here, therefore, involved a process of 'writing up' the notes. This involved more than mechanical reproduction to creatively express the notes as ideas, observation of certain kinds, etc., with the help

Table 3: Total Respondents (Interview and FGD) from its Regional Office in Northern India

Level	Gender		Total
	Male	Female	
Addl. General Managers	1	0	1
Joint General Managers	2	0	2
Deputy General Managers	2	0	2
Manager	1	0	1
Dy. Managers	3	0	3
Asst. Managers	10	0	10
Supervisors	4	0	4
Workers and Tradeunions	6	0	6
Toral	29	0	29

Table 4: Demographic Profile of Corporate Office Respondents

Age of Respondents	Gender		Total
	Male	Female	
31-35	8	6	14
36-40	14	3	17
41-45	11	0	11
46-50	14	2	16
51-55	1	0	1
55 and above	2	0	2
Total	50	11	61

of which, a proper start to data analysis was possible to be made. To give due regard to ethical issues, an important strategy in maintaining confidentiality of the names was resorted to. For this purpose, only the levels of the employee interviewed and observed were maintained. Minimum hand notes were taken in front of the interviewee(s) and the unstructured questionnaire was used, as far as possible, as a mainframe to keep the conversations in the contexts of the study as a whole. Majority of the transcriptions to finalise the findings with respect to the various categories were dependent on field and mental notes, and which were transcribed on the same day. The analytical descriptions of these findings were also written simultaneously.

Step 2: Maintaining the Research Diary

A comprehensive record of the research process and activities was maintained containing the records of the research ideas, discussions with fellow researchers, notions about the research process itself and anything that felt pertinent to the research project as a whole and data analysis. Things like the following were recorded:

Table 5: Demographic Profile of Eastern India Regional Office Respondents

Age of Respondents	Gender		Total
	Male	Female	
31-35	4	0	4
36-40	5	0	5
41-45	8	0	8
46-50	11	0	11
51-55	1	0	1
55 and above	0	0	0
Total	29	0	29

Table 6: Percentage-wise Break-up of Population Studied

Level	Designations	Percentage	Cummulative percentage
Top and senior	Director, Executive Director, General Manager, Addl. General Managers, Joint General Managers, Dy. General Managers	26.6	26.6
Middle management	Asst. General Managers, Managers Deputy Managers, Assistant Managers	55.5	82.1
Supervisory and senior workers	Supervisors and Workers, including Trade union office bearers	17.7	99.8
Total		99.8	99.8

- What the researcher did, where, how and why he did, with dates, and a possible indication of time spent.
- Things that the researcher read and which contributed to the literature review and analysis.
- Contact summaries about what people, events or situations involved, what the main themes and issues in the contact were, new hunches generated and what new questions the next contact might address.
- What data was collected, how it was processed and what was the outcome.
- What the researcher thought or felt about what was happening.

Step 3: Transcribing the Field Work

Notes, both field notes and mental notes, were written immediately after the interview before the words and events faded from memory. Emphasis was given to recording what happened, describing things that went on, and also recording the researcher's own actions, questions and reflections that went on and putting back to interviewees new questions to have a deeper understanding.

Van Maanen (1988) distinguished three basic forms of research findings in ethnography:

- "Realist tales" (where observations are reported as facts or documented by quotations from respondents or texts and the author goes beyond subjective viewpoints to present wider, more general and more theoretical interpretations in a manner that is devoid of self-reflections and doubt);
- Confessional tales' (where naturalness is presented along with an account grounded in the data collected to show what actually happened); and
- 'Impressionist tales" (which takes the form of a dramatic recounting of events organized around striking stories in chronological order).

The qualitative data gathered contained all three forms.

All the transcriptions as above were classified into various categories. The responses and observations from various target groups that were obtained by way of observations, interactions and personal interviews and focus group discussions related to the categories and sub-categories of the study. These were reproduced in the respective sub-categories and placed in separate parts. These became the raw data for further data analysis i.e., thematic coding and categorizing.

Step 4: Thematic Coding and Categorizing

Coding is how the data being analyzed is defined. According to Gibbs (2007), it involves identifying and recording one or more passages of text or other data items that exemplify the same theoretical or descriptive idea. Usually, several passages are identified and they are then linked with a name for that idea—the code. Thus, all the text that is about the same thing is coded to the same name. Coding is a way of indexing or categorizing the text in order to establish a framework of thematic ideas.

Coding is easiest using a transcript and is possible to code directly from field notes. Codes form a focus for thinking about the text and its interpretation and can be both data-driven and concept-driven. Coding helped in methodically categorizing various sections of the data to various categories and sub-categories as per the conceptual framework of the study. The raw responses were first categorized into various categories and sub-categories and then within each categories, they were placed according to various issues and themes.

Step 5: Approaches to Quality

Many of the ideas about the quality of research have been developed in the context of quantitative research. There has been strong emphasis on ensuring the validity (ensuring explanations are really true or accurate and correctly capture what is actually happening); reliability (if the results are consistent across repeated investigations in different circumstances with different investigators); and generalizability (if they are true for a wide, but specified, range of circumstances beyond those studied in the particular research. Qualitative researchers have introduced reflexivity to ensure the quality of qualitative research. It also addressed issues of validity, triangulation, reliability, generalizability, and the ethics of analysis. Therefore, keeping in view the importance of quality in qualitative research, the following approach was adopted:

1. Reflexivity

According to Gibbs (2007), reflexivity is the recognition that the product of research inevitably reflects some of the background, milieu and predelictions of the researcher. The scientific model claims that good research is objective, accurate and unbiased. The qualitative researcher, like all other researchers, cannot claim to be an objective, authoritative, politically neutral observer standing outside and above the text of their research reports. According to Brewer (2000: 129, cited in Gibbs, 2007), qualitative researchers are reflexive in the account of the research process, the data collected and the way it is written up, because reflexivity shows the partial nature of the representations of reality and the multiplicity of competing visions of reality. Based on what Brewer (2000: 132-133) suggests for good reflexive practice, the following was adopted:

1. Continuously discuss the features of the study, its setting, what has been left unresearched, why has the researcher made these choices, and what implications for the research findings that might follow from these decisions.
2. Try to be explicit about the theoretical framework on which the present research has been undertaken.
3. Critically self-assess integrity as a researcher by considering the grounds on which knowledge claims are being justified (length of field work, special access negotiated, discussing the extent of the trust and rapport developed with the respondents).
4. Critically assess the data by discussing the problems that arose during all stages of the research. Most of the data extracts are in the form of 'verbatims' and 'quotes'.
5. Show the complexity of the data, avoiding the suggestion that there is a simple fit between the situation under scrutiny and my theoretical representation of it, by discussing negative cases that fall outside the general patterns and categories employed to structure the analysis, which often serve to exemplify and support positive case.

2. Validity

Every effort has been taken to address the validity or accuracy of the research undertaken—not to guarantee that the work is a true picture of reality, but to eliminate obvious mistakes and to generate a richer set of explanations of the data. The commonly deployed methods of triangulation, respondent validation, constant comparison and evidence has been used for the purpose.

Triangulation: Triangulation is getting more than one view on a subject, which helps in getting an accurate (or more accurate) view of the subject matter. While triangulation cannot be used in any ultimate sense to create a single, valid and accurate interpretation of reality, there are still practical uses for it:

1. It is always possible to make mistakes in interpretations and a different view on the situation can illuminate limitations or suggest better things.
2. Informants are not consistent in what they say and do. They can change their minds about what they think and say from occasion to occasion and they may do something different from what they say they do. Forms of data triangulation (for e.g. observing actions as well as interviewing respondents) are useful here, which helps in revealing new dimensions of social reality where people do not always act consistently (Flick, 2007) and this method has been used rigorously.

Respondent validation: As mentioned earlier, the process of transcription is a form of translation from one medium to another and inevitably involves some interpretation. What is being tried to capture faithfully is the respondents' view of the world. This has done by the researcher asking the respondents if he had got it right. Sometimes the respondents agreed and sometimes they disagreed with the interpretation. And at times they would rethink the sensitivities of what they had said and inform the researcher that they wanted it to be changed. Efforts

were made by the researcher to persuade them to the original interpretation as this was likely to result in the creation of right knowledge, which may also do some good to the organisation in the long run. Wherever the account was acceptable, convincing and credible, it has been retained and wherever the respondents disagreed and were reluctant, two things were done:

1. Treated their statements as new data and tried to find out why they have changed or disagreed. The transition in opinion emerged as an interesting new data itself.
2. Where the interviewee wanted his/her previous statement removed and not used, it was honoured, as that has been regarded as the interviewee's foremost right. This was done after efforts to try and convince the interviewee failed. Such data was destroyed and not used in this research at all. This was done as the researcher gave an undertaking to the Organisation at the time of grant of permission itself.

Constant comparison: Constant comparison, a technique of data analysis for creation of codes as a way of checking, both within cases and between cases, is also used for validity. During the time of data analysis also, higher level comparisons are done on case-by-case basis. Comparisons are continuously done throughout the period of analysis and are used not just to develop theory and explanations, but also to increase the richness of description in the analysis and thus ensure that it closely captures what people have told and what had happened.

Adequate emphasis has been made on two aspects of this approach for validity: (i) comprehensive data treatment, and (ii) dealing with negative cases. Continuous analysis of the data was resorted to, to check any explanations and generalizations and ensure that nothing important was missed out. The negative and deviant cases—situations and examples that just do not fit the general points—have been thoroughly looked to integrate into this research document. The negative cases or counter-evidence have been rejected, but only after due investigations to understand why they occurred and what circumstances produced them.

Evidence: To produce a good reflexive research report, and to demonstrate clearly how it is grounded in the data collected and interpreted, evidences in the form of quotations from the field notes, interviews or other documentation gathered have been provided. Efforts have been made to keep these quotations under control to avoid the dangers of keeping them too long or too short.

3. Reliability

As it has to do primarily with the issues of self consistency and reliability of the analysis, proper transcription and checking to ensure that the transcriptions made do not include any obvious mistakes. It has been checked and checked again and even sharing back with the respondents wherever possible.

4. Generalizability

This has been ensured by demonstrating how the analysis is grounded in the data by referring to cases and examples in the write-up.

5. Ethics of Analysis

Ethical practice adds to the quality of the analysis. A poorly executed and badly reported analysis is certainly unethical. All research causes some harm or imposes a cost as it relies on people's goodwill to allow you access to data or interview them. Good research may do some good—it may extend the understanding in ways that are of benefit to people and society, and may give rise to changes in practice and behaviour that are to everyone's advantage. The key to ethics in research is to minimize the harm and maximize the benefits. According to Mason (1996:166-167, cited in Gibbs, 2007), the particular nature of qualitative research and analysis creates two particular circumstances that needs to be taken care of.

The first and the foremost issue in qualitative data is its richness and details, for which the confidentiality and privacy of those involved in research needs to be maintained. The research/informant relationship is one of mutual trust and one of some intimacy. As suggested by Flick (2007b), two principles have understandably been kept in mind: (i) every effort has been made that the respondents cannot be identified by the organisation and thus harmed, and (ii) the research is likely to produce some identifiable benefit to the Organisation apart from creation of knowledge. Many participants actually enjoyed their involvement to get some real benefit from the process and activity. In some cases, what they talked about was stressful or emotionally wearing and in some cases what they felt could put them to some risk. Some things that were given due considerations for this are:

1. Informed consent: Respondents were given information about the research relevant to them in a language they were familiar with.
2. Anonymity of transcription: Confidentiality and privacy, which is a problem in qualitative research because of the richness of the data collected, was ensured at every step of data collection.

3. Transcription: Every effort has been made to ensure to be as faithful to the original respondents as possible in making transcriptions from field and mental notes.

In qualitative research, it is hard to predict at the start what kind of things one is likely to find out and what kind of conclusions will possibly be drawn. The study focus may, therefore, change during analysis. The final outcomes of the study evolved as the data transcription, tabulation and analysis proceeded along. Finally, summary tables and a model of excellence were evolved, which was not predicted initially when the research proposal was finalized and while the work was in progress. It happened when the entire work was complete, and the efforts were on for summarizing the findings and conclusion. As suggested by Mason (1996), the following have been resorted to for:

- Feedback: Some feedback has been made to participants about the results of the research. This has been done in a way that they understand it properly by maintaining confidentiality and privacy and make more valuable, interesting and worthwhile contributions.
- Publication: The organisation undertook commitment from the researcher to take its opermission before publishing any work from this study.

Step 6: Data Tabulation and Discussions

This part of the work has been the most challenging part of the work before trying to make any analysis and making any discussions for reaching generalizations and conclusions.

Primary Data Analysis

The factors of excellence with respect to the two independent categories—"powerful leadership" and "performance culture" have been arrived at in the following way:

All the transcriptions related to each of the sub-categories of both the dependent and independent categories were grouped together. Thus, the transcribed matters related to each of the sub-categories of both the independent categories were placed together. The various responses were segregated and placed together according to the commanalities in the nature of the issues of the responses in those categories. Based on the "response groupings", which related to a particular factor, the research findings were developed. A number of research findings were obtained with regard to the dependent categories (Organisational excellence) and both the independent categories (powerful leadership and performance culture). The research findings of the dependent categories reflected the "attributes of excellence" and the research findings of the independent categories reflected the various "factors" contributing to the attributes of excellence.

Based on an analysis of the responses of the sub-categories of both the independent categories, the research findings were categorized under the various sub-categories and each finding was labled. This became a factor contributing to Organisational excellence. Through this process, the attributes of the three types of Organisational excellence were obtained and discussed the three types of excellence based on the findings related to the various attributes of excellence in the appendices from III to VIII.

Based on the responses related to the various sub-categories of the independent categories, the research findings were given appropriate labels of factors of organisational excellence. These factors of powerful leadership and performance culture are based on the research findings of the various sub-categories of both the independent categories. Based on factors of excellence related to both the independent categories of powerful leadership and performance culture and the attributes of GME, HRME and OME, Appendices 3–8 have been constructed, which relate to:

1. Contributions of factors of powerful leadership to GME attributes.
2. Contributions of factors of performance culture to GME attributes.
3. Contributions of factors of powerful leadership to HRME attributes.
4. Contributions of factors of performance culture to HRME attributes.
5. Contributions of factors of powerful leadership to OME attributes.
6. Contributions of factors of performance culture to OME attributes.

Subsequently specific tables (Appendix IX) were constructed related to attributes of general management, human resource management and operational management excellence and the contributions of factors of powerful leadership and performance culture to these. Based on the contributions of the different factors of powerful

leadership's three sub-categories, and performance culture's three sub-categories, to the attributes of three different types of excellence it was simply seen which of the factors of each of the sub-categories of both the independent categories do actually contribute to the three types of excellence (Appendices 3-8). Appropriate labels were given to each of the research findings after codifying. An illustration of the different ways these findings were codified are given below:

- RF/OE/GME/01 : Awareness and concerns of Globalisation
- RF/OE/HRME/01 : Top Management Vision
- RF/OE/OME/01 : Vision Document

The code 'RF' in the codification scheme refers to 'Research Findings'; 'OE' refers to 'Organisational Excellence'; 'GME' refers to 'General Management Excellence'; 'HRME' refers to 'Human Resource Management Excellence' and 'OME' refers to 'Operational Management Excellence'. The attributes of general management excellence, human resource management excellence and operational management excellence that were obtained in the said manner formed the central constructs and were obtained from the various research findings as found out from the raw data analysis. The findings of the independent categories are the 'factors of excellence' and findings of the dependent categories are the 'attributes of excellence'.

Secondary Data Analysis

The study also investigated various critical incidents, informations and facts gathered from various secondary sources provided to the researcher, during the course of interviews and focus group discussions, such as reports, brochures, documents, consultancy reports, etc.

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There are no miracles in agricultural production.

— Norman Borlaug

Appendix I

Interview Guide

I. Interview questions related to: Leadership Dynamisms

1. What are the Organisational initiatives for developing leadership at unit, regional and functional heads of the departments?
2. Can you give some example of some leadership dynamism that can be cited by you particularly with respect to achieving excellence in the Organisation?

II. Interview questions related to: Globalisation Issues

1. What are its various initiatives including joint ventures and do you think it will be able to make its presence nationally, regionally and internationally?
2. How has the Organisation managed the threat posed by some of our turnkey technical projects consultants who also went for setting up their own hydro projects?

III. Interview questions related to: Vision, Mission and Strategies Issues

1. How aligned are the Organisational vision, mission and strategies?
2. What is the process of finalizing key performance areas and getting more focused results from them?

IV. Interview questions related to: HR Policies and Practices

1. What special HR initiatives is there that is making a difference from before?
2. What is the scene of the union management relations?

V. Interview questions related to: Competency Management

1. How will you share certain issues related to talent and competency management processes in public enterprises?
2. Can you give some example of demonstration of some highly talented individuals and what happened to them?

VI. Interview questions related to: Team Working

1. How cohesive are the Operations and maintenance teams in public enterprises?

VII. Interview questions related to: General Management Excellence

1. Are the Organisations subsidiaries and joint venture projects running satisfactorily, and to best bench marked hydro power generating Organisations?

VIII. Interview questions related to: Human Resource Management Excellence

1. How well planned are the 'Employee development (HRD) initiatives' in public enterprises?
2. How is Organisation able to place the right kind of a person to lead a department or unit or a station or a project or a region or a directorate?

IX. Interview questions related to: Operational Management Excellence

1. What are the various employee productivity concerns in the Organisation and how is that increasing from year to year?
2. How far the Organisation has been successful in reducing project time and cost overruns?

Appendix II

Focus Group Guide

I. Focus group guide for use in FGD with Senior Officers, Officers in non-HR Departments only

1. From when has globalization been given importance in public enterprises? Why it is important to give importance to globalization?
2. To what extent you feel, public enterprises can become a world class global Organisation? What driving forces require to be strengthened for achieving this?
3. What are the various criteria and standards of excellence of these stations and projects and how these are measured?
4. What forces will help in achieving speedier completion of construction power projects?

II. FGD guide for use with officers in HR department only:

1. What are the specific enhanced roles of HR for meeting the challenges in the present business scenario? Is there some linkage seen in addressing the issue of the Organisation becoming world class, transnational with new HR initiatives being developed for Human Resource excellence?
2. How important is HR's role regarded in meeting the demands of globalization pressures and how HR policies can be more suitably developed for meeting those challenges?

III. FGD guide for use with officers in HRD department only:

1. What are the special types of training programs that will be helpful in achieving greater leadership dynamisms and better team working?
2. What special initiatives for Organisation wide 'leadership development' and 'team working' initiatives can be undertaken by HRD either jointly or by themselves?

Name of respondent:.....

Designation: .....

Age: .....

Sex: .....

No. of years of experience: .....

Address:.....

APPENDIX-III

Contributions of Factors of Powerful Leadership to Attributes of General Management Excellence

Sl. No.	Attributes of Excellence	Globalisation Issues	Vision mission and strategies	Leadership dynamism
1.	Moving towards Excellence		Top management vision	Developing managers as leaders, assertive leaders, powerful followers
2.	Consolidation and strengthening of acquired establishments	Demonstration of core competence, hydropower leadership	Vision, mission driven growth strategies	Coaching subordinates, leadership ownership, towards super speciality development, ignorance management
3.	Continuous addition and expansion of unit sizes	Awareness and concerns of globalization, globalization concerns and core competencies, shift of emphasis to mega projects	Implementing performance management systems,	Vision document development, turnaround leadership, powerful leadership
4.	Management of outdated redundant technologies	Demonstrated core competence	Awareness and clarity of vision and KPAs	Developing leadership skills, work pressure management, Confidence in management
5.	**Speedy commissioning of projects**	Growth strategy	Passion for vision, mission, institutionalisation of KPAs	Assertive leadership, shared leadership, project leadership challenges
7.	Reducing Project Completion time to worlds bench marks	Competitive advantage, hydropower leadership	Vision development and its operationalisation	Towards super specialty development, super specialty centered leadership dynamism
9.	Managing political dynamics / external takeover threats	Business strategy,	Top management vision	Confidence in management, powerful leadership, turnaround leadership
10.	Going beyond boundaries	Internationalization strategies, business strategies	Vision development and its operationalisation	Global leadership initiatives, powerful followers
11.	High determination and commitments	National and international competition, vendor development	Implementing Performance Management Systems	Leadership ownership, project leadership challenges, leaders motivation, ignorance management
12.	Organic growth strategies	Growth and business strategies, competititve advantage, shift of emphasis to mega projects	Vision development and its operationalisation	Leadership development by understudy, super specialty development, shared leadership, managing gaps in leadership
13.	Managing joint ventures and subsidiaries	Hydropower leadership,	Implementing PMS, instrumentalities	Coaching subordinates, leadership development by understudy, work pressure management, developing
14.	Human centered management	National and international recognition	Top management vision	Project leadership challenges, global leadership initiatives

APPENDIX-IV

Sl. No.	Attributes of Excellence	HR policies and practices	Talent Management	Team Working
1.	Moving towards Excellence	Strengthening HRD, union management relationships, employee welfare,sustainable human development	Talent initiatives, rewards to talents	High performing generating teams, high performing monitoring teams
2.	Consolidation and strengthening of acquired establishments	Workers union support, employee welfare	Nurturing talents, rewards to talents, talent initiatives, technical competency development	High performing generating teams, high performing maintenance teams, work demand focused teams
3.	Continuous addition and expansion of unit sizes	Transparency in transfers, multi skilling, KPA based appraisal system, innovative HR practices, competency mapping		High performing project teams
4.	Management of outdated redundant technologies	Humanpower productivity, Humanpower strategies, workers unions support, sustainable human development	High accomplishments, talent motivation	High performing generating teams, high performing maintenance teams
5.	**Speedy commissioning of projects**	Humanpower productivity, performance based promotion, performance related pay,	Competency mapping, managing / adjusting to aggressiveness / high bossism, large technical expertise pool,	High performing generating teams, high performing maintenance teams, high performin g project teams, high performing consulting teams
7.	Reducing Project Completion time to worlds bench marks	Competency mapping, KPA based appraisal, performance related pay (PRP)	Competency mapping, working on competency profiles, strengthening process	high performing project teams, high performing consulting teams, high performing monitoring teams, high performing maintenance teams
9.	Managing political dynamics / external takeover threats		Accomplishment pride, technical competency development	New team development, high performing consulting teams
10.	Going beyond boundaries	Competency mapping, managing attrition and employee engagement, strengthening HRD	Competency mapping, broader	New team development
11.	High determination and commitments	Unio n management relations, top team selection, employee welfare, sustainable human development, multi -skilling, strengthening HRD	High technical expertise pool, talent motivation, talent retention, rewards to talents	New team development, high performing moni toring teams, high performing consulting teams
12.	Organic growth strategies	Multi -skilling, Humanpower productivity, Humanpower strategies, strengthening HRD	Managing / adjusting to bossism / aggressiveness, large technical expertise pool	New team development, high performing consulting teams
13.	Managing joint ventures and subsidiaries	Competency mapping, KPA based appraisal systems, performance based promotions, performance related pay	Talent motivation, talent expertise pool	New team development, high performing project teams, project team excellence
14.	Human centered management	Sustainable human development, employee welfare, transparency in transfers, performance based promotions	Talent initiatives, nurturing talents, talent / skill retention	New team development, high performing consulting teams

APPENDIX-V

Contributions of factors of Powerful Leadership to Attributes of Human Resource Management Excellence

Sl. NO.	Attributes of Excellence	Globalization Issues	Vision mission and strategies	Leadership dynamism
1.	Excellence Achievers	Awareness and concerns of globalization, globalization concerns and core competence,	Top management vision, importance of KPAs, awareness and clarity of vision and KPAs	Assertive leadership, shared leadership
2.	Planned Training and Development Initiatives	Globalization concerns and core competence, hydropower leadership, shift of emphasis to mega projects,	Instrumentalities to operationalising and integrating vision and mission, implementing performance management systems,	Developing leadership skills, global leadership initiatives, ignorance management, work pressure management
3.	High Psychological contract	Competitive advantage, hydropower leadership	Passion for vision, mission, vision mission driven growth strategies	Coaching subordinates, leadership development by understudy, ignorance management
4.	High competence and Capacity	Demonstrated core competence, national and international recognition	Top management vision, awareness and clarity of vision mission	Developing managers as leaders, leadership ownership
5.	Employee / workmen development initiatives	Shift in emphasis to mega projects, internationalization strategies, competitive advantage, growth	Implementing PMS, vision mission driven growth strategies	Project leadership challenges, work pressure management, leadership development by understudy
6.	Excellence in Leadership and Change Skills	Hydropower leadership, internationalization strategies, business strategies, competitive advantage	Vision development and its operationalisation, passion for vision mission and its institutionalization	Project leadership challenges, powerful leadership
7.	Handling surplus unskilled category	Internationalization strategies, shift of emphasis to mega projects, business strategies, growth strategies	Internationalization strategies, shift of emphasis to mega projects, business strategies, growth strategies Vision mission driven growth strategies	Internationalization strategies, shift of emphasis to mega projects, business strategies, growth strategies Vision mission driven growth strategies, Coaching subordinates, leadership development by understudy
8.	Excellence in training	Globalization concerns and core competence, business strategies, growth strategies, hydropower leadership	Vision development and its operationalisation, importance of KPAs, instrumentalities to operationalising and integrating vision and mission	Encouraging powerful followership, shared leadership, project leadership challenges
9.	Excellence in Promotions	Competitive advantage, growth strategies, business strategies	Vision mission driven growth strategies	Super specialty development, super specialty centred leadership dynamism, leadership ownership
10.	Excellence in transfers	Hydropower leadership, business strategies, growth strategies	Vision mission drien growth strategies	Project leadership challenges, work pressure management, confidence in management, leaders motivation
11.	Transparency in communications	HRD climate survey, Companywide ERP, BPRE	Vision development and its operationalisation, implementing PMS	Ignorance management, global leadership initiative
12.	Excellence in sustained human development	Corporate social responsibility, Rehabilitation and Resettlements	Vision development and its operationalisation	Turnaround leadership, vision document development

APPENDIX-VI

Contributions of Factors of Performance Culture to Attributes of Human Resource Management Excellence

Sl. No.	Attributes of Excellence	HR Policies and Practices	Talent Management	Team Working
1.	Excellence Achievers	Emphasis on innovative HR, performance related pay, performance promotion, competency mapping	Talent initiatives, rewards to talents, talent retention, nurturing talent	Project team excellence, high performing project teams, high performing maintenance teams, high performing generating teams
2.	Planned Training and Development Initiatives	Multi-skilling, Humanpower productivity, competency mapping, union-management relations, strengthening HRD	Nurturing talents, high accomplishments, competency mapping, technical competency, managing aggressiveness / bossism, working on competency profiles	High performing project teams, high performing maintenance teams, high performing generating teams, high performing consulting teams
3.	High Psychological contract	Employee welfare, union-management relations, sustainable human development	Employee welfare, union-management relations, sustainable human development Strengthening competency mapping process, broader competency framework, rewards to talents, nurturing talents	
4.	High competence and Capacity	Strengthening HRD, competency mapping, KPA based appraisal	Competency mapping, rewards to talents	High performing consulting team
5.	Employee / workmen development initiatives	Humanpower productivity, multi-skilling, union-management relations, workers / unions support	Large technical expertise pool, multi-skilling	High performing consulting teams
6.	Excellence in Leadership and Change Skills	Strengthening HRD, KPA based appraisal, performance based pay, promotion, transparency in transfers,	Broader competency framework, strengthening competency mapping process	High performing consulting team, high performing project team, high performing monitoring team
7.	Handling surplus unskilled category	Multi-skilling, Humanpower productivity, strengthening HRD	Rewards to talents, nurturing talents	High performing consulting team
8.	Excellence in training	Strengthening HRD, competency mapping, KPA based appraisal	Competency mapping, broader competency framework	High performing consulting team
9.	Excellence in Promotions	Performance promotion, KPA based appraisal, competency mapping	High accomplishments, large technical expertise	High performing consulting team
10.	Excellence in transfers	Managing attrition, emphasis on innovative HR, ERP	Talent / skill retention	High performing consulting team
11.	Excellence in Transparency and communications	BPRE, ERP, CSR		High performing consulting team
12.	Excellence in sustained human development	CSR, NGO promotion/ development		High performing consulting team

APPENDIX-VII

Contributions of Factors of Powerful Leadership to Attributes of Operational Management Excellence

Sl. No.	Attributes of Excellence	Globalisation Issues	Vision mission and strategies	Leadership dynamism
1.	Excellence in productivity parameters	Globalization concerns and core competence	Top management vision, vision development and its operationalisation, implementing PMS	Turnaround leadership, powerful leadership, assertive leadership
2.	Humanpower productivity	Growth strategies	Importance of KPAs, institutionalization of KPAs	Developing managers as leaders, encouraging powerful followers
3.	Systems excellence	Business strategy	Implementing PMS, institutionalization of KPAs, operationalising vision document	Leadership development by understudy
4.	Excellence in project commissioning	Competitive advantage, business strategy	Top management vision, vision development and operationalising,	Developing managers as leaders, project leadership challenges, towards super specialty development
5.	Maintenance excellence	Growth strategy, hydropower leadership	Implementing KPAs, implementing PMS,	Ignorance management, work pressure management, coaching subordinates
6.	Excellence in technology management	National and international recognition, internationalization strategies	Vision development and its operationalisation	Project management challenges, turnaround leadership, powerful leadership
7.	Excellence in contract management	Vendor development, business strategy, shift in emphasis to mega projects,	Vision driven growth strategies,	Global leadership initiatives, leadership ownership, project leadership challenges
8.	Overheads productivity management	Shift in emphasis to mega projects	Implementing KPAs, implementing PMS	Assertive leadership, confidence in management, work pressure management
9.	Project monitoring excellence	Hydropower leadership	Implementing KPAs, implementing PMS	Project leadership challenges, vision document development, turnaround leadership
10.	Excellence in consultancy services	National and international recognition, internationalization strategies, CSR, R andR	Top management vision, vision development and its operationalisation	Vision development, ignorance management, super specialty centred leadership dynamism

APPENDIX-VIII

Contributions of Factors of Performance Culture to Attributes of Operational Management Excellence

Sl. No.	Attributes of Excellence	HR policies and practices	Talent Management	Team Working
1.	Excellence in productivity parameters	Strengthening HRD, Humanpower productivity, KPA based appraisals	Rewards to talents	Project team excellence, high performing project teams, high performing generating teams, high performing maintenance teams
2.	Humanpower productivity	Multi-skilling, performance related pay	Nurturing talents, talent / skill retention	
3.	Systems excellence	Emphasis on innovative HR, KPA based appraisal, competency mapping, strengthening HRD	Competency mapping, competency profiling, talent initiatives	High performing contract teams, high performing monitoring teams, high performing consulting teams
4.	Excellence in project commissioning	Top team selection, multi-skilling, sustainable human development	High accomplishments	High performing project teams, high performing monitoring teams, high performing consulting teams, project team excellence
5.	Maintenance excellence	Multi-skilling, employee welfare	Nurturing talents,	High performing maintenance team
6.	Excellence in technology management	Competency mapping	Technical competency accomplishments	High performing consulting team, new team development
7.	Excellence in contract management	Competency mapping, union-management relations, workers/ union support	Technical competency achievements, large technical expertise pool	High performing monitoring team, new team development
8.	Overheads productivity management		Rewards to talents, nurturing talents	New team development
9.	Project monitering excellence		Large technical expertise pool, technical competency achievements	High performing monitoring teams
10.	Excellence in consultancy services	Competency mapping, KPA based appraisal	Working on the competency profiles, broader competency framework	High performing consulting teams

Feature

Scope of Solar Energy in Uttara Kannada, Karnataka State, India: Roof top PV for Domestic Electricity and Standalone Systems for Irrigation

T.V. RAMACHANDRA, GANESH HEGDE AND GAUTHAM KRISHNA DAS

Energy is essential for economic and social development of a region. Dependence on fossil fuels has posed a serious threat due to greenhouse gas (GHG) emissions, dwindling stock of the fuel resource base. Among daily activities, about 80% of the mechanical work requires electrical energy. Dependence on the conventional energy resources for electricity generation is eroding the resources at faster rate. The process of electricity generation causes significant adverse effect on ecology by producing enormous quantity of byproducts including nuclear waste and carbon dioxide. Improving energy efficiency, switch over to renewable sources of energy and de-linking economic development from energy consumption (particularly of fossil fuels) is essential for sustainable development of a region. Green energy technologies have gained importance as they are reliable and environmental friendly. Electrical energy harvesting from solar radiations is one such promising technology which uses photoelectric effect. Solar photovoltaic (SPV) modules directly convert solar radiations to direct current (DC) electrical power which can be used for various applications (or stored in battery) or can be sent to the existing grid.

Uttara Kannada is located in the west coast of Karnataka, India, receives an average solar insolation of 5.42 kWh/m²/day annually and has more than 300 clear sunny days. This solar potential can be utilized to meet the domestic and irrigation electricity demand. Domestic demand of the household in rural region is about 50 to 100 kWh per month and that in urban region is less than 150 kWh/month in Uttara Kannada. The solar potential assessment reveals that, domestic demand can be supplied by installing rooftop SPV modules, since less then 5% of the rooftop is required in majority of the houses and irrigation demand can be met by installing PV modules in wasteland where less than 3% of available wasteland area is sufficient. To estimate the fraction of rooftop required to generate sufficient electricity, rooftop area of a household in selected villages (chosen randomly, representative of agro-climatic zones) is digitized using Google earth image (http://googleearth.com). Electricity demand in households is estimated based on the sample household survey of 1700 households, which indicate the requirement of 50-100 units (kWh) per month per household. Computed rooftop area per households is used to extrapolate for all the villages in the district. Rooftop area required to install the PV module to meet the respective household's electricity demand is computed. In the similar manner the area required to generate electrical energy to meet the irrigation demand in the village is determined. In most of the villages in the district, less than 0.5% of the available wasteland is sufficient to meet the irrigation demand.

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INTRODUCTION

Electricity is a very good energy carrier which can be converted to any other form of energy and hence the demand is increasing in a higher rate (Ramachandra, 2011a, P: 176). Generation of electricity in India is mainly dependent on fossil fuels (fossil fuels: 78%, Hydro: 22%) in which coal is the predominant source (54%) (Planning Commission, Government of India, 2011, P: 4). Dependency on fossil based energy sources is resulting in fast depletion of non-renewable energy sources, apart from the problem of pollution, GHG emission, land transformation, deforestation, etc. The utilization of land for constructing the power plants, transmission lines, substations and distributing stations is an important ecological issue and also construction of these conventional structures is a tedious process, which disturbs the region's ecology, hydrology and biodiversity. This has necessitated an exploration for sustainable sources of electricity generation which are renewable, clean and cost effective (Environmental Health and Engineering, Inc., 2011, P: 10, TERI Energy Data Directory & Yearbook, TERI Press, New Delhi, 2011). Renewable sources currently contribute only 10% to the nation's power basket where coal is the dominant source (56.81%). India ranks fifth in the world with 15,691.4 MW grid-connected and 367.9 MW off-grid renewable energy based power capacity. Solar energy is the promising renewable source of energy which is widely available in the country. India receives an annual average insolation more than 5 kWh/m^2/day and has over 300 clear sunny days in a year (Polo et al., 2010, P: 2395). India receives good solar radiations and yet utilization of solar energy is limited to 1% due to technological and economic barriers (World Institute of Sustainable Energy, Pune, 2011, P: 57). In this scenario, technologies like solar PV, rooftop solar, solar thermal systems are indeed helpful since these are decentralized, require no waste disposal area and consume very less water (Mitavachan and Srinivasan, 2012, P: 163). India receives abundant solar energy above 5 kWh/m^2/day over 58% of its land area. Efficient solar conversion technologies have the capacity to augment the nation's regional lighting, heating and motive electricity requirements. This can potentially avoid extension of electricity grid to remote places and hence minimise the need for further fossil fuel based centralised capacity addition. Promisingly, solar conversion technologies are being promoted for off-grid electricity generation through congenial policies in India (Ministry of New and Renewable Energy, GoI, 2011, P: 18).

Solar energy has a wide range of applications by converting it into thermal energy and electric energy. Parabolic trough system, central receiver system or parabolic dish system for solar-thermal energy conversion is used (Handbook of solar radiation, Allied Publishers, New Delhi, 1981) and photovoltaic cell (PV cell) is used for solar to electric energy conversion. Solar PV cell converts solar radiation into direct current (DC) electric power using photovoltaic effect (Ordonez et al., 2010, P: 2124). The domestic electricity demand in India can be met by installing solar PV modules in an outdoor area or using rooftop PV modules. Rooftop PV system generates direct current (DC) electrical power using photovoltaic effect. This power can be stored in a battery or used as per the requirement. It uses a part of roof area (depending upon the PV module size and output) for installing PV modules which acts as an energy source. The generated electricity is stored in batteries, used directly or it fed to the grid using inverter circuit (Ramachandra and Subramanian, 1997a, P: 946). The National Solar Mission (NSM) launched in 2010, targets 200 MW off-grid solar based photovoltaic (PV) capacity by the end of its first phase in 2013. Ministry of New and Renewable Energy (MNRE), Govt. of India (GoI), has already achieved more than 38 MW by 2011 [http://www.mnre.gov.in/schemes/offgrid/solar-pv/]. In this study potential assessment is carried out for Uttara Kannada district considering the seasonal variations in the district. Digitization of rooftop area is done to estimate the roof area required to meet the domestic demand of the household using solar PV modules.

Need of solar potential assessment in Uttara Kannada

Stratified random sampling of household through the structured questionnaire has been carried out to assess the domestic energy requirement. Domestic monthly electricity consumption in Uttara Kannada district ranges from 50 to 100 kWh (per capita consumption is 15 to 20 kWh). Electrical energy utilization for domestic purpose (lighting, heating, etc.) tops the consumption followed by irrigation. Few small scale and medium scale industries are present in Taluk places (towns) which have the electricity consumption of 150-200 kWh per month (or lesser than 500 kWh/month) (Alam Manzoor, Sathaye Jayant and Barnes Doug, 1998, P: 2).However the district is completely dependent on grid connected electricity supply which is not reliable and does not reach remote localities. Decentralized power supply system can meet

the domestic and irrigation demand of the villages and also helpful in electrifying the remote consumers.Solar PV is a promising technology which can generate sufficient electricity to meet the household and irrigation demand (Ramachandra and Krishna Das Gautham, 2011a, P: 85). Large scale deployment of solar based technologies entails solar potential assessment considering seasonal variability of solar radiation.

Abundant solar energy (5.42 kWh/m²/day) available in the region helps to meet the lighting and heating energy requirements (domestic consumption) through decentralized solutions such as rooftop solar PV systems. It directly converts solar energy into electrical energy using photoelectric effect which can feed the lighting and heating appliances of the household. Study of season wise variations in solar radiation is helpful in allocating the PV modules and forecasting the electricity generation.

The main objectives of the study is to i) assess the scope for solar energy considering the seasonal variability of solar radiation in Uttara Kannada, ii) estimation of household electricity demand, iii) extent of roof top available for deploying solar panel to meet the electricity demand of the respective households, iv) extent of land requirement to meet the demand of irrigation pump sets using solar PV and v) techno-economic analysis of rooftop PV system.

MATERIAL AND METHODS

Study Area

Uttara Kannada with the spatial extent of 10,291 km² is located at 74°92 -75°102 E and 13°552 -15°312 N in the mid-western part of Karnataka state, India (Figure 1). The regions with undulating hills, rising steeply from a narrow coastal strip bordering the Arabian Sea to a plateau at an altitude of 500 m, with occasional hills rising above 600 to 860m lies in the central part of Western Ghats (Ramachandra and Subramanian, 1997a, P: 947). Figure 2 illustrates the topographic undulations of the region. Topographically, the district lies in three distinct zones namely narrow and flat coastal zone, abruptly rising ridge zone and elevated flatter eastern zone. The coastal zone is thickly populated with coconut clad villages. Ridge zone is a part of the main range of Western Ghats, which runs north to south, parallel to the coast. The flat eastern zone joins the Deccan plateau. The taluks, which comprises the narrow flat coastal zone, are: Karwar, Ankola, Kumta, Honnavar and Bhatkal. Similarly, taluks, which comprises the ridge zone, are: Supa, Haliyal, Yellapur, western Sirsi, and western Siddapur. Flatter eastern zone includes Mundgod, eastern Sirsi and eastern Siddapur. Four agro-climatic zones based on geography and climate are coastal, evergreen, dry deciduous and moist deciduous. There are 1291 villages, 7 towns, 5 city municipal

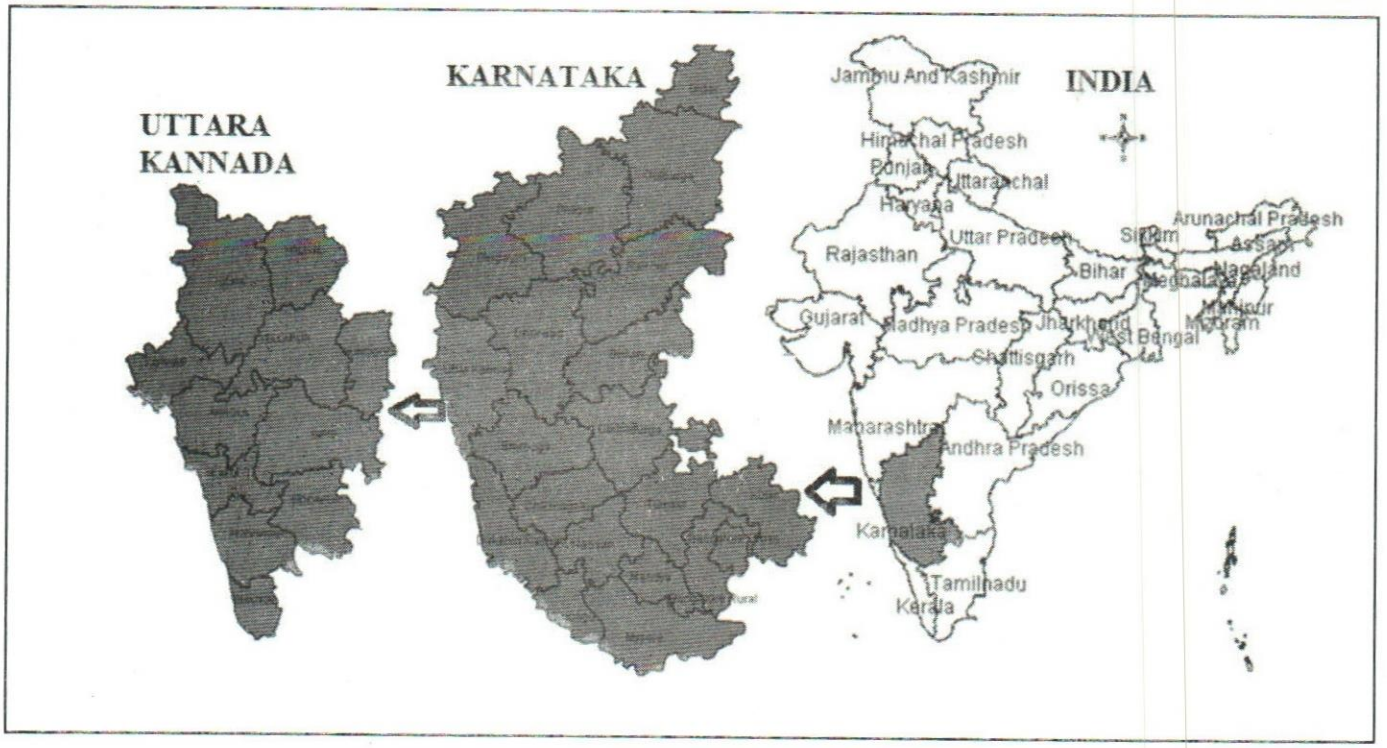

Figure 1: Location of Uttara Kannada

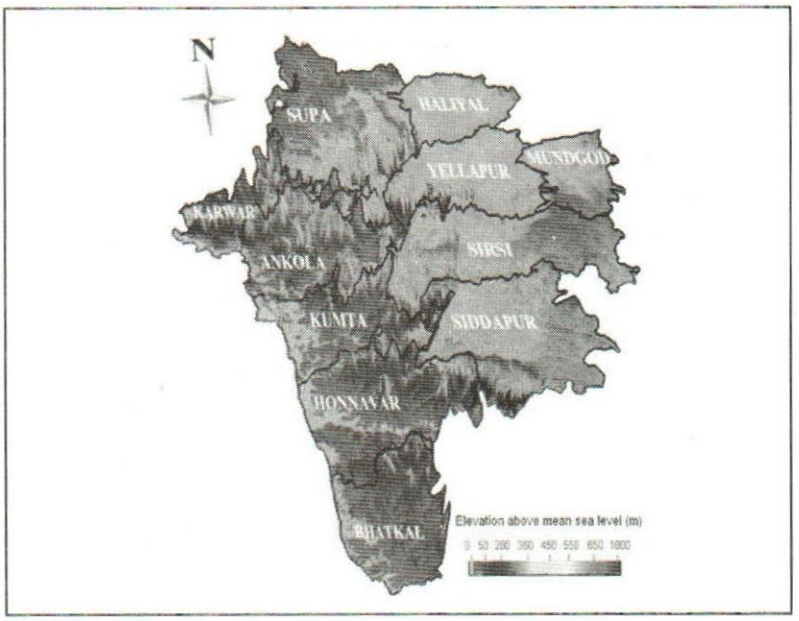

Figure 2: Digital Elevation Model of Uttara Kannada, Karnataka

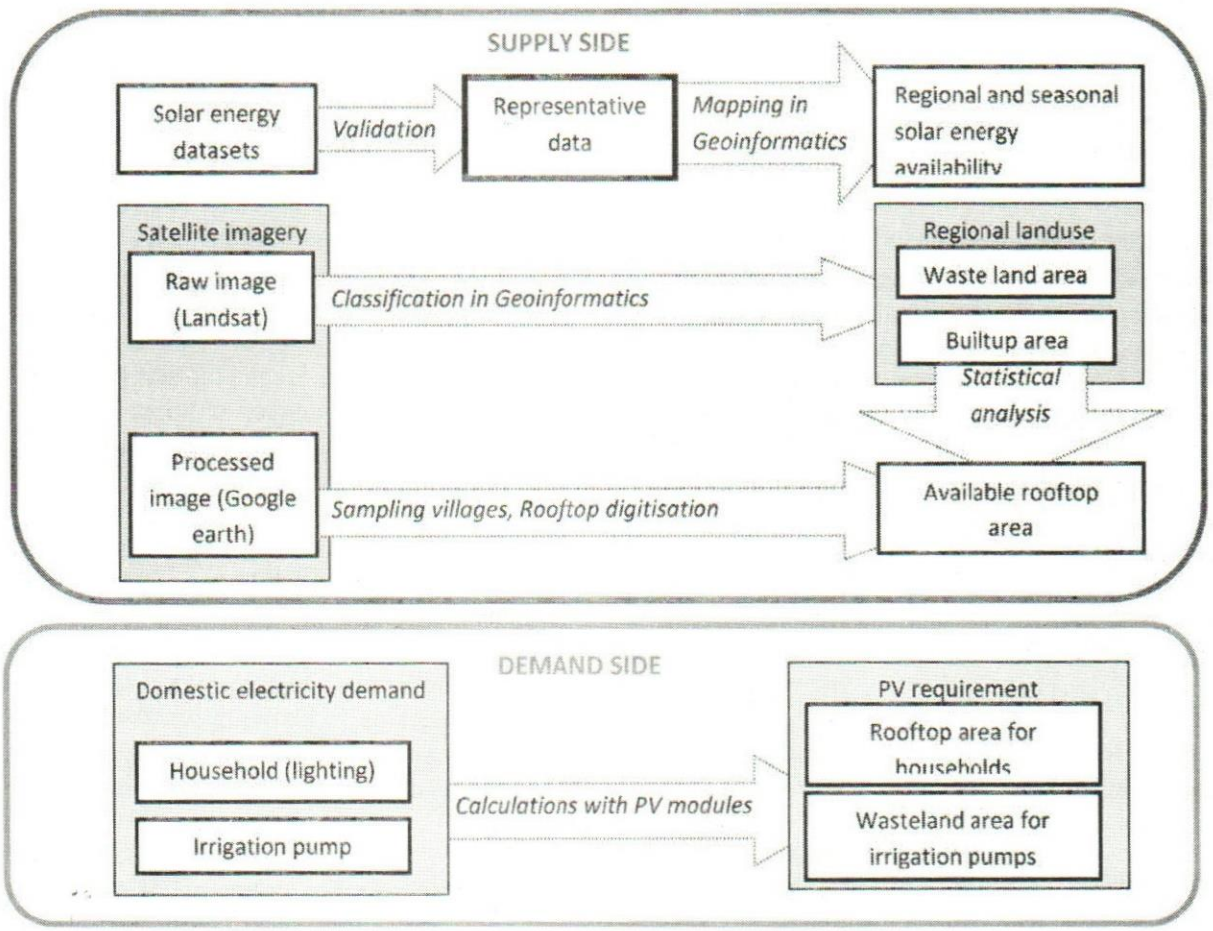

Figure 3: Flow chart of the study

corporations/town municipal corporations/outward growth/ census towns and 2 reservoirs in the district [http:// uttarakannada.nic.in/].

DATA AND METHODS

The study includes assessment of energy at supply side and demand side and is detailed in Figure 3. The supply side includes assessment of regional solar energy availability, spatial extent of rooftop (individual households) and waste land (in the respective villages). The demand side includes estimation of domestic electricity consumption in households and irrigation as well as the extent of rooftop/land area required for installing PV based systems to meet the decentralised demand.

Assessment of solar energy potential

Village-wise solar energy availability in Uttara Kannada was assessed using satellite-based high resolution global insolation data derived on prudent models. Two datasets collected were:

i. Surface Meteorology and Solar Energy (SSE) 1°x1° (~100 X 100 km) spatial resolution global horizontal insolation (GHI) data provided by National Aeronautics and Space Administration (NASA) based on satellite measurements of 22 years (July 1983 to June 2005) (Surface Meteorology and Solar Energy Release 6.0 Methodology, NASA, 2012);

ii. Higher spatial resolution 0.1° X 0.1° (~ 10 X 10 km) GHI data furnished by the National Renewable Energy Laboratory (NREL) based on satellite measurements of 7 years (January 2002 to December 2008) (NREL GHI data furnished by National Renewable energy Laboratory, 2010). These were compared and validated with long term surface GHI measurements based interpolation model for the region. Higher resolution NREL GHI data were used to study the seasonal availability and variability of village-wise solar energy in Uttara Kannada. Seasonal solar maps were generated using Geographic Information Systems (GIS) tools (Ramachandra, Krishna Das Gautham and Jain Rishab, 2012a, P: 8).

Estimation of Builtup and Rooftop area (Digitization of rooftop area)

Estimation of Builtup area: Multispectral data acquired through IRS (Indian Remote Sensing) P6 satellite of 5.8 m resolution was used to estimate the extent of human habitations. Remote sensing data were analysed through standard protocols involving geometric correction, image classification through Gaussian maximum likelihood classifier. The remote sensing data obtained were geo-referenced, rectified and cropped pertaining to the study area. Geo-registration of remote sensing data (IRS P6) has been done using ground control points collected from the field using pre calibrated GPS (Global Positioning System) and also from known points (such as road intersections, etc.) collected from geo-referenced topographic maps published by the Survey of India (1:50000, 1:250000). Analysis of remote sensing data (Ramachandra, Aithal and Durgappa, 2012, P328-333) involved i) generation of False Colour Composite (FCC) of remote sensing data (bands – green, red and NIR). This helped in locating heterogeneous patches in the landscape ii) selection of training polygons (these correspond to heterogeneous patches in FCC) covering 15% of the study area and uniformly distributed over the entire study area, iii) loading these training polygons co-ordinates into pre-calibrated GPS, vi) collection of the corresponding attribute data (land use types) for these polygons from the field. GPS helped in locating respective training polygons in the field, iv) supplementing this information with Google Earth v) 60% of the training data has been used for classification, while the balance is used for validation or accuracy assessment.

Land use analysis was carried out through open source program GRASS - Geographic Resource Analysis Support System (http://grass.fbk.eu/) using supervised pattern classifier - Gaussian maximum likelihood algorithm using probability and cost functions(Ramachandra, Aithal and Durgappa, 2012, P328-333). Accuracy assessment to evaluate the performance of classifiers, was done with the help of field data by testing the statistical significance of a difference, computation of kappa coefficients and proportion of correctly allocated cases. Statistical assessment of classifier performance based on the performance of spectral classification considering reference pixels is done which include computation of kappa (k) statistics and overall (producer's and user's) accuracies. Application of maximum likelihood classification method resulted in accuracy of 88%. Remote sensing data analysis provided i) area under vegetation (forests, grass lands.), ii) built up (buildings, roads or any paved surface), iii) water bodies (lakes/tanks, rivers, reservoirs), iv) others (open area such as play grounds, quarry regions, etc.).

Estimation of the spatial extent of rooftops: Regional rooftop area availability for harvesting solar energy was calculated using remote sensing data through geo-informatics and statistical tools.

Villages representing different agro-climatic zones of Uttara Kannada were randomly chosen and rooftop areas were mapped by manual digitisation of high resolution Google Earth satellite data (http://googleearth.com) with the support of geo-informatics tools (Ordonez et al., 2010, P: 2124, Ramachandra, 2007, P: 108). Roof types in towns and other urban areas were similar in most of the zones, one random sample was manually digitised for estimating the spatial extent of rooftops. The built-up areas for randomly sampled regions and manually digitized total rooftop areas were investigated using statistical tools. Total rooftop areas were extrapolated for other regions based on two different methods:

i) **Method 1– Census based:** Ratio of total rooftop area to number of households (census) in sampled regions provided average rooftop area per household $(R/H)i$ for respective agro-climatic zones *i*. These ratios were used to derive total rooftop areas Ri in other regions based on number of households Hi from the census, as shown in equation 1. R/H value for towns were taken as same in all agro-climatic zones.

$$Ri = HI * (R/H)i \quad (1)$$

where,

Ri is the total rooftop area of households in ith agro-climatic zone in m^2

Hi is the number of households in ith agro-climatic zone

ii) **Method 2–based on Land Use Land Cover (LULC):** Signature separation corresponding to LU (Land Use) classes is done using Transformed Divergence (TD) matrix and Bhattacharya distance. Accuracy assessment is done using error matrix in order to get most precise results (Ramachandra, Joshi and Kumar Uttam, 2012, P: 3). Ratios of total rooftop areas to built-up areas in sampled regions were averaged $(R/B)i$ over different agroclimatic zones *i*. Ratios with large deviations were removed due to possibility of misclassification. The average ratio values for respective zones were used to derive total rooftop areas *Ri* in other villages, as shown in equation 2.

$$Ri = Bi * (R/B)\ i \quad (2)$$

where,

Bi is the total-built up area in ith agro-climatic zone

Regional domestic electricity demand:

Talukwise electricity consumption data were collected from the respective government agencies. Apart from this, stratified random sampling of 1,700 households representing all agro-climatic zones yielded energy requirement per household. Based on this data, monthly electricity usage (in kWh) for household for purposes like lighting, heating etc, and irrigation pump sets were computed (Ramachandra, Joshi, et al., 2000, P: 825).

PV requirement to meet regional electricity demand:

Electricity generation from PV was calculated based on the equation 3. The theoretical energy output from a PV cell,

$$Eth = G * A * n = G * \frac{P}{Istc} \quad (3)$$

where *G* is the Global Horizontal Insolation (kWh/m^2), A is the area of the PV panel, *P* is the rated power output, *Istc* is the insolation at standard test conditions and *n* is the efficiency.

Actual energy output considering the quality factor,

$$Eload = Eth * Q \quad (4)$$

where *Q* is the quality factor of a PV module. Hence wattage of PV to be installed is found by

$$P = Eload * \frac{Istc}{G*Q} \quad (5)$$

Area required to meet the demand is,

$$A = \frac{Eload}{G*\eta*Q} \quad (6)$$

The built-up areas for randomly sampled villages and manually digitized roof-top areas were compared using parametric tests (paired t-test) (Sampling Techniques, C.E.C.S.A., 1975). Ratio of total rooftop area to number of households (census) in sampled villages provided rooftop area per household for respective agro climatic zones. These ratios were used to derive rooftop areas in other villages based on number of households. Percentage share of manually digitized rooftop area in the total classified built-up area for sampled town was estimated. This factor was used for all other town panchayats and municipalities to estimate rooftop areas available. Computed rooftop area is assumed to be available for installing solar energy applications like photovoltaic panels, water heaters, etc.

Figure 4: Rooftop digitisation in Lakolli village of Mundgodtaluk, Uttara Kannada

to meet the lighting and water heating requirement of respective houses.

Figure 4 depicts the digitized rooftops in Lakolli village of Mundgod Taluk in Uttara Kannada. The polygons of exposed (available) rooftops in a village are manually digitised using Google Earth. Rooftops in 30 random regions (including one town) spread across four agro-climatic zones of Uttara Kannada were similarly digitised. Rooftop area per household was calculated for the sampled villages and averaged over each agro-climatic zone respectively. These are given in Table 1 and details of villages/towns in Appendix I.

RESULTS AND DISCUSSION

Solar energy potential (Seasonal variations of solar insolation) assessment in Uttara Kannada

The monthly average GHI (Global Horizontal Irradiance) datasets from NASA and NREL were compared and validated with surface data based model. Figure 5 illustrates the monthly variability of solar radiation. The values indicate that adequate solar energy is available in the region. Higher resolution NREL GHI data were used to study the solar energy potential in Uttara Kannada. Solar maps generated for monsoon, winter and summer seasons,

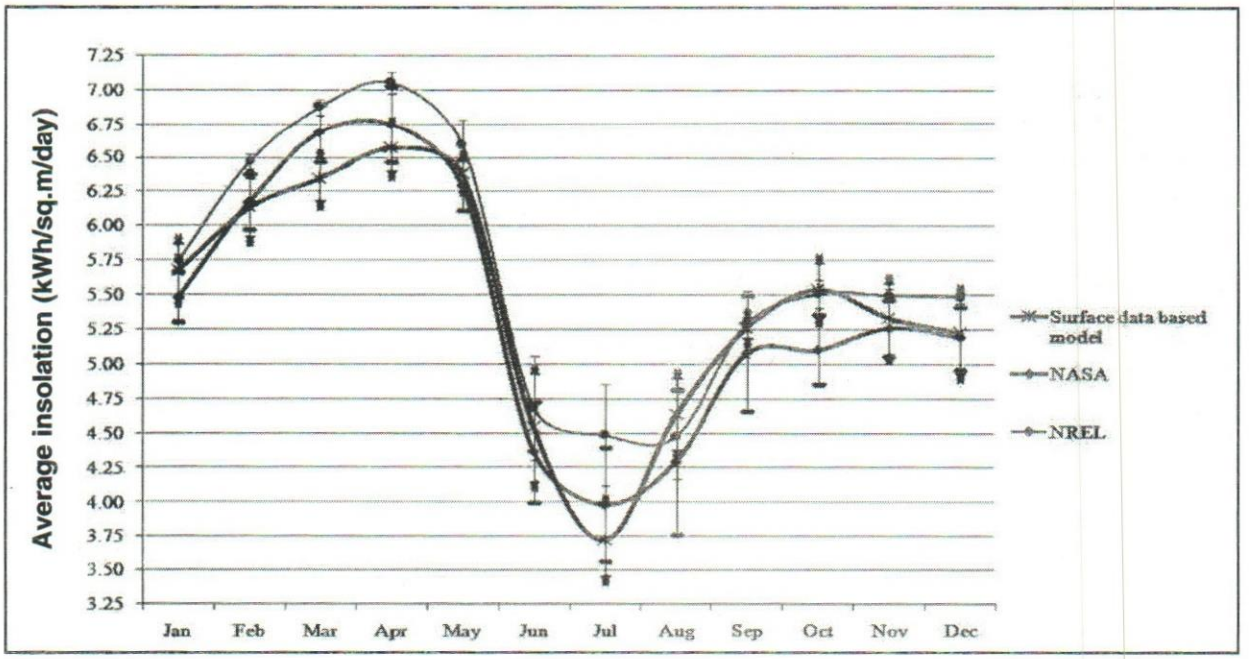

Figure 5: Comparison of different available solar data for Uttara Kannada

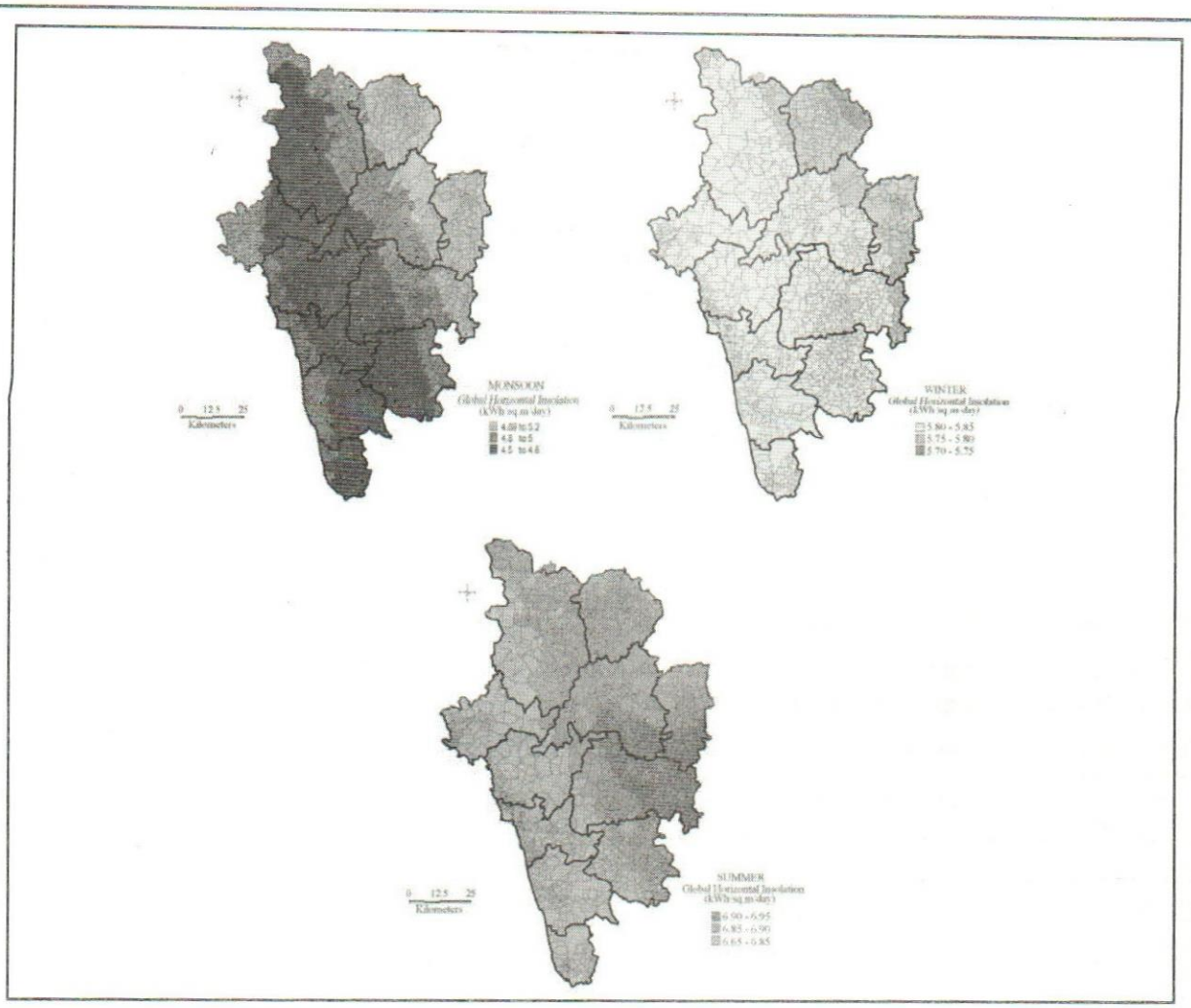

Figure 6: Seasonal variations of solar radiation in Uttara Kannada

show seasonal availability and regional variability of GHI (Figure 6). The seasonal average GHI is highest in summer (6.65 – 6.95 kWh/m²/day), moderate in winter (5.70 – 5.85 kWh/m²/day) and lowest in monsoon (4.50 – 5.20 kWh/m²/day). Annual average GHI values were considered for assessing the technical potential of solar energy in Uttara Kannada.

Figure 6 illustrates the seasonal variations of solar insolation in Uttara Kannada. Solar insolation ranges from 4.5 to 6.95 kWh/m²/day in the districts throughout the year. During Monsoon season, district gets the insolation ranges from 4.5 to 5.2 kWh/m²/day. Coastal and the eastern part of the central (moist deciduous) region receives insolation of 4.8-5 kWh/m²/day. The central region (Evergreen) gets the lowest insolation ranges from 4.5 to 4.8 kWh/m²/day during monsoon. Eastern most part (dry deciduous) receives higher insolation of 4.89-5.2 kWh/m²/day.

In winter, insolation in the district ranges from 5.70 to 5.85 kWh/m²/day. Most of the parts in the district receive insolation of 5.80-5.85 kWh/m²/day. Eastern region of the district (dry deciduous) gets insolation ranges from 5.75 to 5.80 kWh/m²/day. Some parts in this region receive insolation of 5.70-5.75 kWh/m²/day also.

Uttara Kannada gets higher insolation ranges from 6.65 to 6.95 kWh/m²/day in summer. Western part of the district receives insolation of 6.65-6.85 kWh/m²/day. Most of the eastern part (central) gets insolation of 6.85-6.90 KWh/m²/day. In summer, some parts of the district get higher insolation of 6.90-6.95 kWh/m²/day.

Uttara Kannada has a good solar potential and can meet the energy demand in the domestic sector. Energy harvesting through PV based solar system mounted on rooftops of individual houses would help in meeting the respective house's energy demand while bringing down the dependency on the State's grid.

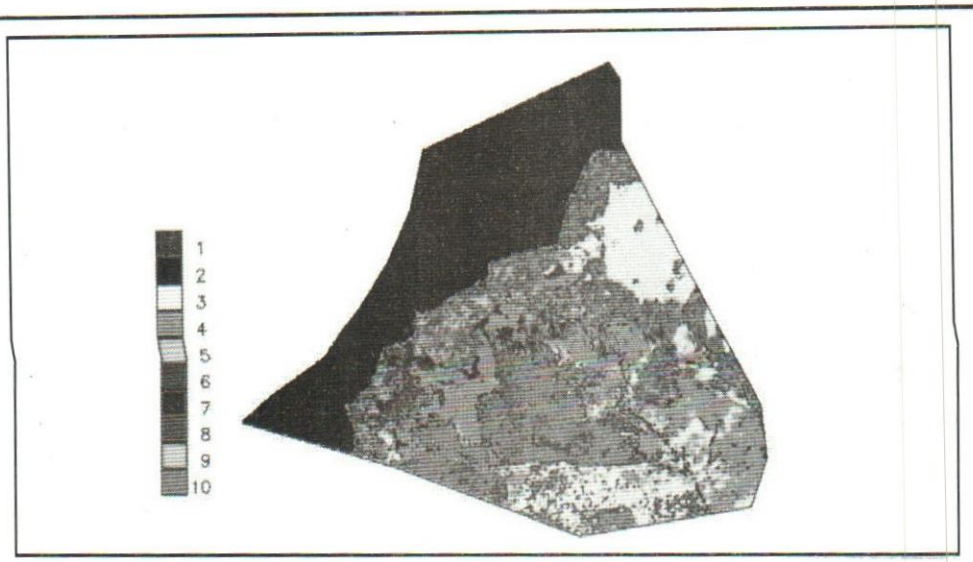

Figure 7: Land use in Aghanashini village of Kumtataluk, Uttara Kannada

Land use Dynamics in Uttara Kannada

Figure 7 shows the land use details of a sampled village in Uttara Kannada. Classification of all sampled villages provided built-up and waste land areas. Based on the rooftop areas already calculated, rooftop to built-up ratio was derived for sampled villages and averaged over each agro-climatic zones respectively (Table 1).

Table 1: Average values of R/H and R/B ratios for different agro-climatic zones

Agro-climatic zone	R/H	R/B
Coastal	72	0.4
Dry deciduous	141	0.5
Evergreen	139	1.6
Moist deciduous	82	0.5

Based on methods 1 and 2 (data and methods section, equations 1 and 2), the averaged *R/H* and *R/B* values were used to derive total rooftop areas in all regions and represented in Figures 8 and 9 respectively. It is observed that Method 1 provides a lower estimate of region-wise rooftop area compared to Method 2.

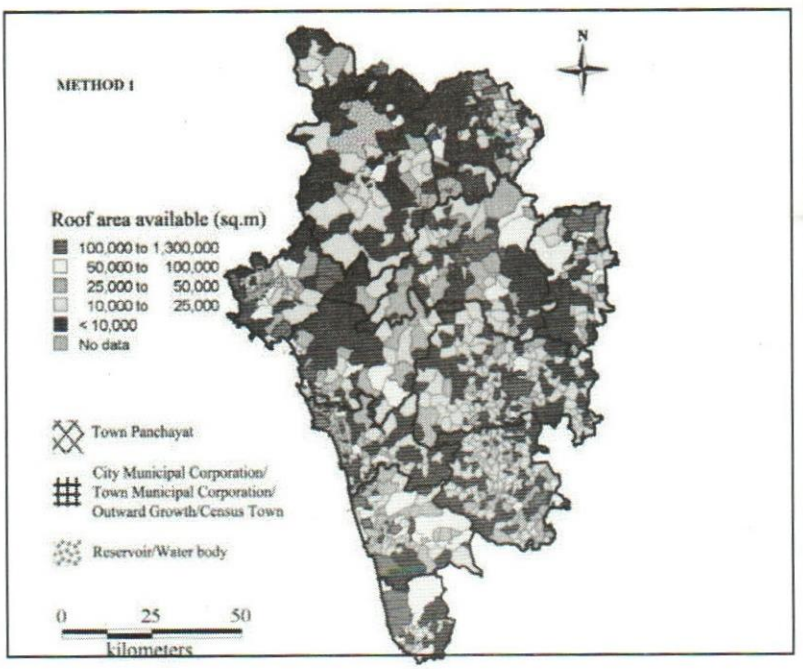

Figure 8: Regionwise rooftop area available based on Method 1

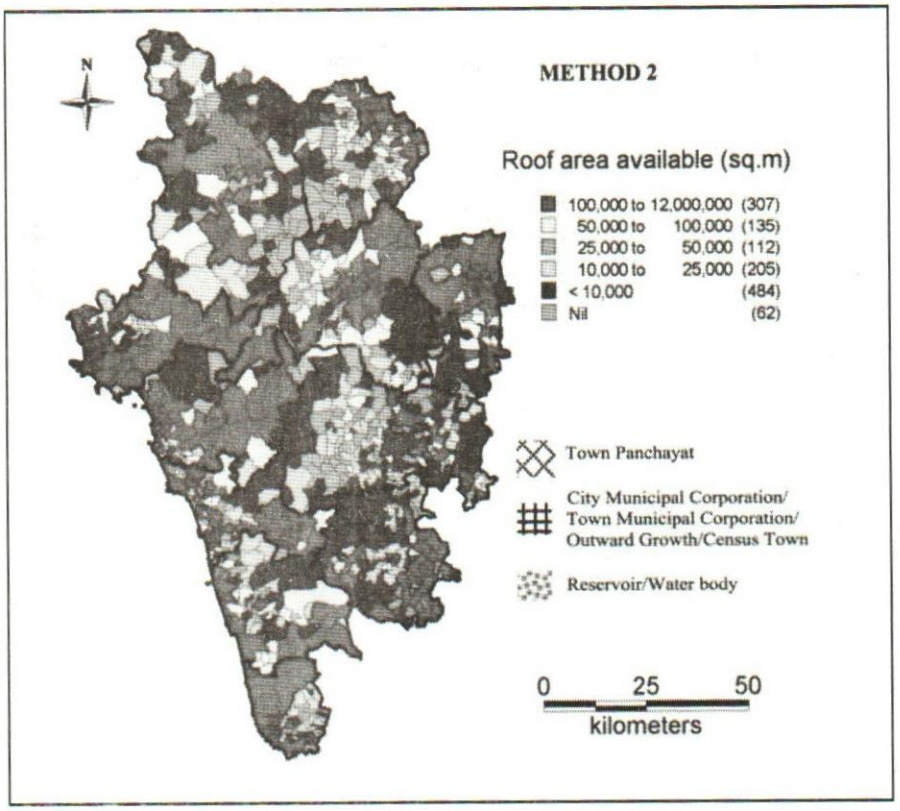

Figure 9: Region-wise rooftop area available based on Method 2

From Figure 8 (Method 1: Extrapolation) it is seen that in most of the villages, total roof area available is less than 10,000 m^2 or it is about 10,000 to 25,000 m^2. There are very few villages where the total roof area is more than 50,000 m^2. By the knowledge of total number of households in the particular village available rooftop area of each house can be determined.

Figure 9 (Method 2: land use) gives the total roof top area available in the villages of Uttara Kannada. It shows that total rooftop area available is more than 1,00,000 m^2 in most of the villages. There is significant number of villages where the total roof area of the village is less than 10,000 m^2. In some of the villages total roof area available ranges between 50,000 to 1,00,000 m^2. Method 2 is based on the signature values of the land use (LU) over estimate the total roof area due to the approximation and lower pixel resolution. However both the results are comparable in the present case and the error is less.

Domestic electricity consumption

Table 2 summarises taluk-wise monthly average domestic electricity consumption based on the data compiled from the government agencies and from sampled households. Average monthly energy consumption of electricity for domestic purposes is about 34±8 kWh per month per household and irrigation requirement is about 3218±2412 kWh/hectare/year. Monthly domestic electricity

Table 2: Domestic electricity consumption

Taluk	Household consumption (kWh/month)	Agricultural consumption (kWh/ha/year)
Ankola	34	2900
Kumta	42	3200
Karwar	40	3100
Bhatkal	40	3100
Honnavar	44	1800
Haliyal	23	1800
Mundgod	37	2100
Siddapur	26	7700
Sirsi	34	7900
Yellapur	25	900
Supa	25	900
max	44	7900
min	23	900
average	34	3218
std.	8	2412

consumption ranges from 23 (for Haliyal) to 44 (Honnavar) kWh. These values were used for calculating the regionwise electricity demand for domestic and irrigation. Coastal taluks (Ankola, Kumta, Karwar, Bhatkal and Honnavar) have higher household electricity consumption. Siddapur and Sirsi taluks with vast extent of horticulture crops lead in the per hectare consumption of electricity for irrigation. Figure 10 gives the monthly average household electricity consumption and Figure 11 shows the annual average electricity consumption for pump irrigation. A large part of Uttara Kannada except the coast is rainfed and hence do not rely on irrigation for agriculture. The electricity consumption ranges from 1,000 - 5,000 kWh/month. There are about 80 villages, which have the domestic consumption of 10,000 to 1,00,000 KWh of electricity in a month.

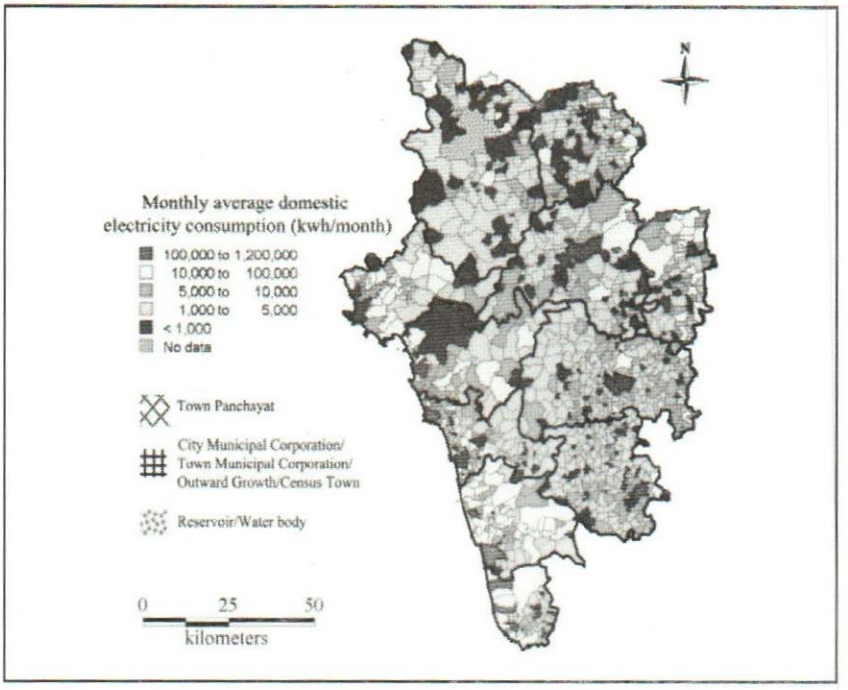

Figure 10: Domestic household electricity consumption

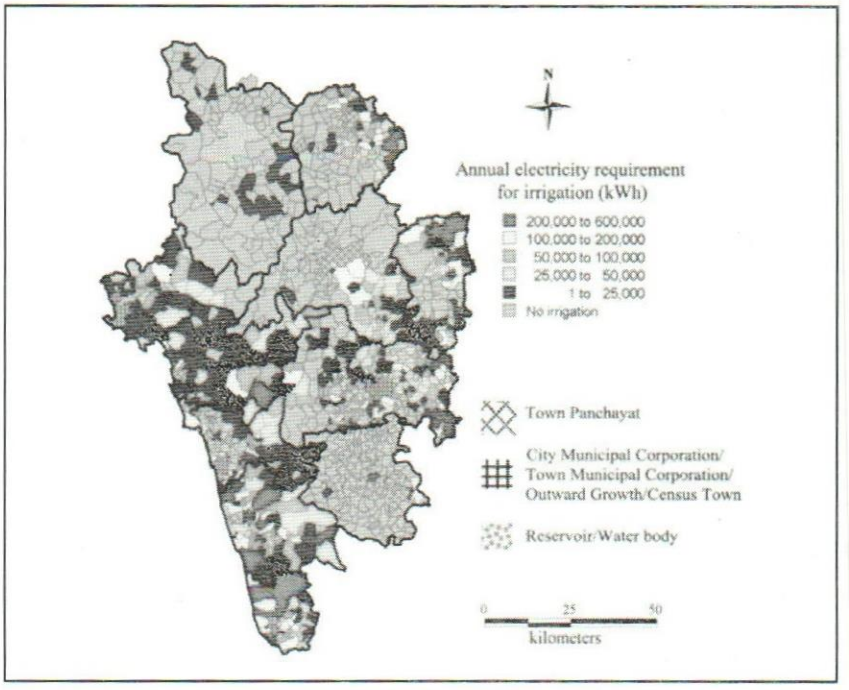

Figure 11: Electricity requirement for pump irrigation

Scope for rooftop PV systems to meet domestic electricity demand

The monthly average electric energy consumption per household is about 50 to 100 kWhin Uttara Kannada. This electricity demand can be met through solar rooftop PV system, which ensures continuous supply of electricity compared to the current system of depending on grid with uncertainties. The rooftop area required to generate the electric energy using PV which will meet the domestic electricity demand in respective villages is given in Figure 12. Majority of the villages require rooftop area less than 250 m^2 to meet the electric energy demand

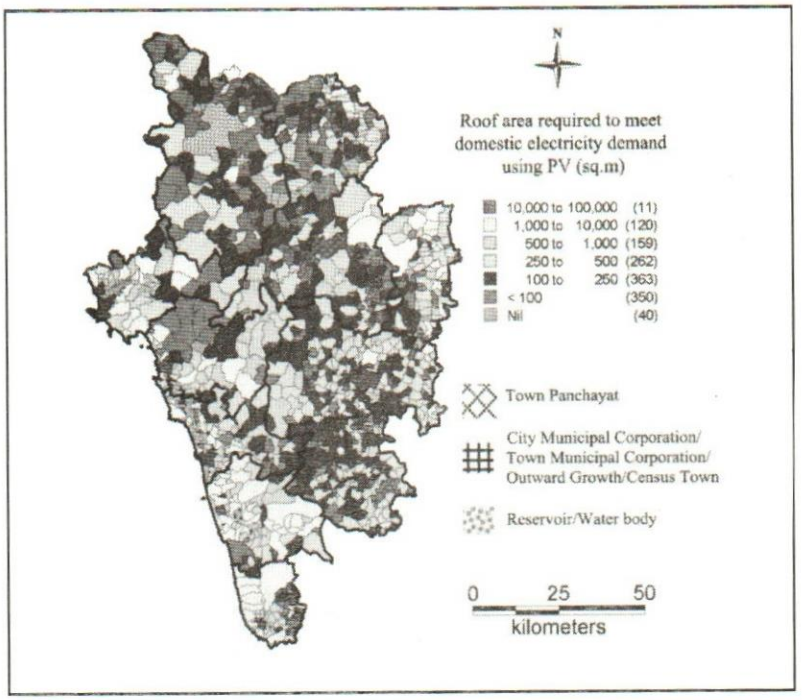

Figure 12: Region-wise rooftop area required to meet household electricity demand using PV

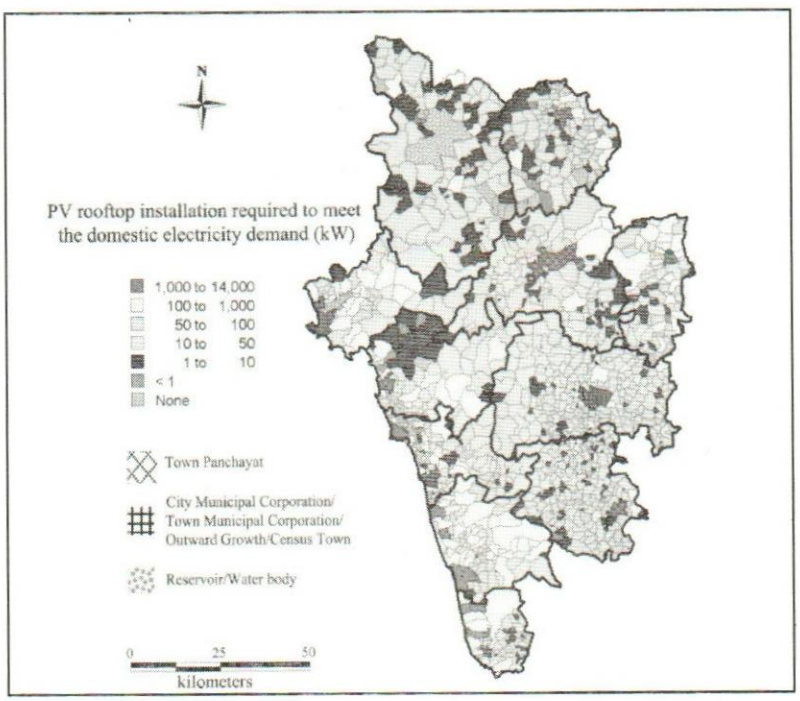

Figure 13: Region-wise PV rooftop installation required to meet the household electricity demand

using solar PV system. Around 26% (350) of the villages in the district require rooftop area less than 100 m^2 and about 27% (363) places need rooftop area ranges from 100 to 250 m^2. Hence more than 54% of the villages require rooftop area less than 250 m^2 to meet the current domestic electricity demand. In very few places total rooftop area required is 10,000 to 1,00,000 m^2 which are normally the city or town

Rooftop area requirement for PV modules was computed and mapped (Figure 12) with the knowledge of region-wise household electricity demandconsidering the solar PV panels of efficiency (n) 14%with modules ofquality factor (Q) 0.5 as discussed in Methods section. In most of the regions, except for towns, less than 10,000 m^2 of rooftop area was sufficient to meet the village's household electricity demand. Figure 13 shows the PV capacity required to meet their demand. Most of the villages required installations within 1,000 kW while towns demanded larger installations upto 14,000 kW per region. Figures 14 and 15 provide information on the share of available rooftop area required to meet household electricity demand, based on methods 1 and 2 respectively.

Figure 14 (Method 1: Extrapolation) gives the share of (% of) available roof area required to meet the domestic electricity demand of household using rooftop PV system. In almost all the villages in the central part (Evergreen region) of the districts, only 1-2% of the available roof area is required to meet the electric energy demand of the household using rooftop PV system. In few villages in coastal region (HonnavarTaluk), 5-7% of the available rooftop area is needed to meet the present household electricity demand. In all other villages, roof area required is less than 5% (or 2-5%) of the total area to meet the demand using solar rooftop PV system. Hence study reveals that, a small part (less than 7%) of the roof area is sufficient to meet the electrical energy demand of the household using rooftop PV system in the district.

As mentioned before, availability of rooftop area according to method 1 was a lower estimation. Based on

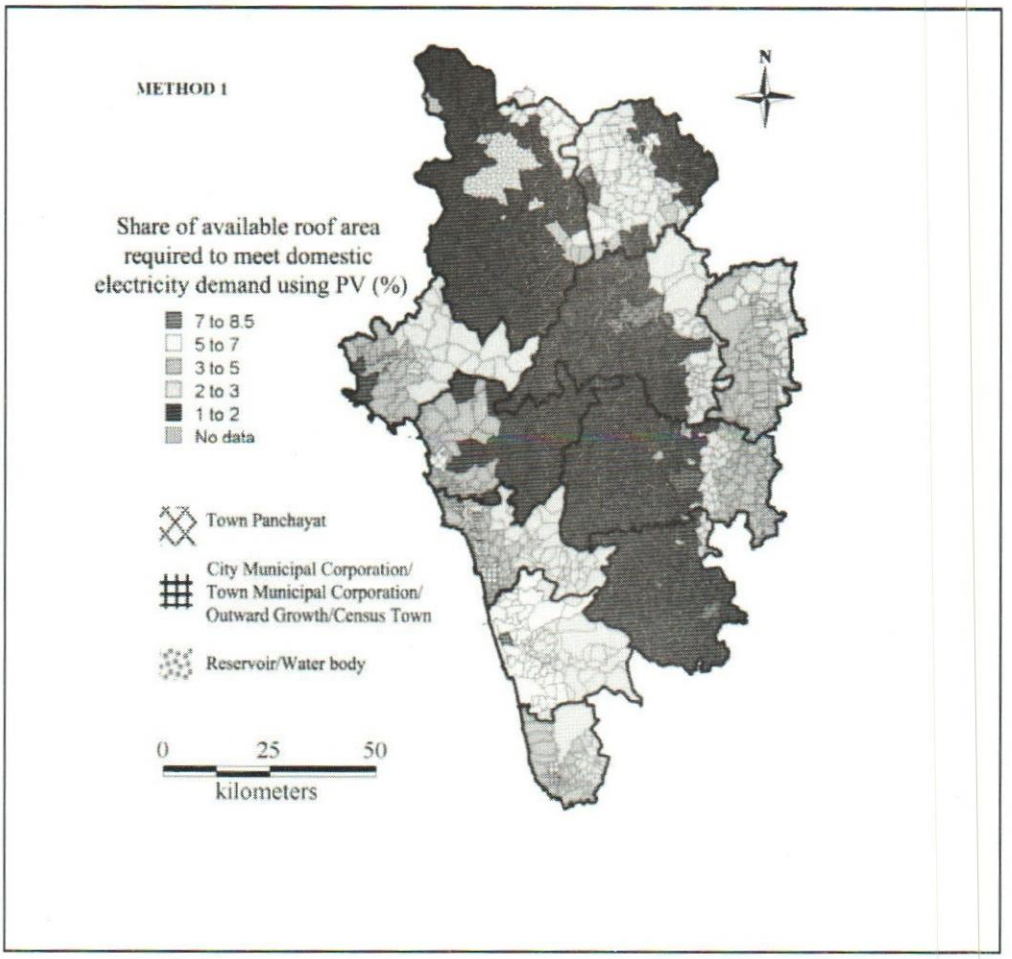

Figure 14: Share of rooftop area required to meet household electricity demand based on method 1

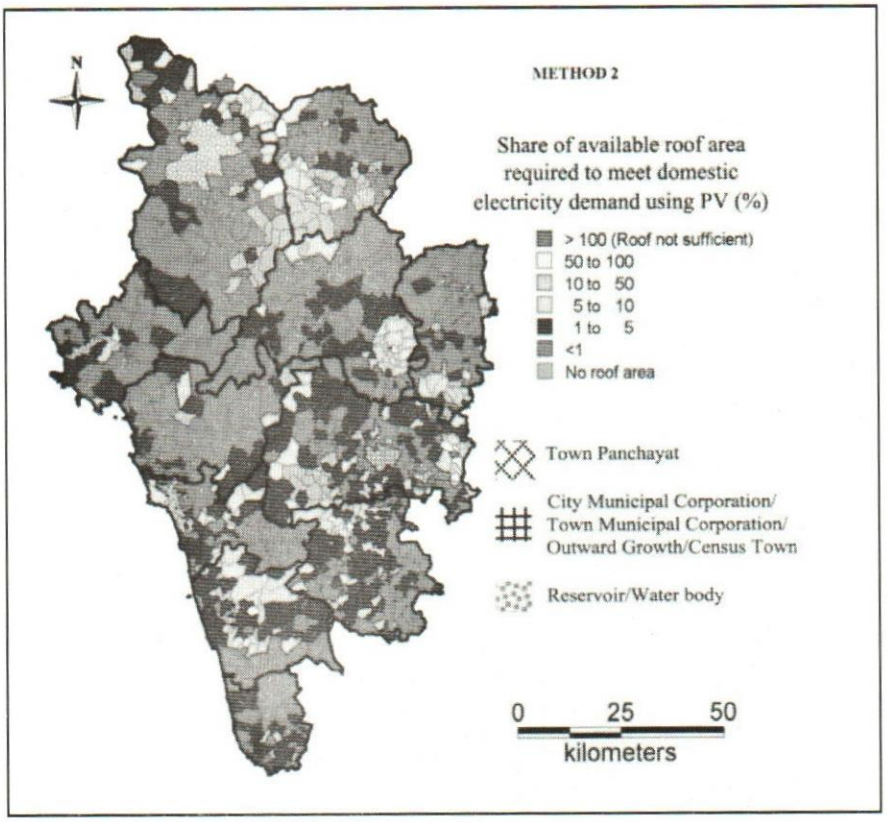

Figure 15: Share of rooftop area required to meethousehold electricity demand based on method 2

this method, less than 7% of the available rooftop area in any region can meet its household electricity requirement using PV. As expected, due to the higher estimation of available rooftop area by method 2, less than 5% can meet this demand using PV in most of the regions. In certain regions where the built-up areas were not classified (due to dense tree canopy, covering the rooftops) and hence rooftop areas were not available according to method 2, it is shown as "roof not sufficient" to meet the demand (Figure 15).

Figure 15 (Method 2: LULC-Land Use and Land Cover) gives the percentage of roof area required to meet the domestic electricity demand using PV. It also shows that in most of the villages, the roof area required to meet the electricity demand of the household using rooftop PV is less than 1%. In some places area required ranges from 1-5 and in few places it is 50-100%. But overall the roof area required is less than 5% to meet the domestic demand of the household using rooftop PV system.

Meeting the electricity demand of irrigation using Solar PV in waste/open land

Village-wise land uses were estimated using IRS (Indian remote Sensing) P6 data of 5.6 m spatial resolution. This analysis provided the details of the extent of wasteland in each village of the district. The proportion of wasteland required to meet electricity demand for irrigation was calculated as discussed earlier (Method section). Figure 16 shows the waste land required to meet the annual electrical energy demand for irrigation considering SPV Standalone panels of efficiency (n) 14% and quality factor (Q) 0.5. Most part of the district is practices rain-fed cultivation without much irrigation. Villages in the coastal zone can meet the irrigation demand with less than 0.5% of the available waste land area. In most of the villages' total electrical energy required for irrigation ranges from 1 to 25,000 kWh per annum. In some places energy requirement is more than 25,000 kWh and less than 50,000 kWh annually. There are few places where the total electrical energy required for irrigation is more than 1,00,000 kWh per annum. The land requirement analysis shows that the electricity demand for irrigation purpose can be met using less than 0.5% of wasteland area in the district. In few places waste/open land area required is more than 0.5% of the total waste/open land area available. However, in Uttara Kannada waste/open land area required will be less than 10% to meet the electricity demand of irrigation by installing PV modules.

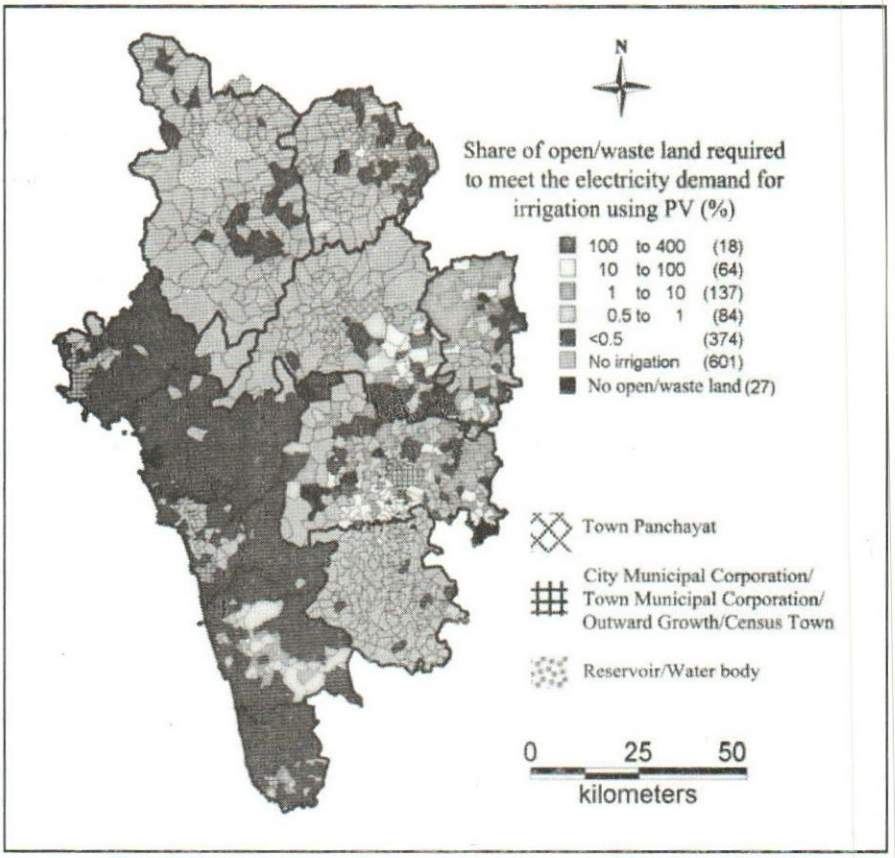

Figure 16: Share of waste land area required to meet electricity demand for irrigation using PV

Techno-Economic Analysis of Rooftop PV System

Electrical energy at household levels is mainly used for end uses such as lighting, heating and pumping of water. The household electricity demand is currently being met by the grid connected system which has its own limitations (Raghavan Shubha. V, et. al., 2011, P: 3180). Many households in the state depend on battery-inverter or diesel generator as a backup system which increases the household expenditure. Also, over 400 million people do not have access to electricity (13 villages in Karnataka) in the country. Hence the decentralized rooftop solar PV systems at individual household level could be the technically feasible solution as it can meet the demand of the household and meeting the increasing demands of rural (remote area) electrification (Ramachandra, Krishnadas Gautham and Jain Rishab, 2012a, P: 3179).

Monthly average electricity consumption of a household in Karnataka (Uttara Kannada district) ranges from 50 kWh to 100 kWh. The average roof area of an urban household is about 1,200 square feet (120 m^2) and that of rural household is 2,000 to 2,500 square feet (200-250 m^2). The portion of this rooftop is sufficient to harvest electrical energy using solar photovoltaic (SPV) system. Table 3 gives the area of PV cell required to generate electric energy at varied efficiencies (like 4, 8, 12 and 16%). Rooftop SPV is a standalone or an off grid

Table 3: Rooftop area (m^2) required for installing SPV[1]

PV module efficiency (%)	PV capacity (Watts)	100	250	500	1000	2000	4000	10000
4	Rooftop area required (m^2) for SPV	30	75	150	300	600	1200	2400
8		15	38	75	150	300	600	1500
12		10	25	50	100	200	400	1000
16		8	20	40	80	160	320	800

[1] Ministry of New and Renewable Energy (GoI)

Table 4: Fraction of rooftop area required for various PV cell technologies

Household with available rooftop area of 100 m²					
Monthly demand	Type of PV module and η				
	Crystalline-Si η=15-20%	Amorphous-Si η=5-7%	Cadmium-Telluride, η=8-11%	CIGS/CIS η=8-11%	
30	1.33	4.00	2.50	2.50	
50	2.22	6.67	4.17	4.17	% rooftop required
100	4.44	13.33	8.33	8.33	
200	8.89	26.67	16.67	16.67	

system and hence do not face any uncertainty such as grid interventions and hence it would be more reliable. The system uses a part of rooftop area for installing PV modules which will be less than 5% of the total roof area. Though the initial cost of such systems is high, it has a payback period of 5 to 7 years and has a life span of more than 20 years (Jain Abhishek, 2012, http://www.bijlibachao.in/Solar/roof-top-solar-pv-system-project-for-home-and-office.html).

For example, to generate 1,000 watts of electricity from 12% of efficiency, 100 m² roof area is required. But this does not give the output for 24 hours a day and all throughout the year. The electricity generated (kWh) from the PV system depends on the panel efficiency and the availability of solar insolation in a location. The factor that defines this output is called CUF (Capacity Utility Factor). For India, it is typically taken as 19% and the energy generated is:

$$\text{Energy Generated Annually (in kWh)} = \text{System Size in KW} * \text{CUF} * 365 * 24 \quad (7)$$

A typical 1 kW capacity solar system will generate 1,600-1,700 kWh of electricity per year. (It may vary according to the location and PV technology used.) This means electrical energy generated per month from rooftop PV system ranges from 130 to 140 kWh (consumption in household is 50-100 kWh). Roof area required for 1KW output PV system ranges from 300 m² (n=4%) to 80 m² (n = 16%) (Installing and Maintaining a Home Solar Electric System, 2012, http://energy.gov/energysaver/articles/installing-and-maintaining-home-solar-electric-system).

Table 5: Unit cost and payback period for SPV system[1,2]

PV module type	Capacity	Cost (Rs/W_p)	Total installation cost	Unit costRs/KWh	Payback period
Crystalline-Silicon PV modules with conversion efficiency of 14-20%	**180** The cost of installed plant capacity of rooftop SPV is about 18 crores/MW	**1 KW_p** Amount of roof space required for the installation of 1 KW_p PV module ranges from 8-12 m²	**1,80,000** Total cost of 1 KW_p system	**15-19** (Without any discount)	**Generally 5-7 years.** (Less than 10 years)

1. Alan Goodrich, Ted James and Michael Woodhouse, 2011. Residential, Commercial, and Utility-Scale Photovoltaic (PV) System Prices in the United States: Current Drivers and Cost-Reduction Opportunities. Technical report by NREL, NREL/TP-6A20-53347, February 2012
2. Alice Solar City 2011. Rooftop solar photovoltaic (PV) system, part of the Australian Government's Solar Cities Initiative

Table 6: Installed plant capacity cost comparison[1,2,3] (Cost/MW)

Type of Power Plant	Cost (Rs/MW) in crores
Coal based (Thermal power plant)	4.5
Hydroelectric	5.5
Nuclear	13
Wind	4 – 5
Solar PV (Grid connected)	20
Solar PV (Rooftop)	1.5 – 1.8 lakhs/KW_p

[1] Nuclear Fissionary, < http://nuclearfissionary.com/2010/04/02/comparing-energy-costs-of-nuclear-coal-gas-wind-and-solar/>
[2] http://aglasem.com/resources/reports/pdf/SOLAR%20VS%20NUCLEAR%20VS%20WIND%20ENERGY.pdf,
[3] http://openaccesslibrary.org/images/HAR224_Adesh_Sharma.pdf,

Table 7: Generation cost comparison of different power plants

Type of Power Plant		Rs/MWh (at 5% Discount rate)	Rs/MWh (at 10% Discount rate)
Nuclear		2440.8	4217.24
Coal		3400.2	4643.17
Gas		3877.65	4339.85
Hydro –	Small hydro	4743	8501.27
	Large hydro	4557.15	8841.65
Wind –	Onshore	4887	8346.17
	Offshore	6276.15	8999.03
Geothermal		4438.35	7244.28
Solar –	PV	12600.45	19058.99
	PV (rooftop)[1]	15854	23273.48
	Solar thermal[2]	9503.1	14809.73

[1] Solar PV (rooftop) system in Germany,

[2] Solar thermal system in United States

Roof area required to meet the monthly demand of a household is estimated for different PV technologies is given in Table 4 considering the average solar insolation of 5 kWh/m^2/day. Area calculated is the actual area of PV module to be installed to meet the demand on rooftop.

Economic Analysis

Table 5 gives the total installation cost of a typical rooftop PV system with the generation cost and payback period. Solar PV module of 1 kW_p with overall system efficiency of 10% is considered for the calculations (LacchiniCorrado, João Carlos and Santos Dos, 2011, P: 183). The costs estimated include all the system components such as battery,wiring and mounting equipment (does not include inverter and backup unit).

Photovoltaic cells directly convert solar radiations into electric power due to the process called photo electric effect. When sun light falls on the surface of PV cell, free electrons are emitted from the cell which flows through the external circuit and delivers the power. The output power is unidirectional or DC power. Normally rated output power is measured in peak Watt (W_p) in standard test condition (STC) which is the product of short circuit current (I_{sc}) and open circuit voltage (V_{sc}). The actual output of the panel may vary according to the location and insolation over the year (seasonal variation). The mean DC output power in Indian climatic conditions ranges from 1,600 to 1,700 kWh per year per kW_p (Vardimon Ran, 2011, P: 592).

The other important aspect which affects the output of the panes is the efficiency which is calculated by measuring the net output of the PV of unit square metre area. The efficiency varies for different materials depending on purity of the silicon and manufacturing technology. For crystalline Silicon, efficiency ranges from 12 to 16% and maximum efficiency achieved is more than 40%. Amorphous silicon, Cadmium Telluride (CdTe) and CIGS (Copper indium gallium selenide) solar cells have lower efficiency of 5-7%, 8-11% and 8-11% respectively (International Finance Corporation (IFC), A Member of World Bank Group, 2011).Cost of the rooftop PV solar system varies from 1.5 to 1.8 lakhs per KW_p installed capacity. Cost may also depend on the other parameters like efficiency, capacity, type of PV cell technology, type of mounting and the geography. Table 6 gives the cost comparison of different power plant on installed capacity basis.

The installation cost of solar PV and rooftop PV are comparable to other technologies and has a payback period of 5 to 7 years. Moreover solar PV system has very less maintenance cost and minimal issues of waste disposal. Also, rooftop solar PV uses the roof space with no landuse restrictions (Lacchini Corrado, João Carlos and Santos Dos, 2011, P: 185).

Thermal power plants are the base load plants (coal or gas based) which supply the larger loads of the country. These plants are centralized plants normally located close to raw material (coal) available places or near to load centres. Such plants may not be installed as decentralized plants for a community or household level. Nuclear and hydroelectric plants are also centralized plants, installed capacity ranges from few hundreds of MW to several thousands. Due to the waste disposal and recitation constraints nuclear power plants are located far away from load centres and cannot be installed in decentralized manner for community level. Hydroelectric plants are the biggest plants which need large area for dam construction to provide suitable head. But small hydroelectric plants (less than 50 MW) can be constructed to supply a small

load centres (community level). Compared to these, solar PV and wind turbine (or hybrid) generation plants can be used as both centralized as well as decentralized to supply community and household level demand. An off grid system may be lower capacity (few hundreds of watts to few KW) which is capable to meet the demand of household or a community demand. Rooftop solar PV systems are the latest development which can meet the household demand and also can supply to the grid. Building-integrated photovoltaic (BIPV) is the upcoming technology in which PV panels are integrated with building materials. (Ramachandra and Dabrase Pramod. S, 2000, P: 15).

Comparative analysis of Generation cost (Cost per MWh) of different power plants:

Generation cost includes the cost of installation of plant (capital cost), operation and maintenance cost (O&M), cost of the raw materials and other expenses. This cost also includes the life time valuation of a plant to the present value. Table 7 gives the generating cost comparison of different power plants (2010) based on the average of 14 countries including three non OECD countries (International Energy Agency (IEA) Nuclear Energy Agency (NEA), Organization for Economic Co-operation and Development, 2010).

Environmental aspect:

On an average, generation of 1,000 KWh of electricity from solar radiations reduces emissions by about 83.6 kg of sulfur dioxide, 2.25 kg of nitrogen oxides and about 635 kg of carbon dioxide. During its 20 years of clean energy production solar rooftop system can reduce tons of poisonous gas emissions to the climate (The National Renewable Energy Laboratory PV FAQs for: U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, 2004).

Conclusion

Solar energy is the most reliable and widely available renewable energy resource for decentralized applications through thermal and electricity conversion. Domestic applications such as thermal conversion, photovoltaic conversion, solar lighting, cooking etc. are influenced by the reception of solar radiation. Solar insolation varies with geography and season, requiring assessment at local levels. Geographic information system (GIS) based insolation data is used for assessing the potential and design of the system where the variations are in acceptable limit and comparison with ground measurements have given better accuracy. Energy potential is computed based on the digitized roof area data from select villages representing all agro-climatic zones in the region with insolation details. With the knowledge of insolation reception and rooftop digitization considering high spatial resolution remote sensing data (Google earth), available potential is extrapolated to the required region of study. Solar PV installation on roof top could be effective in generating electricity from solar sources to meet the domestic energy demand.

Uttara Kannada district has more than 2,70,000 households, which has the electricity consumption of 50 to 100 kWh per month (per household). In meeting this household domestic demand rooftop solar PV systems could play an important role since district has very good solar potential. The fraction of open/wastelands in the district can be utilized to meet the electricity demand of irrigation pump sets using solar PV system. Since the whole country (in tern states and districts) is becoming an energy deficit place, need of further installation of conventional power plants can be scaled down by using decentralized or standalone unconventional methods such as rooftop PV system. Government is also encouraging the solar energy utilization by projects such as JNNSM: Jawaharlal Nehru National Solar Mission, planned to have 20,000 MW of solar energy based power plants in India. Rooftop PV system can contribute significantly to JNNSM and adequately cutting down harmful greenhouse gases and hence reduction in carbon footprint.

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I have always said there is only one thing that can bring our nation down — our dependence on foreign countries for food and energy. Agriculture is the backbone of our economy.

— John Salazar

APPENDIX-I

Sampled regions

Zone	Taluk	Region	Pop	H	Pop/H	R (m^2)	R/H (sq.m)	R/pop	B (m^2)	R/B
Coastal	Bhatkal	Golibilur	506	74	7	4712	64	9	15174	0.31
	Bhatkal	Karikal	880	165	5	10040	61	11	23249	0.43
	Honnavar	Madageri	590	121	5	11460	95	19	15399	0.74
	Karwar	Hosali	610	152	4	10770	71	18	98246	0.11
	Kumta	Lukkeri	1791	280	6	19420	69	11	74672	0.26
		Average					**72**			**0.37**
Dry deciduous	Mundgod	Lakolli	590	116	5	12740	110	22	21896	0.58
	Haliyal	Chibbalgeri	748	126	6	21150	168	28	27470	0.77
	Haliyal	Bidroli	725	137	5	20080	147	28	97171	0.21
		Average					**141**			**0.52**
Evergreen	Honnavar	Hosgod	229	40	6	6475	162	28	4525	1.43
	Honnavar	Dabbod	392	79	5	9629	122	25	15824	0.61
	Ankola	Brahmur	594	114	5	13330	117	22	4625	2.88
	Ankola	Karebail	191	42	5	3848	92	20	1425	2.70
	Karwar	Shirve	374	75	5	10730	143	29	5175	2.07
	Sirsi	Somanalli	198	37	5	9147	247	46	1400	
	Sirsi	Dhoranagiri	302	62	5	13010	210	43	1075	
	Sirsi	Onigadde	348	63	6	10050	160	29	6825	1.47
	Supa	Vatala	245	45	5	6337	141	26	1200	
	Supa	Nandigadde	387	107	4	8912	83	23	5790	1.54
	Supa	Boregali	193	35	6	5590	160	29	750	
	Supa	Viral	91	16	6	2199	137	24	625	
	Supa	Kunagini	95	20	5	2398	120	25	250	
	Supa	Godashet	358	73	5	6270	86	18	5675	1.10
	Siddapur	Halehalla	195	37	5	4612	125	24	100	
	Siddapur	Golikai	332	67	5	9032	135	27	1225	
	Yellapur	Kelashi	245	52	5	8522	164	35	37099	0.23
	Yellapur	Beegar	231	42	6	4432	106	19	2475	1.79
		Average					**139**			**1.58**
Moist deciduous	Mundgod	Chalgeri	455	83	5	6617	80	15	42473	0.16
	Haliyal	Dandeli	53290	11121	5	894200	80	17	2176694	0.41
	Sirsi	Sahasralli	207	40	5	3671	92	18	22099	0.17
	Supa	Kondapa	281	69	4	5212	76	19	4900	1.06
		Average					**82**			**0.45**

Feature

Productivity & Competitiveness of Indian Toy Industry: Prospects & Challenges

K. P. SUNNY AND RAJESH SUND

This paper focuses on major issues and problems faced by Toy manufacturing sector and discuss potentials for the industry besides a comparison of export–import of Indian Toy industry vis-a vis China. The productivity levels of the sector are estimated in terms of labour productivity, capital productivity and total factor productivity during 2008-09 to 2011-12. The concept of 'edutainment' toys has dramatically changed the toy market in India. Toys no longer just fulfill the entertainment requirements of a child, but also cater to the growing requirement of skill development of children. There has been double-digit growth in the demand for toy products over the last five years, in spite of the fact that about 40% of toy manufacturing units closed down during this period. The inexpensive Chinese toys have replaced the branded Indian toys. It has been estimated that almost 80% of the toy market has been taken over by the Chinese toys. The export/import ratio has fallen sharply from a level of 0.65 in 2008-09 to 0.45 by 2012-13 indicating India's declining global competitiveness with respect to toy manufacturing. The estimated partial productivity growth for both labour and capital as well as total factor productivity growth indicates that technology played a significant role in the productivity growth of Toy sector in India. Technology upgradation schemes are vital to make toy sector more productive and competitive in the globalized setting.

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BACKGROUND

Indian toy industry comprises of large number of indigenous manufacturers and a few leading global companies. The toy industry is mainly based in the small and cottage sectors, with about 4000 manufacturers. The toy manufactures are mostly located in Delhi, Mumbai, Punjab, Uttar Pradesh, Haryana, Tamil Nadu and clusters across central states. Around 50% of the toy units are located in Delhi and NCR, 35% are located in Maharashtra while the remaining 15% are scattered all over the country.

The toy market has two broad segments – the "organized" segment, which represents about one-third of the market, and the "unorganized" segment. Mom-and-Pop shops (also known as "Kirana") are mainly "Unorganized" outside the main urban centres, and predominantly operate on a cash-and-carry basis. The "organized" stores are in the big cities – mainly toy specialty stores such as RCS in New Delhi, Hamleys in Mumbai or Prijanka in Hyderabad. Both market segments are growing but the organized market is growing faster at about 35% per year versus the unorganized market at 15%. This difference is partly explained by the relative population growth rates at 2.4% per year for the urban areas versus 1.1% for the rural segment (Lutz Muller, January 2013). The online toy market represents a mere 5% though growing rapidly, is unlikely to have a major influence on the overall demand in the next couple of years.

It is the organized market that attracts large international toy manufacturers such as Mattel, Hasbro, Disney, Lego etc. The unorganized segment gets supplies mainly from wholesalers, who draw their supplies either from domestic manufacturers or Chinese sources. The unorganized marketplace is characterized by very low pricing, small sales volume per store, unconventional

accounting, and a very high percentage of knock-offs of leading Western brands such as Lego. A high degree attributable to knock-offs from China sold in both the organized as well as the unorganized markets. The organized Indian toy market segment is dominated by two leading players – Mattel and Hasbro.

Small toy shops are catering to the masses, while branded ones like Fisher Price, Funskool, Hamleys, Lego and Mattel are catering to the middle and high-class. Funskool Toys is the largest toy producer in India with 30% share, followed by Mattel (20%), Hasbro (9%), Bandai (4%), & Lego (4%) and Leap frog (3%) and the others accounts for about 30%.

Traditionally, the Indian toy industry recorded marginal growth owing to the small scale operations of the indigenous manufacturers which was characterized by limited innovation, lower investments in equipment, technology and minimal marketing. However, in the recent years, the toy market witnessed a steady growth owing to increased urbanization and retail opportunities, availability of branded toys, enhanced income levels etc. Since the modern trade and organized players are growing at 15 to 20 per cent, the industry growth hovers between 10 and 15 per cent. Metros like Ahmedabad, Bangalore, Hyderabad and Pune have recorded the highest growth in toy sales and are fast-emerging as toy manufacturing hubs. With increased availability of toys and games in the market and increasing disposable income, the new emergent pool of customers looks beyond the common toys (those connected with just light, sound and motion).

India is producing quality toys, which is unmatched elsewhere and therefore, the demand for Indian toys is rising by leaps and bounds. Wide range of toys viz. plastics and mechanical, soft dolls, stuffed board games, puzzles, education games, metals and tins wood, electronics toys etc., are produced in India.

Dynamics of the toy industry changed with the opening up of the market for Chinese players. Chinese toys are destroying the Indian toy industry and small and medium toy manufacturers are almost on the verge of collapse. Nearly 2,000 SMEs have closed so far in the last 4-5 years and about 20% of toy companies are on the verge of closure with the rise in imports from China and Italy (Business Standard, August 2013).

Due to the formidable challenges, many toy manufacturers – except Mattel – resorted to tie–ups with reliable Indian counterparts. Funskool India is partners with Hasbro – who has taken a 40% share in the company – and now also with Lego Kool Kidz Products Ltd. has sales and marketing agreements with Little Tikes and Uncle Milton, and Exelixie Management Company has done the same with Simba. Now, even heavyweight ToysRUs has joined forces with Reliance Retail, one of India's largest retailers and is already in tie up with Hamley's, arguably UK's finest toy retailer.

Even though entering the Indian toy market for a newcomer will continue to be challenging, but there are a number of very positive signs that suggest that such an entry should not be delayed too long. The organized market – which is the logical entry point - is growing much faster than the unorganised one for three reasons. One is that urbanization is progressing at a rapid pace – about one-third of the Indian population now lives in cities versus a quarter back in the year 2000. The second reason is that the price levels that Indian consumers are paying for toys are inching up. The third reason is that the Indian authorities are beginning to prosecute the importation, manufacture and sale of counterfeit toys.

A study by ASSOCHAM (2013) highlighted that China has the largest toy market in the world accounting for more than 45% of world's toy market whereas India's toy market has a meager share of 0.51%. Only 20% of the Indian market is served by Indian toy manufacturers while the rest by import of toys from different countries mainly from China and Italy.

The Toy Association of India (TAI) Report (2013) stated that the demand for homegrown toys is growing by 15 to 20 per cent every year. Another important finding of the report is that "the toy sector has primarily become a trader's economy rather than a manufacturing one and there has been significant growth". There is an urgent need for ensuring, 24x7 electricity and supply of raw material for making Indian toy manufacturers competitive. Though Indian toy manufacturers face severe competition from their Chinese counterparts, it helps them to grow stronger.

Smart Research Insights (2012) predicted that toy sector growth will become stronger due to urbanization, expanding consumer base and rising income levels. The size of Indian toy industry is expected to touch Rs. 13,000 crore by 2015 as compared to Rs.7500 crore in 2012. India's toys and games market has reached revenue of almost $2.5 billion in 2011 after maintaining annual growth of almost 9% for four consecutive years as per the estimates by *Market Line*. Market growth is expected to remain at 9% through 2016 to reach $3.6 billion.

National Productivity Council (NPC) (2010) study on 'Productivity & Competitiveness of Toy Sector' analyzed the impact of economic liberalization on productivity and competitiveness of Indian toy sector and recommended immediate, short and long term policy interventions to make toy industry in India a major International force. NPC study recommended setting up two exclusive toy cities in Mumbai and Delhi, to address various issues of toy sector including R&D and design activities etc.

The *Indian toy industry,* exhibits a number of competitive advantages such as skilled and educated workforce, focus on design and innovation, production adaptability and the variety of the products on offer etc. The Indian toy industry is caught in a strange paradox - it has recorded double-digit growth over the last five years; however about 40% of toy manufacturing units were closed down during this period. It has been pointed out that since the cost of labour is going up in China, there are clear signs that customers are now looking at India. India's only problem is manufacturing capacity. Chinese manufacturers are able to consolidate their production through high-level co-ordination and send it to different customers in a single container in a particular country (Business Standard, August 2013).

The issue of differential tax structure and toy safety has become a primary concern for the toy industry as a means to instill confidence in buyers.

In this paper an attempt has been made to illustrate the scenario of Indian toy industry, competition vis-a vis China, productivity trends, levels of output, input, international trade etc.

Growth of Indian Toy Industry

Indian toy industry is reeling under severe competition from cheap Chinese products. It is pulling out all stops to bounce back into children's reckoning with innovative and better designed toys. According to Euromonitor Report (2013), action figures and accessories have shown robust growth of 36% in 2011 within the traditional toys segment. Traditional toys with a price range between Rs 100 and Rs 199 accounted for the majority of sales with 45% share in 2011. Pre-teens between the ages 7 and 12 years were the largest segment of consumers who constituted 43% of the sales in 2011. Licensed toys are becoming a rage among children who generally spend long hours watching children's shows and movies, such as Chhota Bheem, Ben10, Beyblade, etc. Euromonitor Report (2013) estimate this segment to grow by 9% annually between 2011 and 2016.

- **Video games**

  The Video games market performed better than its peers, clocking 43% CAGR between 2006 and 2011. In this segment, online games are becoming increasingly popular not just among teenagers, but also among adults aged between 20 and 30, thanks to increasing disposable incomes, internet connectivity, mobile devices and tablets as well as innovative games coming into the market. More and more adults are playing video games as a pass-time to alleviate the increasing work related stress. All these factors will help this segment to clock an impressive growth rate of 32% during 2011-16.

- **Electronic toys and games**

  Research indicates that kids prefer electronic toys with multiple features over traditional ones. As a result, most of the new launches in this segment are toys with multiple features. The segment as a whole recorded a CAGR of 25% during 2006 to 2011 period. For instance, Think way Toys partnered with *My Baby Excels* to launch the 'Darknight Rises' toy line in India in 2012. The toys were equipped with an infrared remote control system and pre-programmed keys for special stunts and tricks. The toy, which was a hit among children, also featured voice recognition, 360 degree flips, pre-recorded dialogues and much more. Euromonitor Report (2013) foresees a growth of 22% annual growth between 2011 and 2016 for this segment.

- **Ethnic Toys**

  As time passed the Barbie doll replaced the humble clay doll, while Lego took the place of simple wooden building blocks. But, Ethnic toys are staging a comeback with the help of NGOs like *Maaya Organic, Bangalore* which has helped the revival of traditional toy making by infusing market research findings into the ancient Indian craft of wooden and lac-ware toy making. But they are expected to cater to the export segment rather than mass-market segments. "Green" toy makers that use recycled environmentally-friendly material are playing the "non-toxic-yet-cost-effective" card and expect to draw the attention of quality conscious parents. The toys are expected to be touted as the next "big thing" in the Indian toy market. Category-wise historical growth rates and expected growth rates by value are given in table 1.

Table 1: Category-wise Historical and Expected Growth Rates

Category	% CAGR 2006-11	% CAGR 2011-16 (Forecast)
Traditional Toys & Games	15.9	9.1
Video Games	42.7	32.2
Electronic Toys & Games	24.5	22.0

Source: Sarvesh Sharma, NITIE Mumbai, July 2013

Global Toy Market

More than 70% of world toys are manufactured in China. Toys are considered as one of the five most important exports from China. New European standards for imports can adversely affect Chinese toy exports. The percentage of the worldwide market for toys are as follows:

- America – 41%
- Europe – 29%
- Asia/Oceania – 30%
- Africa – 1%

The global toys and games industry is expected to reach $100 billion by 2015, according to research findings of Global Industry Analysts. In recent years the market has been influenced by changing consumer tastes, with children opting for more sophisticated video games and electronic toys. Children are also changing toys more frequently. This means toy and game manufacturers are required to introduce new products on a regular basis, and focus on innovation and technological advancements.

Market growth is fuelled by video, console and computer games, with the industry also benefiting from a growing adult consumer base as this group takes a greater interest in games as a popular leisure pursuit. Industry players are focusing their marketing efforts on older children and adults, with small children no longer considered the industry's main target demographic.

India's Toy Trade with the World

India's toys and games market revenue reached $2.5 billion in 2011 after maintaining annual growth of almost 9% for four years. Market Line estimates specialist store sales accounted for 60% of overall industry revenues at almost $1.5 billion. Market growth is expected to remain at almost 9% through 2016 bringing the market to over $3.6 billion. The Indian toy industry is characterized by fragmentation, small scale of domestic producers, lack of innovation, lack of resources to invest in equipment, technology and advertising. Smart Research Insights predicts growth will become stronger due to urbanization, expanding consumer base and rising income levels. Top players in the Indian toy industry include Hamleys, Funskool India, Hanung Toys & Textiles, Mattel Toys and Ok Play India.

China's toys and games market recorded 10% year-on-year growth in 2011 reaching around $11 billion, reports Global Sources. Market growth is hampered by low overseas sales due to slow recovery from the global recession. Key factors for the industry moving forward include identifying new sources of demand and adhering to increasingly strict safety standards.

China ranks third with 6.75% market share while India ranks ninth with 2.7% of world market, among ten major toy markets in the world. In the case of spending per kid, Australia reported the highest spending at US$ 486 while it is only at US$23 in China and at US$ 6 in India. Among the nations, India reported the highest number of kid population at 352.8 million. This indicates that there is tremendous market potential for toys in India.

Table 2 : World Toy Market - Top 10 Countries in the World in 2010

Country	Country Share in World Toy Market (%)	Spending per Kid ($)	Kid Population	Market 15 years old (%)
United States	26.3	284	62.4	19
Japan	7.5	312	16.9	16
China	**6.7**	**23**	**238.3**	**2**
United Kingdom	5.4	365	10.8	12
France	4.9	307	12.0	10
Germany	4.0	247	11.0	19
Brazil	3.9	59	53.3	4
Australia	2.8	486	4.0	17
India	**2.7**	**6**	**352.8**	**0**
Canada	2.5	317	5.4	17

Source : International Council of Toy Industry.

Table 2 provides details regarding ten major toy markets in the world along with the country's Share in world toy market, spending per kid etc. It may be noted that USA is the number one toy market in the World with 26.3% share of the total.

India's export to World markets has been less than its imports; Exports have increased by more 82 percent

Table 3: International Trade in Toys, Games and Sports requisites, Parts and Accessories between India and the rest of the World [HS Code : 95]

Year	Export (Rs. Lakhs)	Import (Rs. Lakhs)	Trade Ratio (Export/Import)
2008-09	64,192	98,798	0.65
2009-10	63,3512	98,997	0.64
2010-11	74,627	149,756	0.49
2011-12	100,061	203,101	0.49
2012-13	117,058	258,814	0.45
2013-14 (April-Sep)	79,100	144,598	0.55

Source: Department of Commerce, GOI, website: www. commerce. nic.in

during 2008-2013 period while imports increased by a whopping 164 percent during the same period (**table 3).** As a result of fast increasing imports, the export/import ratio fell sharply from 0.65 in 2008-09 to 0.45 by 2012-13. Since import exceeded exports, resulting in the lowest trade ratio during the four years, this declining trade ratio indicates that India's global competitiveness with respect to toy products are going down in the recent years.

The demand for toys have undergone a dramatic change during 1996-2014 period because the concept of 'edutainment' toys has emerged. Toys no longer just fulfill the entertainment requirements of a child, but also cater to the growing needs of skill development of children. Through technology, toys are being made more educational and engaging. The global toys market is characterized by

Table 4: Trade in Other Toys; Reduced Size ("SCALE") Models and Similar Recreational Models, Working/NT; Puzzles of All Kinds from India to World Market (HS Code: 9503)

Year	Export (Rs. Lakhs)	Import (Rs. Lakhs)	Trade Ratio (Export/Import)
2008-09	5767	36258	0.16
2009-10	5819	33359	0.17
2010-11	6756	64551	0.10
2011-12	9078	93902	0.09
2012-13	14227	124084	0.11
2013-14 (April-Sep)	10203	77958	0.13

Source: Department of Commerce, GOI, website: www. commerce. nic.in

licensing agreements between the companies, offering innovative and eco friendly toys to the customers.

Table 4 reports consistent decline in export-import ratio for other toys such as puzzles, small and smaller recreational models during 2008-2013. Exports increased from Rs. 5,767 lakhs in 2008-2009 to Rs.14,227 lakhs by 2012-2013 i.e. reporting about 147 percent increase. In the case of imports it may be noted that it increased from Rs. 36258 lakhs in 2008-2009 to Rs.1,24,084 lakhs i.e. an increase of more than 242%. Trade ratio plummeted from 0.16 to 0.11 during the period under consideration indicating levels at which the imports are increasing i.e. the decline in India's trade competitiveness.

The past one decade has revealed that the Indian toys industry has made quick strides in terms of export and productions. With the lowering tariff barriers, melting of international trade boundaries, the domestics market is now open and the Indian industry is facing the challenges from the domestic distributors and multinational competitors who imports cheaper products mainly from the South East Asian countries and China.

Toy Industry in India vis-a vis China

About 40% of Indian toy manufacturing units have closed down during the last 5 years and a few more are on the verge of closure as Chinese products are flooding the Indian market. A study by ASSOCHAM (2013) reveals that only 20% of the Indian market is served by Indian manufacturers and rest by import of toys from different countries mainly from China and Italy. India's Toy Industry has a meager share of 0.51 percent as compared to China's share of more than 45% of the world's toy market. China's unbranded, cheap toy products have started flooding Indian toy market. Unbranded toys do not adhere to guideline, such as weights and measures which is mandatory for indigenous toy manufacturing. Many do not print the addresses of manufacturers/importers, the maximum retail price (MRP) or manufactured date. The inexpensive Chinese toys have replaced the branded Indian toys. It has been estimated that almost 80% of the toy market has been taken over by the Chinese toys.

The Chinese are offering toys at very low prices with large varieties to choose from. They look attractive and cheap, hence, within the reach of common people. Chinese counter parts are selling simple toys at 20-25% cheaper than Indian manufacturer. As a result although the Indian toy market is worth over Rs 10,000 crore, yet the domestic industry contributing only 30%. The remaining demand is met by Chinese imports. Toy industry contributes

significantly to employment levels in China with 7,287 businesses operating 12,388 establishments and employing 635,299 people in 2013.

Guangdong Alpha Animation & Culture Co Ltd is an important domestic player in China. It represents 3.2% of the Chinese market of traditional toys and games. It supplies the Chinese market with games and toys from its base in Shantou. This city is a hub for toys and games production in China, with several other companies in the region manufacturing toys for the domestic and export market. Guangdong Alpha is mainly focused on the domestic market. In addition, it also exports games and toys to UK and a number of regional and neighboring markets. The company's overall value share within traditional toys and games increased in 2011. Mattel, Hasbro and LEGO are market leaders worldwide for traditional toys and games. While Mattel is the leading company in the world in terms of sales, in China it ranks 4th with only 0.8% share.

Chinese manufacturers use network clustering to reduce supply chain costs. On the other hand, India has a scattered Industrial set up due to the differential tax incentives offered by State Governments. China is the world's biggest toy producer and exporter, taking a two-third share of the international market. China exported toys worth $11.45 billion in 2012, including $2.6 billion to the EU, making the EU China's second-largest market for toys.

The toy factories are an important part of the economic boom that has brought many out of poverty in China. Chinese manufacturers have been innovative and specialize in novelty items. East and South China are major areas of production and export. Guangdong is the largest exporter of toys, with exports amounting to US$11.9 billion in 2005. Zhejiang has moved up from third position to overtake Jiangsu as the second largest exporter. Shanghai, Shandong and Fujian rank 4th, 5th and 6th respectively.

China's toy exports are mainly Original Equipment Manufactured (OEM) products for foreign brands. China's toys export totaled US$ 24.74 billion in 2013, down by 1.61% year on year, of which, the export of traditional toys (include dolls, educational toys, puzzles, electric trains and toy musical instruments etc.) exceeded US$ 12.39 billion, up by 8.18% year on year, accounting for 50.07% of China's total toys export in 2013. The export of video games(not coin or disc-operated) reached US$ 6.83 billion, down by 19.30% year on year, accounting for 27.59% of the total; export of baby strollers & bicycles surpassed US$ 2.85 billion, up by 7.42% year on year, accounting for 11.53% of the total; export of festive articles totaled US$ 3.68 billion, up by 5.35% year on year, accounting for 14.84% of the total.

Major retailers in Beijing and Shanghai, including 17 top department stores and 131 stores of leading toy and baby product retail chains, such as Shin Kong Place, Yansha Youyi Shopping City, SCITECH Plaza, Parkson China, Cuiwei Group, Bao Da Xiang Shopping Center for Kids, Shanghai BaiLian Group, Lijia Baby and MAMA's Goodbaby etc, participated and started the promotion of Safety Commitment Campaign on Toys & Baby Products, to guide Chinese consumers to buy Safety Commitment Brands and high quality products. Till now, 123 overseas and Chinese famous brands, including Mattel, LEGO, Barbie, Transformer, Hot Wheels, Hape, Vtech, SIKU, Beleduc, COMBI, Britax, Chicco, AVENT, NUK, Cybex, as well as Goodbaby, Silverlit, Yeehoo, Gigo, RASTAR and Banbao etc, have joined the campaign and pledged their commitment for producing safety and quality products in China.

Apart from these China's domestic toys and games has advantages of Low wages, Counterfeiting and piracy, Minimal worker health & safety regulations, Lax environmental regulations & enforcement, Export industry subsidies, highly efficient "industrial network clustering", catalytic role of Foreign Direct Investment (FDI), superior infrastructure - both general and specific to toy sector, proximity to Hong Kong, large scale operations and an undervalued currency.

India's Trade in Toy Products with China

Though China is highly competitive in toy manufacturing as compared to India, still some exports are taking place from India to China. **Table 5** reports that India's export of toys, games and sports requisites, parts and accessories to China remained almost stagnant during 2008-2009 to 2012-13 period.

India's export to China with respect to toys, games and sport requisites is less than 1% of India's total volume of toy export to the world. In the case of imports of toy products from China there is considerable increase during the last five years. Moreover, the import of toy items from China is about 74.3% of total toy products imported from the world during 2012-13. Trade ratio also exhibits a dismal picture as the export competitiveness considerably eroded during 2008-2013.

Table 5: India's Trade with China in Toys, Games and Sports Requisites; Parts and Accessories [HS Code: 95]

(Rs lakhs)

Year	Total export from India to World	India's Export to China	Export to China (as % to total)	Total import by India from World	India's Import from China	Import from China (as % to total)	Trade Ratio (Export/ Import)
2008-09	64192	145	0.22	98798	54453	55.11	0.0027
2009-10	74627	216	0.29	98997	68514	69.20	0.0032
2010-11	100061	276	0.27	149756	108536	72.47	0.0026
2011-12	117058	745	0.64	203100	155369	76.50	0.0048
2012-13	79100	677	0.86	258184	191839	74.30	0.0035

Source: Department of Commerce, GoI, website: www.commerce.nic.in

Table 6: India's Trade with China in Other Toys; reduced-size ("scale") models & smaller recreational models, working/ not; puzzles of all kinds [HS Code: 9503]

(Rs lakhs)

Year	Total export of India to World	India's export to China	Export to China (as % to total)	Total import by India from World	India's Import from China	Import from China (as % to total)	Trade Ratio (Export/Import) India with
2008-09	5767	10	0.17	36257	30572	84.32	0.00033
2009-10	5818	3	0.05	33358	29619	88.79	0.00010
2010-11	6756	25	0.38	64550	57476	89.04	0.00044
2011-12	9077	162	1.79	93401	86900	93.04	0.00187
2012-13	14227	340	2.39	124083	113256	91.27	0.00301

Source: Department of Commerce, GoI, website: www.commerce.nic.in

Table 6 reports India's trade with China and rest of the world with respect to other toys, reduced size (scale) models and similar recreational models, working or not; puzzles of all kinds. It may be noted that India's exports to China comprises of only a marginal proportion less than 2.5% of total export of the toy products. While the total export to world more than doubled during 2008-09 to 2012-13, imports have increased more than three times during the same period. Import of this category of toy product from China constitutes more than 90% of total imports by India. Since India is a net importer with respect to both China and rest of the world, there is hardly any export competitiveness for India in this toy product category as well.

Challenges of Indian Toy Industry

According to Euromonitor (2013), spending on toys and games in India is set to grow 157% between 2009 and 2014, much faster than other Asian countries such as China (84%), Taiwan (35%), South Korea (33.1%) and Singapore (17.2%). Indian toy industry is estimated to be around Rs 8,000 crore as on March 2013 and is expected to grow at 30% by 2015 due to the rising demands of toys by the middle class population spending huge amounts for their children (ASSOCHAM, 2013).

Chinese toys offer a wide variety at a cheaper price and attract the children of all ages, the wide range like fun games, electronic toys, board games, construction toys, stuffed toys, educational games, toy cars, etc. The total imports of the Indian toy industry have increased at a CAGR of 25.21 % during 2001-2012. The imports are mainly from two countries viz: China and Italy. The imports from China have grown at a CAGR of 30 % while imports from Italy have grown at a CAGR of 38.6 % during 2001-2012 (ASSOCHAM, 2013).

It is not only Chinese competition that toy manufacturers in India, dominated by micro, small and medium enterprises (MSMEs), are battling against, they face a major challenge from the differential tax structure on electronic and non-electronic products. In accordance with the present tax structure, government imposes Value-Added Tax (VAT) at 5% on non-electronic toys, while the electronic toys attract VAT at a much higher rate of 12.5%. Toy-makers are seeking a uniform VAT rate for all

categories of toys as electronic toys are more in demand. About 70-80 per cent of toys are electronic ones. The differential tax structure has been a deterrent for manufacturers wanting to enter the segment. According to the Toy Association of India (TAI), there is a possibility of Chinese imports escaping the higher tax under the present system. "Sometimes, traders are trading imported toys as mixed products, which includes both electronic and non-electronic toys, and paying the lower tax meant for non-electronic toys on the entire mix. There is always a possibility of such malpractices". The differential structure of Value-Added Tax (VAT) on electronic and non-electronic toys adversely affected the toy sector. Uniformity in tax structure has been a long-pending demand of the toy industry.

Productivity Analysis of Indian Toy Manufacturing Sector

The organized factory sector occupies an important position in toy manufacturing in India. Though the share of registered manufacturing is less in comparison to unorganized sector, its importance cannot be under estimated. The registered factory sector consists of both small and large enterprises. Major statistical characteristics of the organized factory sector are available from Annual Survey of Industries (ASI). Hence, the developments in the organized factory sector can be measured on a time series data. An attempt has been made in this section to analyze the productivity performance of the toy industry (organized factory sector/ or registered manufacturing) in India.

The most significant determinant of competitiveness of any industry is its productivity levels and growth. One important determinant could be its labor productivity. However, besides labour and capital total factor productivity also are critical determinants to competitiveness of the sector.

The toy manufacturing productivity growth has been analyzed during 2008-09 to 2011-12. The sectoral classification adopted in the paper is based on the 3-digit NIC industry Classification scheme 2008.

Data and Variables

Gross Value Added (net value added + depreciation) has been used as numerator for the estimation of productivity ratios. In order to eliminate the price effect on the Gross Value Added (GVA), it has been deflated by whole-sale Price Index (WPI) for toys since it covers most of the categories of the Toys.

The price adjusted GVA has been divided by total number of workers to estimate gross value added per worker or labour productivity. New classifications of industries based on NIC-2008 provide a basis for the standardized collection, analysis and dissemination of industry wise economic data. Therefore labour productivity indices for toy manufacturing sector has been estimated during 2008-09 to 2011-12.

Table 7: Overview of Toy Manufacturing: Registered Factory Sector

(Value in Rs. Lakhs, others in Numbers)

Sr. No.	Indicators	2008-09	2009-10	2010-11	2011-12	CAGR % 2008-09 to 2011-12
1	Number of Factories	131	91	98	102	-8.00
2	Number of Workers	3103	2375	2495	1657	-18.87
3	Gross Value Added	6968	9365	8200	5055	-10.14
4	Value of Output	42029	30475	37825	41281	-0.60
5	Fixed Capital	10937	14447	16333	11767	2.47

Note: GVA, Value of Output & Fixed Capital at 2004-05 prices
Source: Computed from Annual Survey of Industries (ASI)

Key Features of Registered Factory Sector

Some of its important Characteristics of Registered Toy Industry based on Annual Survey of Industries is given in **table 7.**

It may be noted from table 7 that negative growth rates have been reported for Value of Output, Gross Value Added, Number of Factories and Number of Workers. It may be noted that nearly 40% of Indian toy manufacturing units have closed down in the last 5 years and rest 20%

are on the verge of closure as Chinese products are flooding Indian market.

Productivity Analysis of Toy Industry

Methodology adopted for the estimation of labour & capital productivity are as follows:

A. Labour Productivity

Labour input is considered as the total number of persons engaged in the production process. The data compiled from Annual Survey of Industries summary results for factory sector for various years. The Gross Value Added data has been first deflated by the whole sale price index for the Toy Manufacturing sector (Broad Category) for the series from 2008-09 to 2011-12 with NIC classification 2008.

$$\text{Labour Productivity (LP)} = \frac{\text{((Gross Value Added/Price Index) X 100)}}{\text{No. of Persons Engaged}}$$

Labour Productivity Growth

Labour productivity growth has been estimated as:

$$\text{Labour Productivity Growth} = \frac{\text{[Labour Productivity(t) – Labour Productivity(t-1)] X 100}}{\text{Labour Productivity } (t\text{-}_1)}$$

B. Capital Productivity

Book value of fixed capital computed from the ASI data has been used to estimate the capital stock based on Perpetual Inventory Method.

- The book value of fixed capital at 2008-09 is multiplied by Gross net ratio of capital to find out the first year capital stock.
- Incremental capital at constant prices (deflated with the machinery and machine tools prices index at 2004-05 prices) is added annually to the initial year capital stock of 2008-09 for estimating the capital stock at constant prices.
- Incremental capital = (Fixed capital 2009-10 - Fixed capital 2008-09)
- Annual depreciation of 5% is deducted from the capital stock assuming the life of capital 20 years.

To calculate the capital productivity we have divided Gross Value Added at constant prices by the estimated capital stock from 2008-09 to 2011-12.

C. Total-Factor Productivity Growth (TFPG)

Total Factor productivity Growth has been considered as the result of technical progress.

$$\text{Capital Productivity} = \frac{\text{Gross Value Added at constant prices}}{\text{Capital stock at constant prices}}$$

$$\text{Capital Productivity Growth} = \frac{\text{[Capital Productivity(t) - Capital Productivity}(t\text{-}_1)\text{]} \times 100}{\text{Capital Productivity } t\text{-}_1}$$

Technical progress or TFPG is estimated as the difference between output growth and aggregate input growth.

TFPG = GVA – [WL x LPG + WK x KPG]

Where, WL + WK = 1 and
WL = Wage Share in Total Cost

WK= Capital Share in Total Cost

The estimated partial productivity (labour and capital) and Total Factor Productivity growth during 2008-09 to 2011-12 are given in **table 8.** It indicates that technology plays a significant role in the productivity growth of Toy sector in India. It may be noted from declining capital productivity that more and more capital investment is taking place in the registered toy manufacturing sector as compared to earlier years. The higher capital investment in turn contributed to higher technical progress and contribution to productivity growth resulting in higher total factor productivity growth.

Therefore, it may be noted that technology up gradation schemes are vital to make the toy sector more productive and competitive in the globalised setting. The averages of capital productivity growth is negative while labour productivity growth is positive during these 4 years

Table 8: Partial and Total Factor Productivity Estimates of Toy Manufacturing Sector

Year	Capital Productivity (Rs.)	Labour Productivity (Rs. Per person employed)	Capital Productivity Growth Rate (%)	Labour Productivity Growth Rate (%)	Total Factor Productivity Growth Rate (%)
2008-09	1.41	189507			
2009-10	2.15	359515	52.82	84.76	-31.18
2010-11	1.19	313452	-44.78	-16.48	-22.72
2011-12	0.92	291605	-22.25	-12.59	-19.64
Average for the period 2008-09 to 2011-12			**-4.74**	**6.19**	**-9.37**

Source: Computed from Annual Survey of Industries (ASI)

which indicates that increase in capital formation requires to make on continuous basis to provide impetus for TFPG of Toy Industry in India.

Conclusion

With the lowering tariff barriers, melting of international trade boundaries, the domestics market is now open and the Indian industry are facing the challenges from the domestic distributors and multinational competitors who imports cheaper products mainly from China. Only 20% of the Indian market is served by Indian toy manufacturers while the rest by import of toys from different countries mainly from China and Italy.

Although the toy sector has primarily become a trader's economy rather than a manufacturing one, there has been double-digit growth over the last five years, in spite of around 40 per cent of toy companies have closed down during this period. As a result of fast increasing imports, the export/import ratio fell sharply from a level of 0.65 in 2008-09 to a low level of 0.45 by 2012-13. Since import exceeded exports, resulting in the lowering trade ratio during the four years, this declining trade ratio indicates that India's global competitiveness with respect to toy products are going down year after year.

The concept of 'edutainment' toys has dramatically changed the demand. Toys no longer just fulfill the entertainment requirements of a child, but also cater to the growing needs of skill development of children. The inexpensive Chinese toys have replaced the branded Indian toys. It has been estimated that almost 80% of the toy market has been taken over by the Chinese toys. In recent years the market has been influenced by changing consumer tastes, with children opting for more sophisticated video games and electronic toys. Children are also becoming increasingly accustomed to changing toys more frequently. Thus toy and game manufacturers are required to introduce new products on a regular basis, and focus on innovation and technological advancements.

Partial productivity growth and total factor productivity growth estimations indicates that technology plays a significant role in the productivity growth of toy sector in India. Increased level of capital investment is taking place in the registered toy manufacturing sector as compared to earlier years, which is contributing to higher technical progress and contribution to productivity growth resulting in higher total factor productivity growth. Thus technology up gradation schemes are vital to make the toy sector more productive and competitive in the globalised setting.

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Stay committed to your decisions, but stay flexible in your approach.

- Tom Robbins

Database

Labour Productivity and Output Growth: A Comparison of Asian Countries with USA

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Labour Productivity Growth: Economy Level

Per worker measures of labour productivity growth of Asian countries far exceeded that of US, allowing the countries to close the gap with the US gradually over time. The Labour Productivity Growth in India was 5.6 per cent per annum on average between 2000 and 2011, compared to 9.4 per cent in China and 1.7 per cent in US respectively. The Labour Productivity Growth based on average annual growth rate of GDP at constant basic prices per worker, using 2005 PPP is given in Table 1.

Table 1: Average Annual Labour Productivity Growth (2000-2011)

Country	Growth (%)
Bangladesh	2.4
China	9.4
ROC	2.8
Hong Kong	3.2
India	**5.6**
Indonesia	3.2
Japan	1.0
Korea	3.0
Malaysia	2.0
Myanmar	9.9
Philippines	1.9
Qatar	-1.8
Singapore	1.8
Sir Lanka	3.7
Thailand	2.5
Vietnam	4.5
ASEAN	3.0
USA	1.7

Labour Productivity by Industry

Cross–country comparison of average annual growth rate of labour productivity growth by industry for the period 2000-2010 is given in Table 2. Positive labour productivity growth was achieved across all industry sectors by India. The service sector is major push on India's economy level productivity performance but agriculture and mining are major drag in achieving high productivity growth, in fact, the sector that managed the fastest labour productivity growth were transport, storage and communication (9.5 per cent), finance, real estate and business activities (6.8 per cent), construction (6.4 per cent). Mining as part of the industry sector with the slowest productivity growth at 1.5 per cent, whereas labour productivity growth achieved by agriculture sector was only 2.5 per cent.

As compared to Asian countries, the US labour productivity growth was stronger in three sectors: agriculture (4.1 per cent), manufacturing (5.1 per cent) and transport, storage and communication (4.9 per cent). If we look at individual countries, however, there was stronger performance than the US in various sectors. For example, Agriculture, China (6.7 per cent) and Korea (4.9 per cent); wholesale, retail trade, hotels and Restaurants, China (8.3 per cent) and India (6.1 per cent). In case of transport, storage and communication, India (9.5 per cent), Indonesia (9.9 per cent), and China (7.1 per cent). Similarly in Finance, real estate & business activities in China (8.9 per cent) and India (6.8 per cent).

Although different countries top the ranking in different industry segments, China was the only country with labour productivity persistently strong and close to the region's leaders across all sectors. In contrast, India experienced relatively lower labour productivity growth in agriculture, mining, manufacturing and electricity, gas and water supply.

Output Growth by Industry

The agriculture sector is much more significant in most of the countries of Asia than in the US. Overall construction sector retrenched in the US, while growth has been strongest in Asia. As far as India is concerned, construction (9.1 per cent) presumably reflecting the effort in building and upgrading infrastructure for the development needs (Table 3). The agriculture sector is much more significant in most of the countries of Asia than in the US. Overall construction sector retrenched in the US, while growth has been strongest in Asia. As far as India is concerned, construction (9.1 per cent) presumably reflecting the effort in building and upgrading infrastructure

Table 2: Average Annual Labour Productivity Growth by Industry (2000-2010)

(%)

Sr. No.	Country	Agriculture	Mining	Manufacturing	Electricity, Gas and Water Supply	Construction	Wholesale and Retail Trade, Hotels and Restaurants	Transport, Storage and Communication	Finance, Real Estate and Business Activities	Community, Social and Personal Service
1	Bangladesh	**0.8**	7.4	1.3	7.8	-1.2	3.3	2.1	-0.6	5.0
2	China	**6.7**	9.0	8.0	8.1	7.6	8.3	7.1	8.9	8.0
3	ROC	**3.0**	5.9	6.1	3.1	0.0	2.1	2.8	-0.2	0.2
4	Hong Kong	**-1.8**	0.0	5.3	3.0	-1.1	5.0	2.3	1.0	0.1
5	**India**	**2.5**	**1.5**	**3.4**	**3.1**	**6.4**	**6.1**	**9.5**	**6.8**	**3.6**
6	Indonesia	**3.1**	-3.0	2.5	4.0	1.9	3.7	9.9	-0.4	0.0
7	Japan	**0.9**	-1.1	3.7	1.0	-0.5	-0.6	0.8	0.7	0.3
8	Korea	**4.9**	-3.3	6.8	3.4	1.0	2.9	0.7	-0.6	-0.5
9	Malaysia	**2.7**	-7.2	4.2	-4.4	-0.9	1.8	0.6	-0.8	3.2
10	Myanmar	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	Philippines	**1.2**	4.5	2.8	1.0	1.6	-0.7	3.8	-2.7	3.4
12	Qatar	**-2.3**	-9.4	0.4	6.2	0.1	4.3	3.2	2.3	1.4
13	Singapore	**-6.9**	0.0	3.9	1.2	0.1	2.4	0.5	-0.4	-0.1
14	Sri Lanka	**2.8**	11.2	2.4	13.6	4.7	1.7	4.5	-0.8	3.3
15	Thailand	**1.5**	5.9	4.0	6.1	-0.7	0.0	4.3	1.6	-0.2
16	Vietnam	**3.7**	1.1	3.7	1.4	-1.5	1.0	5.3	-8.3	-1.4
17	ASEAN	**3.1**	-2.2	2.7	1.1	0.4	2.1	5.3	-1.2	0.5
18	USA	**4.1**	-2.2	5.1	0.9	-2.3	1.9	4.9	2.0	0.0

for the development needs (Table 3). manufacturing (8.1 per cent), wholesale and retail trade, hotels and restaurants (8.8 per cent), transport, storage and communication (12.2 per cent) and finance, real estate and business activities (9.5 per cent) are the fastest-growing sectors enjoying robust expansion.

It is interesting to note that the output in all industrial sectors in China grew faster than those in India except transport, storage and communication showing India's special strength. Industrial specialization in service has intensified in India, with agriculture hollowing out. The average annual growth rate of industry GDP at constant prices are given in Table 3.

Table 3: Output Growth by Industry (2000-2010)

(% age)

Sr. No.	Country	Agriculture	Mining	Manufacturing	Electricity, Gas and Water Supply	Construction	Wholesale and Retail Trade, Hotels and Restaurants	Transport, Storage and Communication	Finance, Real Estate and Business Activities	Community, Social and Personal Service
1	Bangladesh	**3.4**	7.9	7.2	6.8	7.2	6.5	7.3	4.4	5.5
2	China	**4.1**	10.7	10.7	10.7	11.9	12.1	8.7	11.4	10.5
3	ROC	**0.1**	-4.2	6.9	2.8	-0.4	3.3	3.0	2.6	2.6
4	Hong Kong	**-2.7**	-6.9	-3.8	1.6	-2.2	6.2	4.1	4.5	1.6
5	**India**	**3.1**	**4.6**	**8.1**	**5.8**	**9.1**	**8.8**	**12.2**	**9.5**	**6.3**
6	Indonesia	**3.4**	1.1	4.4	7.7	6.7	5.8	12.1	6.5	5.2
7	Japan	**-1.1**	-7.7	1.8	1.0	-2.7	-0.5	1.2	0.6	1.3
8	Korea	**1.3**	-1.1	6.1	5.4	2.0	2.4	5.0	3.6	3.6
9	Malaysia	**2.9**	0.4	3.4	4.6	2.7	6.3	5.9	6.9	5.3
10	Myanmar	**7.9**	13.2	19.8	12.0	18.6	10.8	16.7	22.5	12.0
11	Philippines	**2.8**	10.7	3.7	4.4	4.7	5.2	6.7	6.2	4.4
12	Qatar	**6.0**	9.8	10.6	6.6	21.5	16.5	22.9	16.2	10.2
13	Singapore	**-0.2**	0.0	5.5	4.0	2.5	6.4	3.9	5.4	5.0
14	Sri Lanka	**2.8**	12.1	4.0	6.3	6.2	4.8	8.3	5.6	4.3
15	Thailand	**2.0**	5.0	5.4	5.6	3.8	3.5	5.7	5.7	3.4
16	Vietnam	**3.5**	1.7	9.9	12.2	9.3	7.5	8.8	5.4	6.3
17	ASEAN	**3.5**	1.5	5.0	6.3	5.8	5.6	8.0	6.1	4.8
18	USA	**3.1**	0.1	1.1	0.1	-3.7	1.3	3.4	2.0	1.2

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