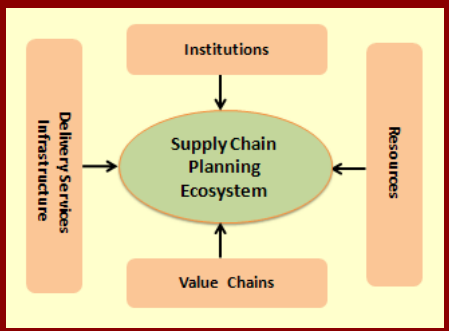
Design of Smart Villages

INDIA

Moving up the Service Chain



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Abstract

In this paper, we describe the ecosystem for a village and then map out an integrated design procedure for building a smart village. We define a Smart Village as a bundle of services which are delivered to its residents and businesses in an effective and efficient manner. Dozens of services including construction, farming, electricity, heath care, water, retail, manufacturing and logistics are needed in building a smart village. Computing, communication and information technologies play a major role in design, delivery and monitoring of the services. All the techniques and technologies needed to build a smart village are available now and some of them are being used in villages in India but these are disparate, fragmented and piecemeal efforts. We recognize that the need of the hour is - strategy, integrated planning and above all monitoring and execution of the activities using appropriate governance models. Our integrated design is a way forward to deal with the demographic deficit and also achieve the goals of inclusive growth. It is replicable and can be used to design and build smart villages in other parts of the World.

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1. Introduction

1.1 Current state of Indian Villages

Of India's 610 districts, the National Rural Employment Guarantee Act has a list of 200 backward districts. Similarly, out of India's 600,000 villages, around 125,000 are truly backward. There are 78 regions in the country, as per the NSS (National Sample Survey) classification. Based on these regions, the World Bank (2004) identifies 18 regions where human development is low. Currently, there is lot of public spending to improve the infrastructure, water and sanitation in these areas. The Socio- economic dualism in Indian economy is tackled by the Government by taking responsibility for uplifting the rural and the economically poorer sections. The Government does this by giving subsidies, loan waivers, and quota systems in educational institutions, jobs and offering several other schemes based on caste and profession. All these efforts are disparate, fragmented and piecemeal efforts and not much improvement has been achieved in most of the villages.

On the other hand, the villages themselves are a powerhouse of large pool of man power. As we perceive there is a huge scope for the villages to be self sufficient and sustainable on their own. About 700 M people in India live in villages and at least half of them are below 25 years of age. Availability of this rapidly expanding pool of young workers could and should be a major advantage for India's economy if – a. the new generation of workers is healthy and educated b. the government succeeds in addressing social infrastructure (housing, health care, schools, colleges and universities) c. labor markets are generated for all categories of people primarily for those who are educated up to only the middle school. Hence, there is an imminent requirement for vocational training in villages. Vocational education can be broadly defined as a training program which prepares an individual for a specific career or occupation. The National Sample Survey 61st Round results show that among persons of age 15–29 years, only about 2% are reported to have received formal vocational training and another 8% reported to have received non-formal vocational training indicating that very few young people actually enter the world of work with any kind of formal vocational training. This proportion of trained youth is one of the lowest in the world. The corresponding figures for industrialized countries are much higher, varying between 60% and 96% of the youth in the age group of 20–24 years.

By not providing attention to this aspect, the planners are creating huge opportunity for several devastating risks of either huge epidemics or diseases such as HIV, TB, and hepatitis sweeping across the country and also for raise of unrests by jobless. There is no integrated approach for a village design so far and various services are provided in an ad-hoc manner. Most of them are left unfinished or not maintained properly. Schemes such as NREGAS provide employment for some rural folks but these have become breeding grounds for huge leakages and corruption. Though IT services are provided by leading service providers such as TCS, NIC, HP and others, these automate the existing manual accounting processes rather than streamlining, redesigning, modularizing and standardizing the entire value delivery processes. There are a few initiatives like e-panchayats and e-kiosks, designed to provide information and for payment of bills. While these efforts are really laudable and may be meeting the identified goals but they are still not strategically designed to contribute to the growth of the village in a wholesome fashion. Thus, the design of a village with all the essential utility services such as electricity, heath care, water and employment guarantee through farming and small scale industries is an important issue. Therefore there is an impending need to reconsider design of a village and hence Smart Villages.

In recent times, there is an immense interest in the development of Smart Cities [3]. But as we perceive, in the Indian context, villages are the heart of the nation. Hence, for the development to percolate to the grass root level, focus must be devoted to the progress of villages. In spite of a large scale migration of people from rural to urban areas, which is increasing the burden and posing a huge threat to the cities, still there are some villages which are thickly populated. The main aim is to smarten the villages using advanced wireless, IT and other latest technologies and also to encourage entrepreneurial attitude among its residents to achieve self sustainability. This is the backdrop of our interest for this paper which goes in line with the vision of Mahatma Gandhi – “The best, quickest and most efficient way is to build up from the bottom. Every village has to become a self-sufficient republic. This does not require brave resolutions. It requires brave, corporate, intelligent work.”[3]

1.2 About this paper

In the subsequent sections of this paper, we first define and describe what we mean by a Smart Village. We then propose an Ecosystem framework to understand the concept of

Smart Villages thoroughly. Then we suggest a methodology for the design of a Smart Village. In the next section, we propose governance models and performance frameworks for Smart Villages. In the end, we take a case of an agriculture based village and elucidate the various concepts discussed.

2. Smart Village Ecosystem

Definition (Smart Village Ecosystem): An Ecosystem comprises of networks of SMEs, farmers, employees; local, state and central governments; other industrial, social and political organizations; infrastructure, logistics and Information Technology, communication services that connect the companies and the states to the external economic and social environment; and resources including natural, financial and skilled human resources with connections, knowledge of the industrial environment, interacting together with the Landscape (space or domain) and climate to provide the services for a village.

Figure 1 shows a typical smart village ecosystem. This Ecosystem approach integrates all the institutions that are responsible, resources needed, services to be rendered and the service delivery technologies and mechanisms. We define ***smart village*** as a bundle of services delivered to its residents and businesses in an effective and efficient manner. The Smart Village ecosystem brings all the services of the village and its providers and users on a single platform.

Dozens of organizations need to collaborate across industries to build a smart village. These include Governments, Social organizations, Companies big and small, Farmers, labor etc. Many of these organizations fall outside the traditional value chain of suppliers and distributors that directly contribute to the creation and delivery of a product or service. The ecosystem also comprises entities like regulatory agencies and media outlets that can have a less immediate, but just as powerful, effect on the business in the village.

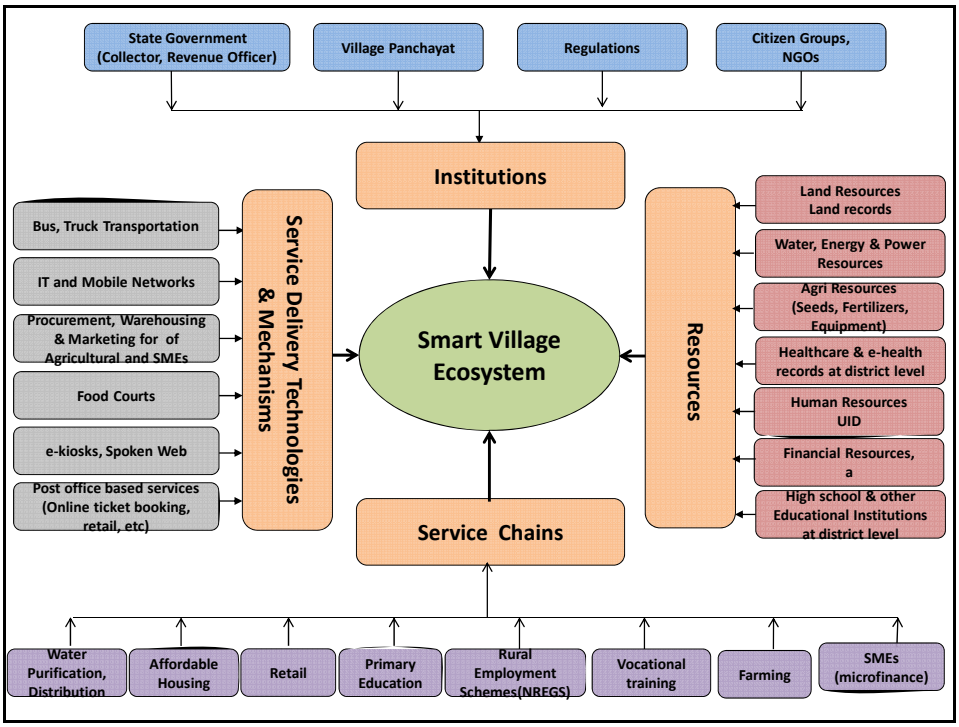

Figure1: Smart Village Ecosystem

The smart village is a formation resulting from co-evolution of four distinct forces and innovations these four sectors. They include

- Modular services and Modular service chains
- Service delivery technologies such as logistics and IT and their mechanisms
- Institutions that influence the governance and regulations
- Resources and their management

The basic services offered to the rural residents are supply of purified water, affordable housing, primary education, vocational training, help in farming techniques, procurement of seeds and fertilizers, training and employment opportunities in SMEs like leather, crafts, food processing units, retail / kirana shops. The services delivery technologies and mechanisms like road transportation by bus/truck ; IT and mobile networks; procurement, warehousing and marketing for agricultural and SME produce; Food Courts; e-kiosks for bill payment; applications like Spoken web for commodity price broadcast, social networking, etc; post office based services like ticket booking, e-purchase, etc need to be developed. Existing infrastructures like post offices can be used as village information centers that provide all the information from market prices of various commodities, advice related to agricultural, animal husbandry or health related issues, educational

information for students of class X and XII, employment opportunities, career guidance for young people, to online applications for pan card, driving licenses, tax and bill payments etc. They can also have a call centre based regular monitoring and grievance system so that their complaints are attended to. This calls for a lot of awareness and training in the initial phases to educate and make people acquainted with the new systems. Vocational training has to be provided on a large scale to make them familiar with IT, maintenance of records, operation of the equipment and managing their finances.

Proven initiates such as micro finance need to be nurtured more strategically in rural areas. Insurance schemes like crop insurance, livestock/cattle insurance, health insurance, life insurance, insurance in case of natural disasters etc should be provided. There is a huge gap between the skills needed to work in the agriculture sector for low wages and those needed for working in services such as health care, plumbing, brick making, or other more skilled occupations where the wages are higher. The governments have identified about 400 needed skills including in maintenance, operation and repair of various systems so that the village can be self sufficient. We must fundamentally innovate, develop new pedagogical tools, and apply technologies in ways that it has not been applied anywhere else in the world.

The government and other agencies have several innovative schemes for providing the employment to the rural populations and provide free access to services such as water, power, etc. The effect is not felt because lack of systematic strategy, planning, developing a group of companies' that can work together in a coordinated fashion to reach the end goal of proving the services and also employment. Our paper provides a holistic picture of the village and the prioritized execution of various activities.

2.1 STERM Framework

The Smart Village ecosystem is built on the STERM (Science, Technology, Engineering, Regulations and Management) framework. The Royal Society report on hidden wealth argues that innovations which have contributed to the quality life on this planet are as a result of STEM (Science, Technology, Engineering and Mathematics). But, evidence from our studies shows that two more sciences make immense contribution to the service sector growth: institutional economics (regulations and policy) and management science. Thus, our thesis is that application of STERM to services can create competitive and

efficient service sector. The significance of Science, Technology and Engineering in the design of smart services is widely known. The other two factors are Regulations and Management. Regulations play a pivotal role in every business and impact the day to day activities of the villages directly. All the government schemes and acts, market dynamics bear a close relationship with the Regulations. Management is very much essential to carry forward the activities of any system. Management in a smart village involves disaggregation of services into standardized processes and planning and executing them using appropriate business models, technologies in particular computing, IT and communication.

Entrepreneurship is absolutely fundamental to design, develop and operate smart villages. Numerous new innovations are needed for building smart villages which include audio visual interfaces for all applications, equipment that can withstand harsh environments, talented people with capabilities that far exceeds those of the current IT workers. We need innovations on the scale of products such as Tata Nano, low cost medical equipment as done by GE, low cost housing, re-conceived washing machines or an oven or a school, processed food, food courts with hygienic affordable and nutritious food, etc. Innovations and risk analysis must be carefully looked into for each of the service that is being designed. Developing and nurturing the smart villages is the best way India can reap the ***"demographic dividend"*** i.e. the large and expanding workforce. All these innovations can be exported back to both advanced and under developed countries and the models used can be replicated.

3. Methodologies for the design of a Smart Village

The design methodology that we propose for building a Smart Village consists of

- Assessment of the Investment Climate of the village
- Formulate the Growth Strategies for the Village

3.1 Assessment of Investment Climate of the village

Investment climate of a region is defined as policy, institutional, and behavioral environment, both present and expected, that influences the returns, and risks, associated with an investment. We perceive these as location specific factors like infrastructure, primary occupation of majority of people, nature of industries/business (SMEs) and finance inflow/outflow that impacts the investment and growth of the region.

The investment climate of villages differs depending upon the significant occupation of the village and its natural resources. The primary occupation of the villagers can be farming, aqua culture, working for industries such as apparel or leather goods or doll making. The village can be a tourist location, pilgrimage centre, or a place of historical importance etc. Mines, Forests, Ocean shores or River banks can be part of the natural environs of the village. So the growth strategy of a village depends primarily on its investment climate. Hence, assessment of investment climate of the village is the first step in design of a Smart Village.

3.2 Formulate Growth Strategies of the Village

Providing quality utility services like power, water, sanitation, and essential services such as education, healthcare, transportation, infrastructure (roads, railways, buildings, equipment) etc must be the primary strategy for the development of every village. Some of the utility services can be managed at a district level and others such as health care, schooling etc need to be managed at village level for proximity and accessibility reasons. Investment climate of the village is also impacted to a very large extent on the availability of the above mentioned utility and other services in the villages.

The next step is to formulate Growth Strategies for the village to make it self-sufficient taking into account the investment climate and other factors discussed above. Strategic questions such as what the kind of SMEs needs to be developed in the village, the kind of vocational training to be given to the residents of the village and how to attract investment as well as entrepreneurs must be formulated and answered. For example: If a village is a tourist location, then the growth strategies would be aligned towards construction of restaurants and hotels, development of transportation services like cabs or buses, vocational training to act as guides, security, working as chefs in restaurants or kirana shops selling the unique products made in the village, pharmacies and hospital services through mobile van etc. The residents of the village can be trained to be engaged in providing the above mentioned services. Once there is a clear picture on the kinds of industries/ SMEs that must come up in the village, then the funding agencies Micro finance Institutions or NGOs that can be decided. The Business Development comes to the village.

Although, we concentrate on self sufficiency of the villages here, the issue of the village being a part of a SME cluster or a part of the global value chain should not ignored. There are several villages in India like jaipur rugs, pochampally saress which are a part of the global value chains. Even here orchestrators who can manage the order to delivery supply chain, with deep domain knowledge and connections with the government and industries are needed. The Governments need to support these entrepreneurs and enable their success.

Once the design methodologies for designing the Smart Village are formulated the next aspect is execution of the strategies using appropriate governance models.

4. Governance Models

Currently the village panchayats are governed by the president and his team. These are elected representatives of the people. But their capabilities are well below those required to build a smart village. The village governance system should have several orchestrators working together along with the people and the businesses. Water, Power and Retail could be orchestrated at the district level for a group of villages, governed by a group of companies. Schools, health care and farming may need local attention. The knowledge based technologies which provide the smartness and the relationship with other stakeholders need to be built by people with entrepreneurial talents. Thus we see building a smart village requires talents available beyond the village or district. We discuss below an organizational structure and assign the responsibilities and that would make a smart village work.

The Governance model we propose is a collaboratory model where in various organizations like Funding agencies, Industries, Business Development units collaborate with Government and local village Panchayts to develop a Smart Village. At the highest level is the Advisory Board with members from the Village Panchayat, Funding agencies, Government and Industry which sets the agenda for growth and maintenance of high quality services. The Executive Director who works with the Business Development receives inputs and reports to the advisory board and is responsible for planning and execution. In the next level three managers are responsible for the day to day activities of various services of the village which are grouped into three clusters. The services in Cluster1 are Utility services like water, power, affordable housing and transportation. The

services in cluster2 cater to the services that are local to the entire village and they are healthcare, education, waste disposal, retail. The last cluster is the employment development cluster that deals with services like government rural schemes, vocational training, post office based services and promoting SMEs among the rural population. Thus the village needs a professional organization structure which collaborates with neighboring villages for mutual benefit.

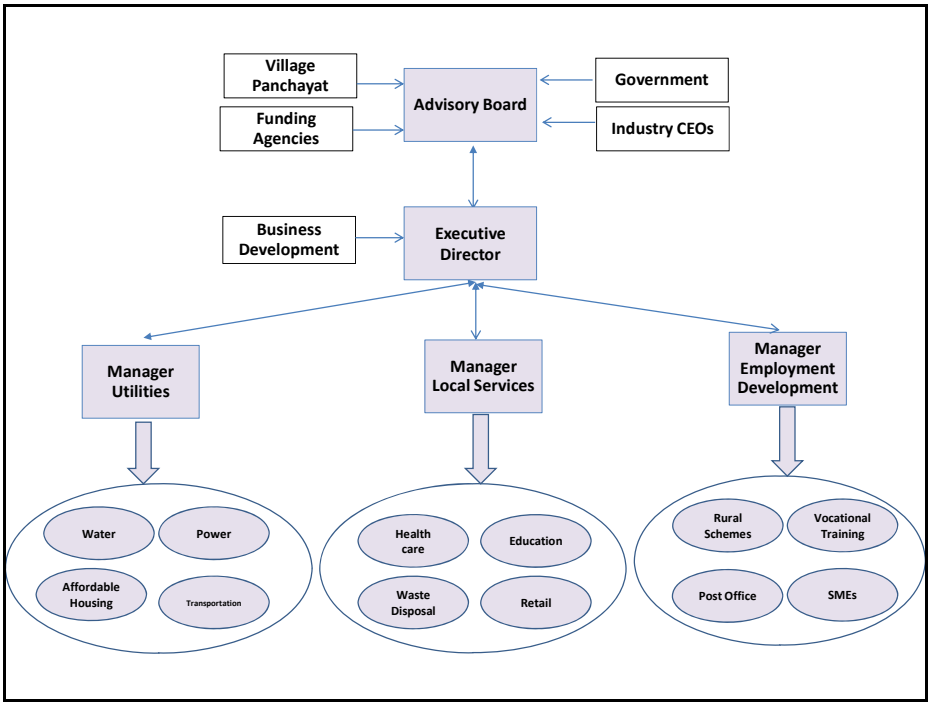

Figure 3: Governance of a Smart Village

Information and Communication Technologies (ICT) play an instrumental role in the governance of a Smart Village. ICT can help in streamlining the existing processes and interaction and communication across all levels of people involved in Governance of the Smart Village. New technologies like Cloud Computing can be adopted to maintain huge amounts of data at village level or by groups of villages at district level. This can avoid Operation and Maintenance (O&M) overheads of huge servers at the village level where not much talent would be acquainted with the rigorous server operations. This can smoothen the work of the people involved in governance, giving them the opportunity to focus on the core governance of the village. The execution of various services can be monitored and controlled using remote call centers with trained employees. Once the governance models are used to orchestrate various services, there must be a method to measure and monitor the performance of the services and their overall impact.

5. Performance measurement

Performance measurement is a key step in assessing the effectiveness of the services being rendered. This performance measurement must be oriented towards measuring the performance of individual services as well as measuring the performance of the smart village on the whole. For each of the service, certain parameters/metrics can be identified, which can be used to measure the service performance like timeliness, reliability, responsiveness to complaints, user satisfaction, innovation in the system, usage, accessibility etc. Whereas for the entire Smart Village performance depends on the effectiveness of individual services rendered, the kind of vocational training and its impact on betterment of skill development and employment, the innovations in the systems, increase in connectivity to outside markets, growth in trade and per-capita income, sustainability of the village. To measure the performance of these aspects of the Smart Village, a balanced scorecard approach as developed by Kaplan and Norton can be used. These scorecards can be used to communicate the information and strategy to all the stakeholders. The components of the balanced scorecard are learning and growth performance, internal processes performance, financial accountability and customer satisfaction [11].

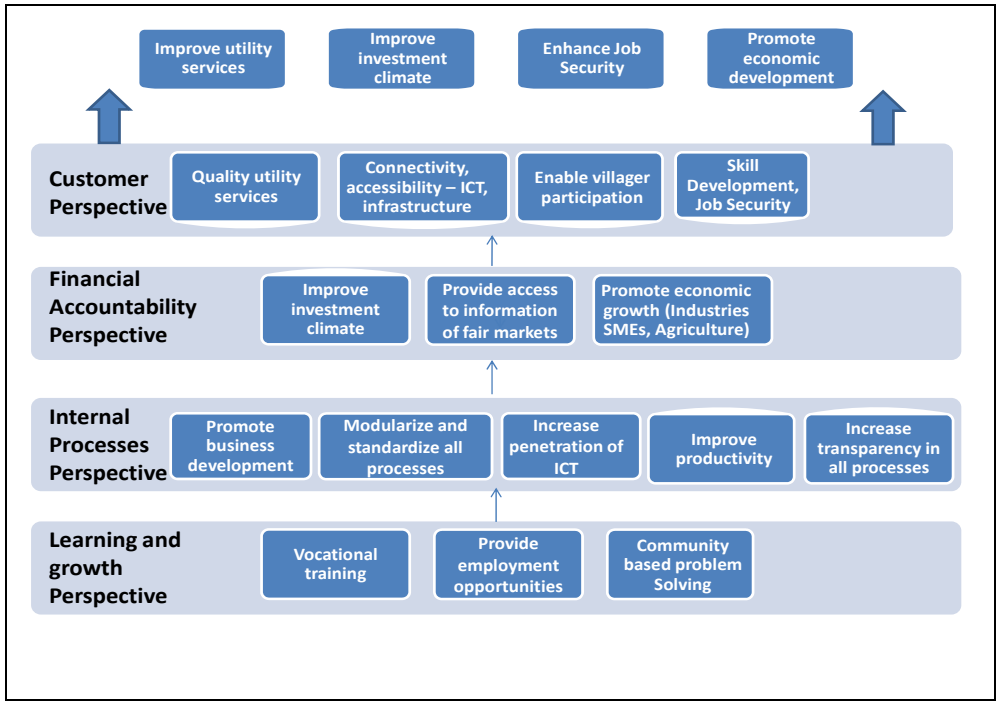

Figure 4: Balanced Score Card for the Performance of a Smart Village

All the components of the balanced score card must ultimately meet the objectives of the Smart Village which are to improve the utility services, improve the investment climate, enhance skill development and promote economic development. Service quality is achieved when all these characteristics hold good simultaneously. These performance measures can be used to improve the system to continuously make it better. The feedback from this balanced scorecard from all stakeholders can be used to revise and upgrade the objectives of the system and to improve it on a regular basis.

6. A Case of Agriculture based villages

India is primarily agriculture based country with 300 million small farmers and an equal number employed on farms. 12 million Kirana shops supply food to the population employing 30 million people. In this section we consider a case of agriculture based village and apply the Ecosystem framework discussed above to elucidate the concepts discussed.

The farms produce products such as wheat, rice, fruits, vegetables etc. and dairies generate milk from live cattle. These are distributed to the population for consumption. There are consumed either fresh or processed as food. The food supply chain is the vehicle that supplies the farm produce to the consumers via kirana shops or big retailers. We all know that services like logistics, retail, marketing, Internet are integral parts of the food supply chain. Their role is enabling and strategic in moving materials, marketing and inventory management. Currently there is lot of discussion about the inefficiencies in food supply chain and wastages in warehousing, logistics and in kirana shops. Also there is discussion if foreign direct investment should be allowed in multi brand retail.

Agriculture is important for providing food security for the country and is a protected part of the economy through various regulations. The scenario that we presented above is very generic. The supply chain is highly inefficient and lots of food is wasted away. The food inflation is another worry. On the other hand, India is well endowed with highly fertile land and live rivers and good climate. 51% of our land is cultivable where as the global average is 11% and we have good seasons to produce all the fruits and vegetables that can be produced anywhere in the world. ***The question then is - can we improve the situation and provide quality food services for local consumption at affordable rates in both urban and rural areas & serve the expectations of younger populations. Can we***

do this by redesigning and rebuilding the current service networks such as logistics, retail using smart technologies such as IT, sensor networks etc and using precision agriculture? Can we follow an Integrated Service, Manufacturing and Farming to create Food Solutions for the populations?

Breakthrough Innovations are possible with **out of the box** thinking in terms of product offerings made to various customer segments with booming employment opportunities. The world took notice of the market opportunity and several companies such as Reliance and India's other big corporations — Bharti Group, Aditya Birla Group, Mahindra & Mahindra and the Tata, and global retailing majors Wal-Mart to Carrefour have entered the market. This effects the food supply chain since 50% of retail in India is food.

The governments from their side provide rural employment schemes. There are several acts such as the Agricultural Produce Marketing Committee (APMC) Act, the minimum support price announced by the Govt. for 24 crops acts as insurance for farmers against sharp price fluctuations and provides inputs to the PDS and the essential commodities act empowers the Govt. to control production, distribution & pricing, etc to secure equitable distribution and fair pricing. ***Yet the food retail industry has not made its impact on the country and lot more needs to be done before it attains breakout status. The two important issues are how do you achieve astounding 'breakout growth' and employment generation particularly for the 600 M with 7th grade.***

To address the above mentioned challenges, we propose innovations in food supply chain ecosystem for agri based villages. All the utility services like water, power, education, healthcare, affordable housing etc are required for the agri based village as evident in Smart Village Ecosystem. However, the main focus of the agri based village will be food supply chain wherein the farming and SMEs will be the major concern. Hence, we map the food supply chain and enumerate the various innovations in value chain, institutions, resources and delivery infrastructure.

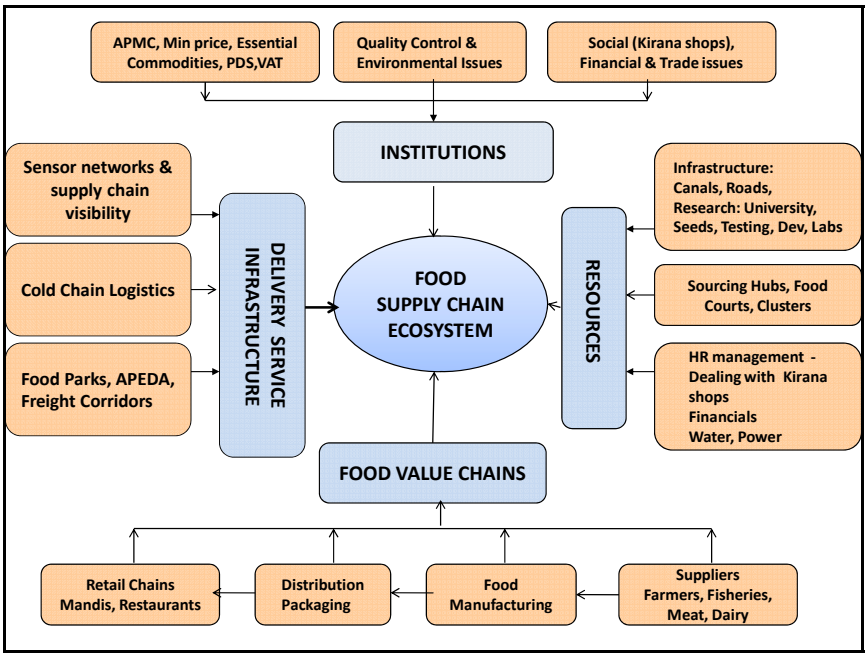

Figure 2: Food Supply Chain Ecosystem

6.1 Innovations in Food Supply Chain in the four components

Innovations must come from all aspects of the food supply chain ecosystem as elaborated below.

6.1.1 Product and Value Chain Innovation

- Seed-Feed agriculture, Food Processing, wellness and convenience embedded Protein rich food, Convenient packaging, Standardization
- Low cost high quality food, certified food like Halal, Organic etc. Store formats, Home delivery, e-retail, International markets through JVs
- Market Channel Innovation
- Operational Innovation; Outsourcing, Vertical Integration into land ownership & Farming or real estate.
- Developing SMEs in areas of food processing like rice/flour mills, packaging,

6.1.2 Institutions and Service Chains

- The availability, price and quality of the products and services that people use are affected by the Government and Institutional policies. Many successful services companies owe their existence and success to the opening up of markets. Companies such as Airtel, Jet Airways in India and South

West, E-bay and others in USA owe their existence to policy shift in the government. In the agri supply chains there are several Regulatory Innovations that are possible.

- They include Green, VAT, Trade, Hygiene, Regulations on packaging, Pricing, Procurement like APMC act, Essential commodities act, Minimum support price for PDS, FDI in agriculture, multi brand FDI in retail.

6.1.3 Delivery services Infrastructure

- Cold chain, Packaging, Sensor networks for visibility, Delivery with poor infrastructure, Distribution backbone, Product recalls, Local sourcing due to logistics costs
- There is no well designed hub-and-spoke distribution network in India and partly the taxation barriers between states act as barriers to efficient regional distribution.

6.1.4 Resources and Resource Management

- Water, Power, Post harvest research, Food clusters, Food courts, Product development and Testing laboratories, Talent.

7. Conclusion

There is no denying fact that we need smart villages that provide welfare to the rural folks. This is the biggest challenge facing all developing countries today. There are technologies available and they are successful elsewhere. But the failure comes from lack of strategy, integrated planning and above all monitoring and execution of the activities. The STERM (Science, Technology, Engineering, Regulations and Management) framework can be used to design and build these villages. We need to develop the ecosystem for each village depending on its location and investment climate. Our suggestion is to build smart villages as contracts under PPP for group of companies with mandate to develop smart villages. The gains of success of these smart village efforts are foreseen to be tremendous. They can be replicated to millions of villages around the World in India, China, Brazil, and South Africa to name a few and this is in line with the inclusive growth that is being advocated by these Governments. Also, these concepts can be extended to small towns and also townships surrounding the big Cities.

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