Integrated Low Cost Agriculture for Internal Consistency and External Synergy for Sustainability of Smallholder Farmers: Case of Nava Jyoti Agricultural Community

XIMB Sustainability Seminar Series, Working Paper 4.0, August 2012
Amar KJR Nayak[1]

Abstract

Both from a theoretical perspective and empirical evidences from smallholder agricultural community, the paper argues that alien technology intensive agriculture is unsuitable for smallholder farmers in rural agricultural settings. It argues that integrated low cost agriculture locally developed over decades by agricultural communities is internally consistent for sustainable agriculture and externally synergistic to smallholder farmers, local ecology and greater overall performance to different stakeholders. Performance of smallholder farmers and the processes adopted in Nava Jyoti community over the last three years and evidences from a sample of organic farmers in India suggests that integrated low cost agriculture is the only way for sustainability of our food production system at the base of the pyramid; that could ensure food sufficiency, nutritional security and environmental safety for all. Intensive Agricultural Technology with GM Crops at its core may only be an illusion for food security.

Key Words

Food security, agricultural technology paradigm, smallholder farmer, net farmer income, internal consistency, external synergy, integrated low cost agriculture, sustainability

[1] ©Amar KJR Nayak, Professor of Strategy and NABARD Chair Professor, Xavier Institute of Management, Bhubaneswar, Email: amar@ximb.ac.in

Integrated Low Cost Agriculture for Internal Consistency and External Synergy for Sustainability of Smallholder Farmers: Case of Nava Jyoti Agricultural Community

Both from a theoretical perspective and empirical evidences from smallholder agricultural community, the paper argues that the technology intensive agriculture is unsuitable for resource poor smallholder farmers in rural agricultural settings. It argues that integrated low cost agriculture is internally consistent with the characteristics of small holder farmers and externally synergistic to rural agricultural community, ecology and consumers.

Indeed, the issue of genetically modified food production needs to be seen from the perspective of the level of technology intensity in agriculture and most importantly, its alienness and suitability to the context of small holder farmers in India and across the world. In order that we develop an effective policy on technology use in agriculture, we need to understand (a) characteristics of technology, (b) characteristics of the smallholder farmers including their agricultural community and ecological balance, (c) strategic fit in terms of internal consistency of the technologies and external synergy and (d) comparative performance of technologies in terms of net income to smallholder farmers, food safety for consumers and ecological sustainability. Accordingly, the paper discusses these issues before presenting the strategy for implementing integrated low cost agricultural practices among smallholder farmers and performance in terms of short term outputs and long term issues of sustainability. Empirical evidences of high performance from a few farmers from across India; practicing integrated low cost agriculture is also provided.

1. Characteristics of Technology; Agricultural Technology

Technology in agriculture includes both product technology and process technology. Genetically modified seeds, inorganic fertilizers, chemical pesticides are some of the examples of high end product technologies in agriculture. In addition to agricultural inputs, there are several processes in agriculture for cultivation, harvest, post harvest, storage and value addition, where technology intensive and costly equipments are required. Machinery and equipments such as tractors, combined harvesters, deep bore-well pumps, and motors are a few such items. Large storage facilities and large processing facilities also require a variety of high end, costly technological gadgets.

Indeed there is an intricate relationship between the type of product technology and the process technology associated with a product technology. For example, genetically modified seeds would require specific conditions or internally consistent to genetically modified seeds. These specific conditions, however might not be in synergy to the external conditions, viz., smallholder (purchasing capacity of GM seeds and other associated inputs, knowledge and skills for effectively using GM seeds) and the natural ecology (population of micro organisms in the ecology, diversity of life systems, safety of local live stock, etc).

Since technology is both knowledge intensive and capital intensive, it remains exclusive and is also elusive for many. Given the complexities of product technology and the associated process technology, transfer of a new technology could be highly challenging especially among those who are not involved in the development of the technology. The nature of high end technology is such that scientists working on high agricultural technology would not find it very useful to partner with smallholder farmer in their research pursuits to develop newer and advanced technologies. Moreover it is impractical to involve the huge population of smallholder farmers in the development of high end technologies in select research laboratories of the world. As a result of this complex process of technology development and gradual delineation of smallholder farmers from agricultural scientists, transfer of new technologies developed in isolated laboratories is highly expensive, highly time consuming process and often finds little use among the smallholder farmers (Chambers, 2005, Hamida etal. 2006).

Technology evolves over time through the use of information, scientific knowledge, and through experimentation. The process of technology development also requires higher levels of investments. Given these features, higher level technology is not only understood by fewer but is owned by a few people or organizations that have access to large capital. So the smallholder farmer being aware that she/he does not have the capital acquire a technology, would be little motivated to learn about the technology. Further, the dependency of a technology with capital intensive process technology or vice-versa also keeps off the smallholder farmers from adopting a technology. Moreover, the inapplicability of a particular technology to small landholding may also be a reason for the disinterest of the smallholder farmers to adopt a new technology.

'Path dependency' (Leibowitz S.J. & Margolis, S.E., 2000) is one of the key characteristics of any technology; whether it is product technology or process technology in any sector or industry. A scientist involved in a particular technology development becomes **path dependent** on the type of technology he/she has been working on and has limited capacity to develop alternate technologies that may needed by different types of farmers in different economic-social-environmental contexts. Path dependency is also true of users of a technology. Smallholder farmers who adopt a particular technology; unless otherwise supported by other associated technologies and processes, he/she may not be able to get his/her appropriate return on investment. There are indeed several studies that have argued for less technology intensive agriculture that is appropriate for smallholder farmers (Kenmore, 2011, Rupela, 2011, Reddy, 2011, Alvares, 2009).

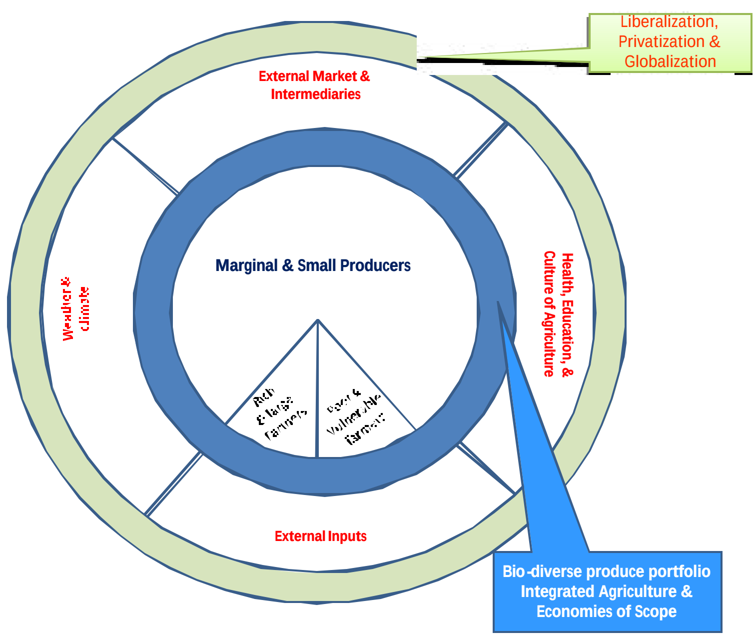
2. Characteristics of users of Technology; smallholder farmers and rural agricultural ecology

A small producer or a smallholder farmer in a rural agricultural context could be characterized as some one who holds or owns very little private property in terms of resources/asset/land, one who engages in larger number of production activities with lower product specialization, has lesser amount of capital to engage with, is lesser educated, has lesser access to information, knowledge and technology, one whose overall volume of production is very low, one who adopts rudimentary methods and techniques in his/her work. The individual family health as well as the community health is also poor. The primary education available for the children in the community, that could promise a better future, is also weak in such context (Nayak, 2008).

While the internal conditions of the small famer or landless small producer, who form over 80% of the total producers, is rather weak and vulnerable, the external conditions are highly unfavorable for their existence. The agricultural input market is better organized and the prices of inputs have been rising. The players in the product market are better endowed with information, resources, capital and are better organized to bargain harder with the small producers because of the various ownership advantages of the bulk buyers and traders. Historically, the village *sahukars* and the local traders have indeed been on an advantageous position to exploit the small producers. This could be explained from the resource based perspective of Penrose (1995) and Wernerfelt (1984). It is indicative of the fact that while the prices of agricultural products have multiplied several times in the recent years, the farm gate prices that the farmer gets have hardly increased over the years. In the light of the greater industrialization, urbanization, privatization, liberalization, globalization, commoditization in the growing market economy system, the small farmer and the landless small producer are indeed in a highly asymmetric disadvantageous position.

In addition, the uncertainty in the weather and climate, especially the rainfall leading to incorrect assessment on the timing of sowing by the small farmers makes the situation challenging and highly risky. Further, poor health, lack of primary education in the rural areas and reducing incomes from the agricultural activities has lead to the out-migration of people from the rural agricultural communities. Not only has the overall climate of liberalization, privatization, and globalization exposed the small agricultural producers to the global commodity markets and industrial economic system, the culture of agriculture has been adversely affected (Nayak & Nayak, 2011). **Figure 1** depicts the risks and vulberabilities of the smallholder producers.

Figure 1: Risks and Vulnerabilities of Smallholder Producers



The asymmetries are so many that as we deal with one of the problems, the inefficiencies arising out of other problems greatly reduces the overall outcome of the efforts put in to resolve the first problem. The situation of a rural community or that of a small farmer or landless small producer can be described like a pot with several holes; where the more you pour water, the more of it flows out of the pot. Retention of water in such a pot is unlikely. **Figure 2** below depicts this seemingly irrepairable situation.

Figure 2: Resource Inflow to Community with Asymmetric Disadvantage & Value Creation

The high asymmetrically disadvantaged situation demands that we take a system's view to resolving the problems of the small producer for rural agricultural settings. Mapping the characteristics at different levels of local ecology, individual members of the cluster, and external market conditions may provide a better understanding to resolve the challenges of balancing the characteristics at different levels. The problems across different levels and within each level need to be simultaneously attempted at in order to resolve the multiple problems faced by the small producers in the current globalizing market economy (Nayak 2012).

Logically, the agricultural technologies viz., seeds, plant growth nutrients, plant protection measures, irrigation measures, farm machinery, post harvest machinery and processes, technologies for value addition, etc, that we prescribe for the smallholder farmers should not only be internally consistent with each other but also the whole technology and the package of practice should have synergy to the externality that is smallholder agricultural community, local ecology and acceptability of the produce thereof in the market.

3. Strategic Fit: Internal Consistency and External Synergy

For an agricultural technology to be most effective for the smallholder farmers, the technology including the product technology, and the processes involved for administering this technology should be (a) the technology should be internally consistent with different aspects of the product and the associated process technologies, and (b) the technology should be in synergy with other systems in the value chain, viz., smallholder farmers, local ecology, and overall performance to different stakeholders. In the field of strategic management, the ideas of internal consistency and its significance for greater performance has been well developed (Miles, R.E. and Snow, C. 1978).

To assess the internal consistency of a particular paradigm of agricultural technology, we may consider three main dimensions, viz., product inputs, processes or methods adopted, and organizational issues. The elements of product inputs and basic conditions would consist of seed, input for plant nutrition, input for plant protection, water in a given soil. The elements of processes and methods includes cropping pattern, level of farm integration, land preparation methods, water management methods, weed management methods, harvesting methods, post harvest methods, processing technologies, and storage and transportation methods. The elements organizational process would include organizational design, management process and market process.

Under the technology intensive paradigm, the various product inputs would consist of GM seeds, chemical fertilizers, chemical pesticides, more water usage in an increasing dead soil. For greater efficiency, these technology intensive product inputs need to be consistent with the methods, processes and associated technologies adopted. The features of these processes and methods include mono-cropping for commercial purpose and product specialization with little integration with other farm production. Regular tilling of land is a part of this process with tractors and power tillers. Greater water consumption necessitates provision for canal irrigation and deep bore wells in this approach. Weeds are a menace in this practice and expensive weed management is part of this process. Similarly the harvesting methods, post harvest methods, processing, storage and transportation involve more complex unit operations leading to the need for technology intensive equipments and machinery. The organizational issues to be consistent with the above product and process technologies; industrial organizational design with centralization, hierarchy, specialized managers are required to manage these operations. There is no limit to the boundary of the market for agricultural produce under this paradigm.

Contrary to the technology intensive paradigm, under the integrated low cost agriculture paradigm, the various product inputs would include local seeds, organic manure, organic pesticides, and less water in an increasingly live soil. Accordingly, the process technology that will be internally consistent to the above product technologies will be different from those under technology intensive technology. Multiple and diverse cropping pattern is adopted which in turn helps leverage seasonality for better food and nutrition security, and better soil health. Accordingly, integration of agriculture with horticulture, agro-forestry, livestock and other related activities is consistent and helps in leveraging the scope of production under this system. Lesser tilling to no tilling of soil is adopted to ensure minimal disturbance and imbalance to the micro-organisms that enhance the life of the soil and the capacity to convert insoluble nutrients to water soluble form and makes them available for plants. Instead of larger water consumption, lesser water is required for the soil as it is least exposed to sun because of rich biomass on the land. The method of in-situ water conservation also helps capture water from rainfall and the ground water is well charged; which can be utilized through shallow open wells. Weeds are not considered as a menace but are leveraged to better soil cover and rich biomass for plant growth. Further, the practice of mulching with dry plant biomass minimizes the growth of weeds and water requirements by plants. Accordingly, the harvesting method, post harvest methods, processing methods, storage and transportation methods adopted simpler and smaller technologies and processes. The organizational process include community based organizations that work more on trust and cooperation and accordingly need simpler management practices with minimal hierarchy. Under this paradigm, the market space is not far away from the area of production as the focus is to minimize food miles to be able to retain maximum quality of food items.

For comparative analysis of various elements of different dimensions of agricultural technology under different paradigms please see **Table 1**. For highest efficiency in any paradigm of agricultural technology, the elements in each paradigm have to be internally consistent with each other.

Table 1: Paradigms of Agricultural Technology

Technology Intensive Approach	Agricultural Technology	Integrated Low Cost Agriculture
	External Input Technology	
GM Seeds	Seed	Local Seeds
Inorganic Fertilizers	Plant Nutrition	Organic manure, plant biomass
Inorganic pesticides	Plant Protection	Organic pesticides
More Water	Water	Less Water
Biologically poor soil	Soil	Biologically rich soil
	Process Technology	
Mono-crop for commercial purpose	Cropping Pattern	Multiple and diverse cropping to leverage seasonality for better food and nutrition security, & better soil health
Specialized mono-crop cultivation with little integration with other farm production	Level of Farm Integration	High degree of integration of farm crops with horticulture, agro-forestry, and livestock to leverage higher economies of scope in nature
Regular tilling with Tractor, power tiller, etc	Land preparation methods	Lesser Tilling for minimal soil disturbance
High Water intensity methods using Canal Irrigation, Deep Bore wells	Water management methods	In-situ water conservation methods
High degree of weed management	Weed management methods	Little weed management through mulching & mechanical weeding
High technology equipments like Combined harvester, etc	Harvesting methods	Generally, simpler technologies because of smaller farm size
Highly mechanized post harvest management	Post harvest technologies	Simpler post harvest techniques
Large scale, technology intensive machinery	Processing technologies	Simple decentralized processing system
Large scale storage and transportation	Storage & transportation methods	Smaller storage facilities with minimal transportation
	Organizational Process	
Traditional Industrial Organization Design	Organizational Design	Sustainable Community Organization Design
Centralized, Hierarchical, highly qualified external managers	Management Process	Decentralized, simple, local rural youth as managers
Market boundary for products is unlimited and aimed at global commodity markets	Market Space	Direct marketing limited to a radius of 350 KM from production location.

In addition to retaining internal consistency for highest efficiency, an agricultural technology needs to be in synergy with the other external systems of the value chain for highest overall performance. When the said technology is internally consistent and externally synergistic, it would achieve a strategic fit for long term sustainability of all. The external systems in relation to agricultural technology include the smallholder farmers and the local ecology. The synergy among these three systems can be assessed through the overall performance or the overall value that they create. The greater is the synergy in the characteristics among the three systems, the greater is the overall performance.

The key elements of agricultural technology include product technology, process technology including organizational issues for implementing the technology that is discussed in the previous section. Similarly, the characteristics of the smallholder farmers can be seen in terms of their social-cultural formations, resource bases and capability bases. The elements of local ecology could consist of bio-diversity, specific micro-climatic conditions, annual seasonal cycles, suitable cropping patterns, local traditions and culture, common natural resources, etc. The level of synergy across these three systems will result in the overall performance of the whole system.

The overall performance may be assessed for different stakeholders, viz., small holder farmers, consumers of food produced, and sustainability of local ecology. The smallholder performance may be viewed from short term (higher net income, food security, nutritional security), medium term (lesser dependence on seeds, lower capital investment external, adoption and improvement of local technology), and long term (healthier soil, better water conservation, better adaptation to climate changes) outputs and outcomes. Performance at the consumer level can be assessed from better quality food, safer food and food price to be fair and stable. Performance of local ecology can be seen from the perspective of safer environment and a sustainable ecosystem. For details on elements of different systems please see **Chart 1**.

Among all the three systems, we have little flexibility to modify and play with. First, our understanding of the dynamics of the local ecology is minimal and we have little control over it. Second, the smallholder farmers and their rural agricultural communities are highly complex systems, intricately linked to local ecosystems and are hard to change in the short run. However, agriculture technology is the only system among the three systems that is under our control; through which we can either improve or destroy the overall value creation process. Given the above situation, the greater is the synergy of the agricultural technology (including product technology, process technology, organizational process) with the other two systems, the greater is overall performance.

Synergy across the systems can help us achieve short term local efficiency, medium term effectiveness for farmers and consumers, and long term sustainability of our ecosystems and environment. Lack of synergy across the three systems viz., local ecology, smallholder farmers, and agricultural technology will only produce sub-optimal performance. Introduction of agricultural technology that is not in synergy with the other two systems will gradually erode the base of local ecology, agricultural community, paralyze the small holder farmers and the disease the consumers. From the above system's perspective (Goldratt & Cox, 1992), the choice of agricultural technology is highly critical for the overall performance.

Chart 1: Internal Consitency and External Synergy across Local Ecology, Smallholder Farmers, Agricultural Technology and Performance – An Analytical Framework

Local Ecology

Specific micro-climatic conditions,

Bio-diversity & variety of crop production

Annual Seasonal Cycles

Production of agricultural produce, horticultural produce, forest produce, local livestock & allied products

Local Culture & Social specificities

Local history and tradition

Larger common properties

Lesser private property with the majority of the population

⇄

Smallholder Farmer

Smaller Quantities of Produce
Larger variety in Product Basket
Lower value added products
Smaller Land Base

Lower Resource Base
Lower Asset Base
Lower Capital Base
Limited Ownership (advantages)
Lower Credit based Transactions

Lower Competence Base: Information-Knowledge-Technology Limited Formal Education
Simpler Management Skills
Lower Organizational capabilities

⇄

Agricultural Technology

Agri Input Technology
Seed
Plant Nutrition
Plant Protection
Water
Soil

Process Technology
Cropping Pattern
Level of Farm Integration
Land preparation equipment
Water management
Weed management
Harvesting equipments
Post harvest technologies
Processing technologies
Storage & transporation

Organizational Process
Organizational Design
Management Process
Market Space

⇄

Overall Performance

Smallholder Farmer
Higher Net Income
Food Security
Nutritional Security

Self Reliance on Seed
Lower Capital Investment
Faster adoption to traditonal technology

Healthier Soil
Conservation of Water
Better adaptation to climate changes

Consumer
Better Quality Food
Safe Food
Fair & stable Food Price

Local Ecology
Safer Environment
Ecologically Sustainable

4. Comparative Performance of Agricultural Technology Paradigms

The two paradigms of agricultural technologies that we would like to compare are *technology intensive agriculture* and *integrated low cost agriculture*. The characteristics of these two technology paradigms are shown in **Table 1**. The performance is assessed for three different stakeholders, viz., smallholder farmers, consumers, and local ecology. The specific indicators are shown in **Chart 1**.

From a theoretical perspective the use of technology intensive technology including the product technology, process technology and organizational processes is not in synergy with the smallholder farmers as well as with the local ecology. Further, given the contextual reality and limitations of the smallholder farmers, all the technology intensive technologies cannot be availed and used by the smallholder farmers and hence there is an increasing internal inconsistency within agricultural technologies that smallholder farmers are currently using. Hence as a result of lack of synergy of technology intensive agricultural system with the local ecology and smallholder farmers as well as increasing internal inconsistency within the current agricultural technologies of smallholder farmers, the logic of adopting technology intensive agricultural systems is defective. Instead of creating value, it should logically destroy the capacity to create value across the systems.

Whereas, integrated low cost agricultural system is naturally synergistic to smallholder farmers as well as to the local ecology. It is also internally consistent to the existing technologies and capabilities of the smallholder farmers. Logically, integrated low cost agriculture should create greater value across the system and improve the overall performance for smallholder farmers, consumers and sustainability of local ecosystems. Based on an action research with a smallholder agricultural community in the state of Odisha and field observations of a sample of farmers practising integrated low cost organic agriculture across India, the paper buttresses the theoretical argument that the paradigm of integrated low cost agriculture yields high overall performance as compared to the paradigm of technology intensive agriculture.

4.1 Case of Nava Jyoti Smallholder Agricultural Community

The Case of Nava Jyoti Agricultural Community http://www.navajyoti.org is a case of action research to develop a sustainable community enterprise system in a rural agricultural setting in a developing country context. It has been designed and structured to resolve the various asymmetries and vulnerabilities of resource poor small farmers/producers. The 'community enterprise system' has been designed taking into consideration a number of factors such as optimal size of membership, **economies of scope or multi-cropping, integrated agriculture with low cost inputs, appropriate technology of the producer community**, community ownership and management by the producers/farmers with operational inputs by professionals.

Context of Smallholder Farmers' in Nava Jyoti Community

The community of Nava Jyoti consists of people from around the Nava Jyoti Kendra, Nuagada Gram Panchayat (GP) in the district of Rayagada in Orissa. There are about 1000 families (roughly 5000 people) from Nuagada GP and Gulliguda GP. Currently, about 600 families (roughly 3000 people) are registered as members/shareholders of the Nava Jyoti Producer Company Ltd. The profile of the community is as follows:

Population:
Scheduled Tribes: 85 %
Scheduled Caste: 12%
Coastal Migrants: 3 %

Occupation:
Farmers (Small & sub-marginal Farmers): 40%
Non Farmers (unable to support through land based activities: 60%

Level of Employment:
Average No. of days of Self Employment on Farm/Forest: 120 days
Average No. of days of NREGS: 21 days
Average No. of days of Unemployment/Hunger days: 224 days

The farmers/producers of this community are engaged in different types of agricultural production including forest and livestock produce. The community practices traditional farming which happens to be organic and integrated. However, with the popularity of modern agricultural practices that are introduced through the various Government schemes; many unsustainable technologies and practices are available as a choice in the community. This has not solved the problems of the small resource poor farmers. Even the various agriculture and credit extension services set up by the government has not reached these farmers. Migration of youth from these communities seeking jobs as urban and industrial labour and household workers in nearby towns and far off cities is on the rise. The paucity of people working on the farms is in turn showing signs of reduced food production and shortages in food supply.

Risk, Vulnerability and traditional Safety Measures of Smallholder Farmers

Today the marginal and small farmers are exposed to various risks due to four key factors, viz.,

- Sharp price rise in external agricultural inputs,
- Unpredictable weather fluctuations due to climate changes,
- Complex dynamics in the external market and terms of intermediaries,
- Rapid changes in the culture of agricultural communities including migration of people from agricultural activities and some government policies for the poor.

These four factors are also heavily influenced by the strong global forces of liberalization, privatization and globalization across the world. Unable to engage effectively with the above forces of change, many marginal and small farmers/producers are becoming poorer and vulnerable.

There are two factors that the farming communities have adopted to survive in the past: (a) integrated agriculture with diverse cropping patterns, (b) small, cohesive sustainable communities that are able to meet their needs at farm gate prices. However, both these protective measures have been weakened by the introduction of modern farming practices, commoditization of farm produce, growing links to international trade and the emergence of new institutional arrangements.

Based on the need of bio-diversity for sustainability, this action research project adopts the economies of scope rather than economies of scale adopted by the commercial large enterprises. In other words, the Producer Organization enables the small farmers and producers to produce multiple items in agriculture, livestock, horticulture and forest produce and do primary value addition and other allied activities within their community and ecology. The economies of scope, rather than the economies of scale is appropriate for the small landholding, rain-fed, weather and season dependent agricultural production and allied activities of such smallholding farmers/producers. Diversifying the product mix of the small farmers/producers is appropriate for meeting the nutritional requirements of their families' and their communities.'

Transition Strategy: Stages & Process of Implementation

The first step to build a sustainable community system is to build the social infrastructure of the community. As the above process of social mobilization takes place, the other activities of hiring professionals, locating successful farmers in the area, putting in place the required funding, writing the plans and budgets in consultation with the community for meeting their needs are also undertaken. Building basic physical infrastructure and creating a provision for production and emergency credit are also necessary. Systematic mapping of strengths, weaknesses, needs and challenges of the community, mapping of resources, current engagement and sources of income of the farmer/producer families are undertaken as a baseline study. Based on these findings, listing of the produce/items to work with in consultation with the successful farmers and resource persons was undertaken. Subsequently, local youth are selected and trained on marketing, book keeping, low cost farming and production and on agricultural inputs/ practices as understudies to the resource persons and as apprentices to the professionals staffed in the community enterprise system (Nayak & Nayak, 2011).

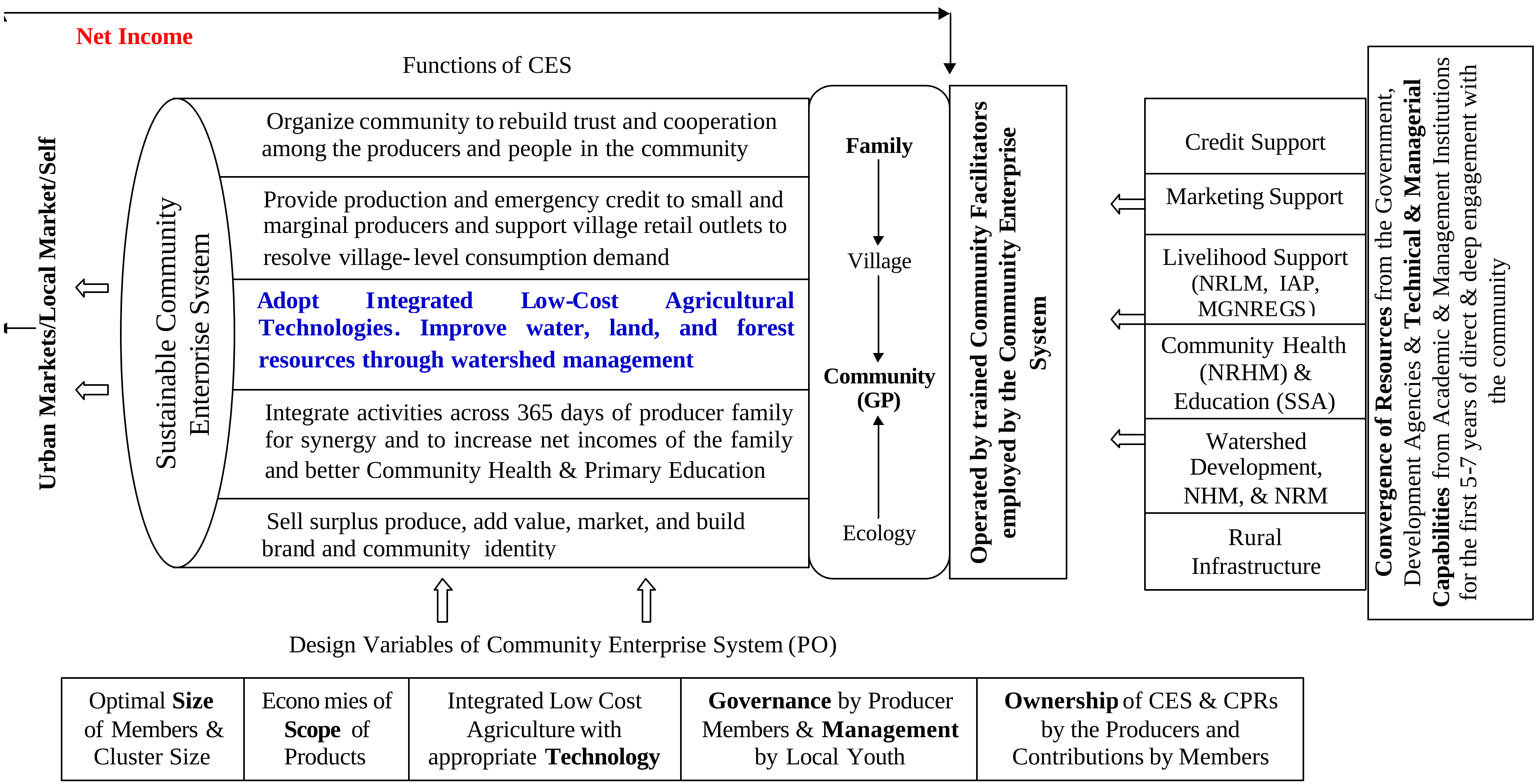
Structure and Design of Nava Jyoti Model

The proposed Community Enterprise System is based on the understanding that sustainability of the resource poor small and marginal producers could be protected and strengthened through the two key rings of safety measures viz., (a) integrated low cost agriculture and diversified production (b) producer organization that serve as a local institution of, by, and for the small and marginal farmers/producers, but staffed by professionals including local men and women who would gradually take charge of the local producer institution or the community enterprise system.

The basic structure and design variables of the proposed community enterprise system (Nayak 2008, 2009, 2010, 2011) are illustrated in **Figure 3**. The design essentially approaches the issues of sustainability from the community perspective and the capabilities of the people in the community. Sustaining and improving the quality of life of family of the small and marginal farmer/producer is the main purpose of the proposed system. A community of about 1000 farmer/producer families in the cluster consisting of about 55 villages with its natural endowments and the ecology is the basic unit of operation in the proposed community enterprise system. Among all the functions of Nava Jyoti, Integrated Low Cost Agriculture is a prime function. The approach is to integrate local agriculture systems with livestock, fisheries, horticulture, forest produce, medicinal, aromatic and dye plants along with other allied activities in the given ecological settings of the community. It is also linked to produce inputs on farm as far as possible and subsequently improve the water, land and forest resources,

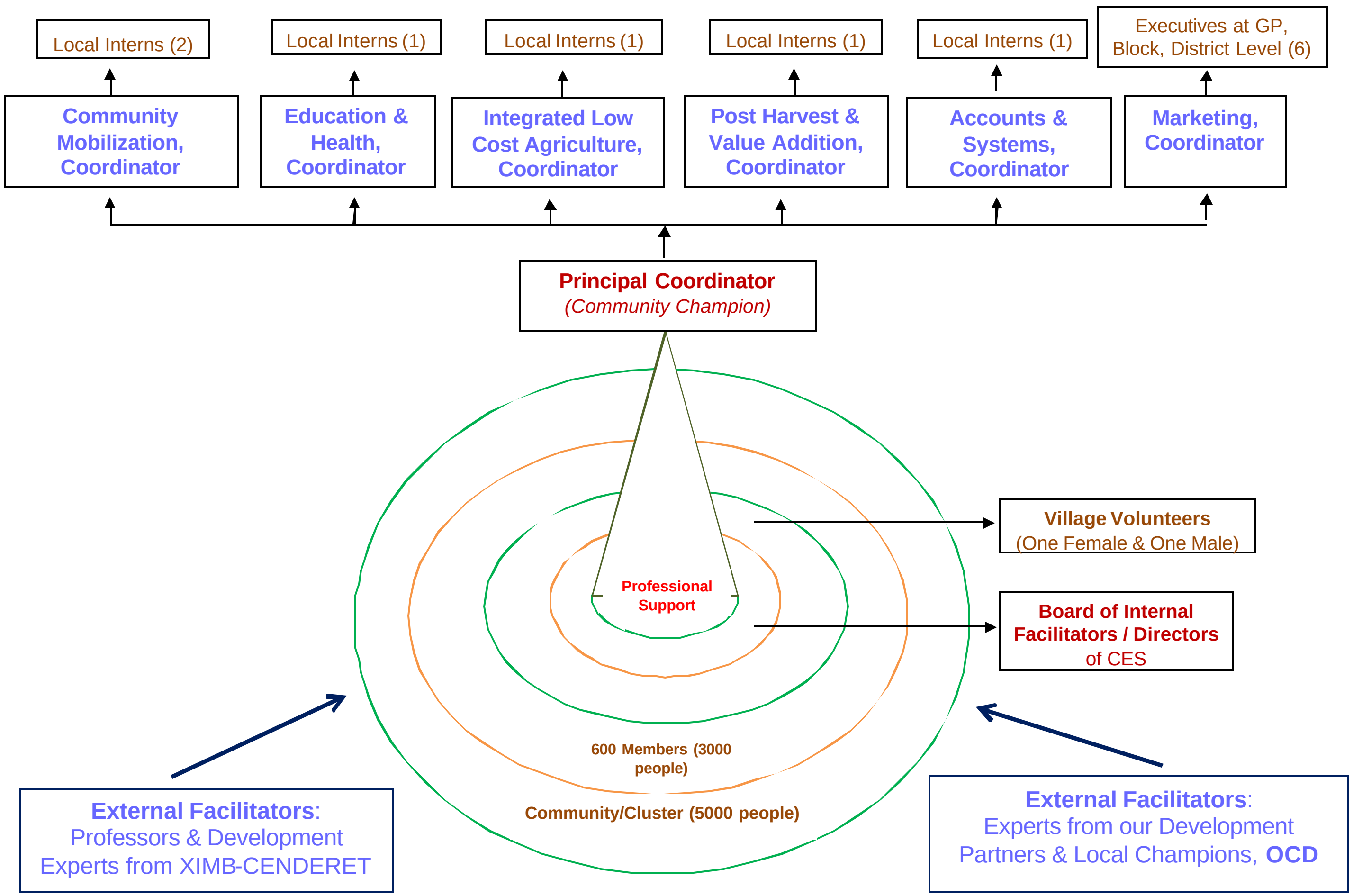
To ensure sustainable extension services, the model incorporates training of local youth under successful farmers in the area and through on job training by professionals facilitating the producer organization to upgrade the skills, inculcate discipline to work systematically before they take up the responsibility to operate the community enterprise system on their own. Please see **Figure 4** for the governance and management structure of Nava Jyoti Community Enterprise System (Nayak 2010, 2011).

Figure 3: Design, Functions, Resources, Markets and Management of CES



Source: Nayak (2008, 2009, 2010, 2011)

Figure 4: Organizational Structure of CES



Source: Nayak (2010, 2011)

Key Outputs for Smallholder Farmers of Nava Jyoti

- Nava Jyoti has been registered as a Producer Company within a year of its inception. It's owners are about 600 small farmers who are also it'sproducer-members. Nava Jyoti has a Bank Account with a transaction of about 1,600,000 INR within two years of starting it's operation. This producer organization has begun to emerge as the community enterprise system of, by and for the resource poor producers of the cluster of about 55 villages.

- Depending on the farm and non farm products, the income of farmers has increased by 45% to 90% within the first year of its marketing efforts. The details of income earned on different items during 2009-10 and 2010-11 are provided in the website of Nava Jyoti: http://www.navajyoti.org or http://www.ximb.ac.in/~navajyoti/index.htm

- The community enterprise has been successful in seting up value chains from production to marketing, of some major local produces viz., farm produce, forest produce, fruits & vegetables and livestock produce.

- Nava Jyoti has within two years set up two offices locally viz., a registered community office and a marketing office. Its demand for organic and naturally grown agricultural produce has a good demand not only in the local market, but also in markets at the district level as well as at the state level.

- Farmers are happy not to use inorganic chemicals and pesticides in their fields. The usage of cow dung, and organic biomass has increased. The organic waste which was left unused in the past, has a price in the community. Eleven village level Farmers Club have been formed and more such clubs are being formed in the community to learn and adopt organic low cost integrated agriculture.

- Nava Jyoti as a organic brand is recognized by consumers in several colonies and a few popular retail outlets in Bhubaneswar, the state capital and in Rayagada, the district capital. Consumers have been showing increasing preference to buy organically grown food items.

4.2 The adoption of integrated low cost agriculture across the country – Empirical evidences

Across India, farmers who had adopted technology intensive, inorganic chemical based farming have already begun to practice integrated low cost agriculture in the name of organic farming. A small sample of farmers from states such as Maharastra, Kerala, Uttar Pradesh, Andhra Pradesh, Odisha, Goa, Uttarakhand, and Himachal Pradesh, was used to interview and visit their fields to understand their technology, process and the relative performance over the technology intensive agriculture.

Mr. Subash Sharma from Yavatmal in Maharastra who has moved from inorganic chemical based farming to low cost integrated agriculture is extremely satisfied with his crop yield, reduction in cost, substantial increase in income over the years, satisfied customers, improved soil health, water conservation, little problems of pests, ability of his land and plants to stand the climate changes. From a debt ridden farmer, he has graduated to become a well off farmer. His annual net income has been over INR 6.0 lakhs an year.

Mr. Joseph from Trissur in Kerala argues that he does not need any support from the Government. He says "If people get land to cultivate, they will produce more than their requirements by following integrated low cost agriculture; there is no need for technology intensive agriculture." Mr. Joseph with a family size of seven spends only about Rs.1000 per month for purchasing food items like meat, fish and fuel from outside. All other requirements including tea are produced from within one hectare of land. Additionally, he earns about INR 6.0 lakhs per year from this one hectare and another partially developed one hectare of land.

Mr. Sanjay from Gandhi Bhawan, Tindwari of Banda district in Uttar Pradesh has been practicing integrated low cost agriculture. He cited that when there was heavy frost in the area in one year (2009), while all farmers adopting chemical fertilizer based agriculture substantially lost their wheat crop, Mr. Sanjay's crops were little affected by this change in weather. He also adopts very successful low cost storage and processing methods that increases the shelf life and quality of his agricultural products.

Similarly, there are several well known farmers who have been practising integrated low cost agriculture across the country. In states such as Sikkim, Kerala, Andhra Pradesh, Karnataka, Madhya Pradesh, Tamilnadu, Goa, Uttarakhand, Gujurat and Odisha, the local state governments have taken special measures to promote organic agriculture or integrated low cost agriculture. In addition to promote individual farmers to adopt integrated low cost agriculture, there have been several smallholder agricultural communities and producer groups such as Mahila Umang, Uttarakhand, Centre for Sustainable Agriculture, Timbaktu Organic, and Deccan Development Society from Andhra Pradesh, and others that have been following the integrated low cost agriculture with great success.

Several state governments like Sikkim, Himachal Pradesh, Andhra Pradesh, Kerala, Madhya Pradesh, Uttar Pradesh and Tamilnadu have undertaken steps to facilitate low cost organic agriculture. These states have come forward with a separate Organic Farming Policy. The state of Sikkim has a clear plan to make the state a fully organic state. Field visits to farmers adopting integrated low cost agricultures across the states in India; show that these farmers are very happy with the overall outputs and outcomes for themselves, for their customers and their local ecology.

5. Summary

From the above analysis, it appears that the paradigm of external input based and alien Agricultural Technology with GM Crops at its core may only be an illusion for our food security. Both from a theoretical perspective and empirical evidences from smallholder agricultural community, the paper argues that the external input based and alien agricultural technology is unsuitable for smallholder farmers in rural agricultural settings. It argues that integrated low cost agriculture is internally consistent for sustainable agriculture and externally synergistic to smallholder farmers, local ecology and greater overall performance to different stakeholders. It also suggests that integrated low cost agriculture is the only way for sustainability of our food production system at the base of the pyramid; which could ensure food sufficiency, nutritional security and environmental safety for all.

References

Alvares, Cluade and Coelho, N. (eds).2009. The Organic Farming Sourcebook, Other India Press, Goa.

Chambers, Robert Woods. 2005. Ideas for Development, Earthscan Publications Limited. http://books.google.co.in/books?id=dsTBkFnYjRYC&pg=PA157&lpg=PA157&dq=CDR+Agricultural+setting&source=web&ots=E8jgo_YNj0&sig=FxT4BO9aNQezEqPy6ukP_g0ZiL8&hl=en&ei=5cuWSff-OJy6Mo2qnZMM&sa=X&oi=book_result&resnum=4&ct=result

Goldratt, E.M. and Jeff Cox. 1992. The Goal: A Process of ongoing Improvement, North River Press.

Hameeda, B., Rupela, O.P., Wami, S.P., and Reddy, G. (2006). Indices to Assess Quality, Productivity and Sustainable Health of Soils Receiving Low Cost Biological and/or Conventional Inputs, International Journal of Soil Science 1 (3): 196-206.

Kenmore, Peter. 2011. Save and Grow: A policymaker's guide to the sustainable intensification of smallholder crop production, Food and Agriculture Organization of the United Nations.

Miles, R.E. and Snow, C. 1978. *Organizational Strategy, Structure and Process*, New York, McGraw Hill, 1978.

Nayak, Amar K.J.R. 2008. Participation and Development Outcomes in a top-down institutional set-up: Empirical evidences from the KBK districts of India, 20th Annual Convention-2008, Association of Indian Management Schools, Mumbai, (*Awarded Gold Medal for Best Research Paper).*

Nayak, Amar K.J.R. 2008. Variables towards Non Competitive Strategies - A Perspective, Creativity, vol.1

Nayak, Amar K.J.R. 2009. Variables towards Non Competition and Sustainable Strategies, IAJBS International Conference, XLRI, Jamshedpur.

Nayak, Amar K.J.R. 2010. Optimizing Asymmetries for Sustainability: A Development Prism for Agriculture and Rural Development, Global Forum for Agricultural Research, CGIAR, Montpellier, France.

Nayak, Amar K.J.R. 2010. Optimizing Asymmetries for Sustainability: A Development Prism for Agriculture and Rural Development, International Conference of Jesuit Higher Education, UID, Mexico. http://www.uia.mx/shapingthefuture/files/1-Frontier-Ecology/Ecology-Asymmetries-Nayak.pdf

Nayak Amar K.J.R & Nayak S. 2011., Nava Jyoti PC, A Case towards Optimizing Asymmetries for a Sustainable Community Enterprise System in rural agricultural settings, 3rd EMES International Research Conference on Social Enterprise, Roskilde, Denmark.

Nayak, Amar K.J.R. 2012. Institutional and Organizational Asymmetries: Small Producers and Sustainability of Rural Agricultural Communities, Keynote Address, National workshop on Markets that Empower Farmers (& Consumers), XIMB-ASHA.

Penrose, Edith. 1995. The Theory of the Growth of the Firm, Third Edition, Oxford University Press, New York.

Reddy, R. 2011. Cho's Global Natural Farming, South Asia Rural Reconstruction Association.

Rupela, Om. 2011. Status of BIFSRA Plots 7-8 July 2011 Challenges and Way forward, Accion fraternal ecology centre, Anantapur.

Stephen E. Margolis and S.J. Liebowitz (2000), Path Dependence, Lock-In, and History, http://www.utdallas.edu/~liebowit/paths.html

Wernerfelt, Birger. 1984. 'A resource-based view of the firm', Strategic Management Journal, Vol.5, 171-180.

Acknowledgements:

I would like to thank **XIMB, NABARD**, and **Rabo Bank Foundation** for all the support and encouragement in undertaking the action research on Nava Jyoti and for undertaking an all India survey on natural farming. I have greatly benefitted from the NABARD Chair Unit at XIMB in undertaking these research activities. I also thank my friends and colleagues; Dr. Om Rupela, Dr. Peter Kenmore, Mr. Subash Mehta , Mr. Subash Sharma and the community of low cost organic farming in India and Nava Jyoti community in particular for their support and guidance in understanding the subject and the rural agricultural context.