

Agricultural Resources Information System (AgRIS): An e-Government Programme for fostering agricultural growth, poverty reduction and sustainable resource use in India*

"A Step towards establishing a location-specific e-Government model for the Poor"

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Abstract

Good Governance and institutions are indispensable for sound agricultural and rural development in developing countries. Models of e-Government (i.e. digital government) are continuously evolving and improvising to harness the potential offered by the Information and Communication Technologies (ICTs) and deal with new realities in the area of governance, through out the World. Generic Models of e-Government (www.digitalgovernance.org) viz., Broadcasting / Wider-Dissemination Model, Critical Flow Model, Comparative Analysis Model, E-Advocacy/ Lobbying and Pressure Group Model, are relevant while discussing "design of an e-Government for Poor". Studying and influencing the "**Geometry of Information Flows**" facilitates direct benefits rather than trickle-down benefits for the disadvantaged community (i.e. the Poor).

There have been concerns about persistent rural poverty, unemployment, and inequality, and the resulting social tensions in developing countries. Agricultural wage earners, small and marginal farmers, casual workers engaged in non-agricultural activities, rural women (especially women-headed households), among the others, constitute the bulk of the rural poor in India. The rural poor are not a homogeneous group. At the beginning of the new millennium, 260 million people in the country did not have incomes to access a consumption basket, which defines the poverty line. **Of these, 75 per cent were in the rural areas.** India is home to 22 per cent of the World's Poor. Poverty has multiple and complex causes, which are mutually reinforcing. If poverty is to be reduced, a flourishing agricultural sector is essential in most developing countries.

"Reaching the Rural Poor" makes broad-based economic growth its primary objective, and **treats agriculture as the leading productive sector** within the rural economy and closely linked to non-farm activities. Non-farm activities, often with linkages to agriculture and natural resources, have important multiplier effects. In view of its "multifunctionality", agriculture should be the bottom line for integrated rural development.

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Since the Rio Earth Summit in 1992, agriculture remains high on the international agenda because it brings together critical issues like water, poverty, hunger, and health.

There have been both national and international efforts (DOT Force of the UN, the UN/ESCAP Committee on Poverty Reduction, the Millennium Development Goals, PovertyNet of the World Bank, etc) to improve information flows and communication services to eliminate poverty (ICT for Poverty Reduction), which **are a necessary but not sufficient condition**. In poor rural areas, where agricultural productivity is low and unreliable and there is food insecurity, better **information and knowledge-exchange** can be important in lessening poverty.

This Paper deals with the Government's Digital Initiatives and Agenda (viz., **AGRISNET**, **AgRIS**, **AGMARKNET**, **DACNET**, **VISTARNET**, **APHNET**, **FISHNET**, **HORTNET**, **SeedNET**, **PPIN**, **COOPNET**, **FERTNET**, **ARISNET**, **APPINET**, **ARINET**, **NDMNET**, etc), as a step towards "reaching" agricultural knowledge and technology to the Small Holders (Resource-Poor-Farmers) of the Country. **To usher in "agricultural governance" in the country, the establishment of AGRISNET as the "national information infrastructure" is emerging as a pre-requisite**. As "resources application and agronomic practices" are to match with soil attributes and crop requirements, the Agricultural Resources Information System (AgRIS) is a "**way-forward**" to improve agricultural productivity in rural areas, and a much "**needed domestic strategy**" for sustainable rural livelihoods.

Development and Use of ICT in Agriculture has a promise in ushering agricultural growth, "**but miles to go**". This digital opportunity is becoming a **positive force** for fostering Agricultural Growth, Poverty Reduction and Sustainable Resource Use in India. What was a "**technology push**" in 1990s is taking the shape of "**consumer pull**" at grass-root level in India to usher in agricultural governance in the country. This is a step towards establishing a location-specific e-Government model for the Poor in India.

"Recall the face of the poorest and the weakest man whom you have seen, and ask yourself, if the steps you contemplate are going to be of any use to him. Will he gain anything by it? Will it restore to him control over his own life and destiny?"

... **Mahatma Gandhi,**
Father of the Nation, India.

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1. Sustainable growth and Poverty Reduction: An Appraisal Study

1.0 The rural poor include (i) agricultural wage earners, (ii) small and marginal farmers, (iii) casual workers engaged in non-agricultural activities, (iv) the landless, (v) individuals, (vi) households with few assets, (vii) pastoralists, (viii) rural women (especially women-headed households), (ix) ethnic minorities and (x) indigenous populations. They are not a homogeneous group. There have been concerns about persistent rural poverty, unemployment, and inequality, and the resulting social tensions in developing countries. According to the Food & Agriculture Organisation (FAO) estimates, there were around 840 million undernourished people in 1998-2000, out of whom 799 million in the developing countries, 30 million in the countries in transition and 11 million in the industrialized countries.

1.1 Poverty is a global issue, and its eradication is considered integral to humanity's quest for sustainable development. In the 1990s, the Asia-Pacific Region made impressive progress in poverty reduction. The percentage of the population Below-the-Poverty-Line (BPL) **declined** in the region from 32% in 1990 to 22% in 2000. Yet, the region is still home to two thirds of the World's Poor¹. Within the Asia Region, the South Asia Region is characterized as the World's most food deficit region with high level of poverty, as the population continues to grow at a high rate.

1.2 Most of the widespread hunger in a world of plenty, results from poverty. Poverty and food insecurity, especially in the rural areas is widespread, with increasing landlessness among the rural poor, depriving them of their livelihood base. More than a half-century of persistent efforts by the World Bank and others have not altered the stubborn reality of rural poverty, and the gap between rich and poor is widening. Most of the World's poorest people still live in rural areas and this will continue for the

¹ A **person** is considered **poor** if his or her consumption or income level falls below some minimum level necessary to meet basic needs (i.e. this minimum level is usually called the "**poverty line**"). The most commonly used way to measure poverty is based on incomes or consumption levels. What is necessary to satisfy basic needs varies across time and societies. Poverty lines vary in time and place. Each country uses lines, which are appropriate to its level of development, societal norms and values.

foreseeable future (World Bank, 2002)². **Progress in reducing hunger has virtually halted** (FAO, 2002)³. Over the past 20 years, there has been a school of thought that little has been achieved in terms of the Programme of action: known as the Peasants' Charter⁴, especially agrarian reforms (ANGOC, 1999)⁵.

1.3 At the beginning of the new millennium, 260 million people in India did not have incomes to access a consumption basket, which defines the poverty line. Of these, 75 per cent were in the rural areas. India is home to 22 per cent of the World's poor. Reduction of poverty in India is, therefore, vital for the attainment of international goals (Planning Commission, 10th Five Year Plan [2002-2007], Chapter 3.2, Page No 293). Both the Central and state governments in India, have considerably enhanced allocations for the provision of education, health, sanitation and other facilities which promote capacity-building and well-being of the poor. The Targeted Public Distribution System (TPDS) protects the poor from the adverse effects of a

² World Bank (2002): "Reaching the Rural Poor - A Renewed Strategy for Rural Development", Washington, D.C., 2002 and also see <http://www.worldbank.org/rural>

³ FAO (2002): "The State of Food Insecurity in the World 2002", FAO's Annual Report, 2002.

⁴ **The Peasants' Charter**: To enable the poor to have the right of access and control of productive resources, particularly land, towards the achievement of rural development, especially on agrarian reform, which about 145 governments agreed to pursue, at the World Conference on Agrarian Reform and Rural Development (WCARRD), organized by FAO in July 1979 in Rome.

⁵ Asian NGO Coalition (ANGOC) Statement On The Occasion Of the WCARRD 20/20: Emerging Trends and Perspectives of Agrarian Reform and Rural Development in Asia, Tagaytay, Philippines, 6-7 October 1999.

rise in prices and ensures food and nutrition security at affordable prices. In India, from the Fourth Plan onwards, **"removal of poverty"** became the central concern and thus **rural development and poverty alleviation** came to be recognized as synonymous. The strategies and policies adopted two approaches, **which do not mutually contradict but reinforce each other**, focusing on:

- * Overall economic development (through **percolation/ trickle down/ spread effect**)
- * Poverty Alleviation (beneficiary targeted direct intervention) programmes (PAPs)

Even then, the strategies of Poverty Alleviation Programmes (PAPs) **failed** due to the **"top-down"** and **"over determined"** approach.

1.4 But to her credit, India marched forward **"from inadequate imports to abundant exports"**, **"from fragile farming to food for security"**, and **"from brittle tools to Biodiversity and Eco-friendly equipment"**. With more than 250 million people still employed in agriculture, representing around two-thirds of India's entire labor force, it is clear that **an expanding non-farm sector that exerts upward pressure on agricultural wages**, may

play a crucial role in aggregate poverty reduction. A well-known stylized fact about rural poverty in India is that **agricultural laborers are highly represented among the rural poor** in most parts of the country.

1.5 Economic growth and poverty reductions **were unimpressive** during the 1960s and 1970s, as India was weakly integrated into the global economy and had relied heavily on planning and licensing. The accelerated growth, during 1980s, was due to unsustainable public spending and foreign borrowing. A large share of total **non-farm investment in India** has been directed at public works projects⁶, especially during the 1980s. However, sustaining these expenditures during the 1990s has been difficult, in the face of fiscal constraints, and this has resulted in a slowdown of **public investment-induced poverty reduction** in recent years.

1.6 Public works projects (a pro-rural-industry investment climate) have also played a role in China and an estimated 31 percent of the rural labor force in China is employed in rural industry, compared to 18 percent in India. Rural enterprises in

China have been both a **major engine** of economic growth and a **potent force** for rural poverty reduction during 1980s and 1990s.

1.7 Recent studies [(Shenggen Fan, Peter Hazell, and Sukhadeo Thorat, 2000)⁷ and (Shenggen Fan, Linxiu Zhang, and Xiaobo Zhang, 2000)⁸] show that developing countries can significantly reduce rural poverty, stimulate agricultural growth, and move toward food security if they recognize that **public investments are indispensable tools** for achieving these ends and if they make the right investments (**Table-1** and **Table-2**). In areas where investments in agricultural infrastructure have lagged, such as State of Bihar, State of Orissa, State of Assam and State of Madhya Pradesh, **rates of growth in agricultural productivity and poverty reduction also lagged** (Roy and Pal, 2001)⁹. Eastern Region (ER) of India comprises of 130 districts covering States of Orissa, Bihar, Chhattisgarh, Jharkhand, Eastern Uttar Pradesh, West Bengal and Andhra Pradesh. Most parts of the

⁶ Public Works projects often combine the provision of infrastructure with a **safety net** for the poor in the form of employment provision.

⁷ Shenggen Fan, Peter Hazell, and Sukhadeo Thorat (2000): "Government Spending, Growth and Poverty in Rural India", *American Journal of Agricultural Economics* 82 (No.4, 2000): 1038-1051

⁸ Shenggen Fan, Linxiu Zhang, and Xiaobo Zhang (2002): "Growth, Inequality, and Poverty in Rural China: The Role of Public Investments", IFPRI Research Report 125, Washington D.C

⁹ Roy, B. C. and Suresh Pal (2001) : Incremental Capital-Output Ratio in Indian Agriculture, *Agricultural Economics Research Review*, 14(1):34-46

Eastern Region (ER) **lags** rest of India on some social indicators like:

- Poverty ratio (highest in Bihar)
- Infant fertility (highest in Orissa)
- Overall literacy (lowest in Bihar) and female literacy (lowest in Orissa and Bihar)
- Poverty incidence varies within the Eastern Region.

Given the strong linkage between output growth (particularly agricultural growth) and reduction in poverty, **accelerated agricultural growth is critical**, to reduce poverty in the eastern region (ER) States.

1.8 For the rural poor, strengthened rural infrastructures - **particularly connections to major roads and highways** - would facilitate the development of small enterprises, agro-based activities, and markets, and increase off-farm and non-farm employment opportunities. Evidences show that "**kickstart**" rural nonfarm employment tend to be **a function of** access by rural households to **land, livestock, migration, cash crops, credit**, and labor-intensive **off-farm** work opportunities in the agro-climatic zone (FAO, 1998)¹⁰ and (Thomas Reardon, et al 1998)¹¹. R.B.Singh,

¹⁰ FAO (1998): "State of Food and Agriculture 1998", Food & Agriculture Organisation, Rome, 1998

¹¹ Thomas Reardon, J. Edward Taylor, Kostas Stamoulis, Peter Lanjouw & Arsenio Balisacan (1998): "Effects of Nonfarm Employment on Rural Income Inequality in Developing Countries: An Investment Perspective", FAO Regional Office for Latin America and the Caribbean, 1998

P.Kumar and T.Woodhead (2002)¹² portrays that works of **Nobel Laureate, Professor Amartya Sen** have clearly demonstrated that during years when non-agricultural rural employment increases, rural poverty declines, and that the converse also holds. On-farm, off-farm, and on-off-farm rural employment is essential to combat rural poverty and to secure adequate livelihood within the households of smallholders and land-less agricultural labourers. **Rural Non-Farm (RNF) Income** is very important to food security and risk management.

1.9 Land access is highly correlated with poverty. Poverty, low agricultural productivity and natural resources degradation are **severe interrelated problems** in Less-Favoured Areas (LFAs)¹³. Small Farms are often more efficient producers than large farms in developing countries, and **the right kinds of investments in many LFAs** can yield favourable economic returns while directly benefiting the Poor (Peter Hazell and Lawrence Haddad, 2001)¹⁴. Many expected benefits arising from rapid agricultural growth in Favoured Areas (FAs) **have been confirmed** through empirical

¹² R.B.Singh, P.Kumar and T.Woodhead (2002): "Smallholder Farmers in India: Food Security and Agricultural Policy", FAO Regional Office for Asia and the Pacific (Bangkok, Thailand), March 2002, RAP publication: 2002/03

¹³ Less-Favoured Areas (LFAs) include lands that have low agricultural potential as well as areas that may have high agricultural potential but have limited access to infrastructure and markets.

¹⁴ Peter Hazell and Lawrence Haddad (2001) : "**Agricultural Research and Poverty Reduction**", 2020 Brief 70 (August 2001), International Food Policy Research Centre (IFPRI), Washington D.C

research: **"trickle-down"** benefits for the poor, including those residing in LFAs, and **"higher social returns"** for a nation than investments in LFAs. Studies also highlight that investments in LFAs have faced **diminishing returns** and **increased** social and environmental problems. Anecdotal evidence suggests that **investments in LFAs** can yield relatively high-rates of economic return and significantly reduce poverty, given alternate uses of land and labour of people in these areas. In the first edition of his **"Essay on the Principle of Population (1798)"**, Thomas Malthus formally framed the debate about whether food resources would be sufficient to feed an increasing world population.

1.10 Higher agricultural productivity raises the disposal incomes in the rural households and pushes up the demand support that industry so desperately needs. Non-farm activities, often with linkages to agriculture and natural resources, have important multiplier effects. The World Bank/NCAER¹⁵ study indicates that the poor often face additional barriers, associated with low social status and low wealth. These findings resonate with observations

¹⁵ NCAER - National Council of Applied Economic Research, New Delhi (India)

of (Nicholas Stern, 2001)¹⁶, where access to regular non-farm employment depends critically on a network of contacts that can provide information about vacancies and can furnish references. It is generally the higher-status households who have access to such networks.

1.11 India has over 65 Million Tonnes of Wheat and Rice in Government Godowns; yet poverty induced hunger affects over 200 millions persons. Schemes like **Antyodaya Anna Yojana**, **Annapoorna**, and **Sampoorna Grameen Rozgar Yojana**¹⁷ are good in concept but weak in implementation (Swaminathan, 2002)¹⁸. **Many review articles show that the present global surplus of food grains is the result of inadequate consumption on the part of the poor, and should not be mistaken as a sign of over-production. Dr. M.S.Swaminathan, who is considered as the Father of Green Revolution in India, once said, "We need more science, both in public and private sectors, related to agriculture for falsifying the Neo Malthusian predictions of widespread food and drinking water insecurity".**

¹⁶ Nicholas Stern (2001) : "Building a Climate for Investment, Growth, and Poverty reduction in India", speech delivered at EXIM bank, Mumbai(India).

¹⁷ The objectives of **Sampoorna Grameen Rozgar Yojana Programme** are to provide additional wage employment; food security; creation of durable community, social and economic assets; and Infrastructure development in the rural areas.

¹⁸ M.S.Swaminathan (2002) : "Food Security and Community Grain Banks", YOJANA, January 2002

1.12 During the reform decade (1990-91 to 2000-01) in India, agricultural growth was at a mere 1.71 %, and below the annual population growth of 1.87 % per annum, signaling the advent of the "**Malthusian**" phenomenon of population growth outstripping food production. **1996-97 appears to be a turning point**, with stagnation even of per capita agricultural GDP. During 1990s, National Sample Survey Organisation (NSSO) data suggest that **poverty rates have remained static**, but National Council for Applied Economic Research (NCAER) data show that **poverty rates have fallen** (Subramanian Swamy, 2001). The World Bank (2002)¹⁹ Report lauds that the countries that grew rapidly in the 1990s, such as **China, India, Vietnam, and Uganda**, managed to **reduce the share of their "people-in-absolute-poverty"** by 5 to 8 % per Year.

1.13 According to the white paper on "**Eliminating World Poverty: Making Globalization Work for the Poor**" of the British Government, "**there are substantial inequities in the existing international trading system**". Most farmers in countries like India are subsistence farmers, with marginal

¹⁹ World Bank (2002) : "World Bank lauds India for Poverty Reduction" published in Times of India, March 14, 2002 and also see <http://www.worldbank.org> & NCAER - National Council of Applied Economic Research, Delhi

participation in international trade. Food security is intimately linked with agriculture and trade. Trade liberalisation was expected to contribute to food security through narrowing the difference between production and consumption needs, reducing supply variability, fostering economic growth and making more efficient use of global resources. But the increasing concentration of agricultural markets in the hands of a few multinational companies **has not provided an appropriate framework** for achieving food security.

1.14 Food security is an important ingredient of economic development in developing countries, and achieving “**food security for all**” would require: (i) access to resources by the poor, (ii) better technologies for producing and distributing food supplies, (iii) more efficient and accountable governments, and (iv) timely and appropriate policies in the areas of food production, nutrition, natural resources, markets, and trade. Almost all studies of poverty in India have shown a combination of rising food prices and decelerating agricultural growth is **a sure prescription** for increased poverty. While agricultural growth does have a positive correlation with poverty reduction, rural

development cannot be achieved merely through agricultural development (Choudhry and Rajakutty, 2000)²⁰.

1.15 Raising agricultural productivity complements natural resources conservation because it **requires better management** of soil, water and nutrients. Where feasible, farmers in the semiarid tropics **have made large investments in irrigation wells** to convert small dryland areas into highly productive irrigated plots, which now provide a significant share of household food, fodder, and cash needs (John Kerr, 2000)²¹.

1.16 Rural Poverty is as diverse as are the rural poor in their livelihood strategies. But in most of the poorest countries, agriculture is the main source of rural economic growth. International experience has demonstrated the direct relationship between agricultural growth and rural poverty reduction [(Timmer, 1997)²² and (Hazell and Ramaswamy, 1991)²³]. Growth of the agricultural sector is, therefore, essential to reducing hunger and poverty. Since the Rio Earth Summit in 1992,

²⁰ Choudhury R.C and Rajakutty S (2000) : "Changing the Focus" published in "Survey of Indian Agriculture 2000", The Hindu Publications, Chennai (India).

²¹ John Kerr (2000) : Promoting Sustainable Development in Less-Favoured Areas : Development Strategies for Semiarid South Asia", IFPRI, Focus 4, Brief 6 of 9, 2000

²² C.P. Timmer (1997): "How Well Do the Poor Connect to growth process, consulting Assistance on Economic Reforms", Discussion paper 178 (Cambridge, Mass.: Harvard Institute for International Development)

agriculture remains high on the international agenda because it brings together critical issues like water, poverty, hunger, and health. That is why improved agricultural productivity and growth are central to World Bank's strategy for reducing poverty, as given below:-

- Fostering an enabling environment for broad based and sustainable rural growth.
- Enhancing agricultural productivity and competitiveness;
- Fostering non-farm economic growth;
- Improving social well-being, managing and mitigating risk, and reducing vulnerability;
- Enhancing the sustainability of natural resource management;

1.17 The Millennium Development Goals (MDGs)²⁴ are to: eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women; reduce child mortality; improve maternal health; combat HIV/AIDS, malaria, and other diseases; ensure environmental sustainability, and develop a global partnership for development. The UN/ESCAP's Committee on "Poverty Reduction" has emphasized on:

- Integrating poverty reduction, sustainable development and environmental protection;

²³ P.Hazell and C.Ramaswamy (1991): "The Green revolution Reconsidered: the Impact of High-Yielding Rice Varieties in South India", Baltimore, Md: Johns Hopkins Press.

²⁴ The development goals are as agreed on at international conferences and world summits during the 1990s. At the September 2000 Millennium Summit, world leaders distilled key development goals and targets in the Millennium Declaration. Based on the declaration, the International Monetary Fund (IMF), the Organization for Economic Co-operation and Development (OECD), the United Nations, and the World Bank devised these set of eight goals 18 numerical targets and over 40 quantifiable indicators to assess progress.

- Integrating poverty reduction and population dynamics and migration;
- Strengthening the economic and social position of the poor through a **needs-based, development-based, and rights-based** approach;
- Enhancing the participation of the poor in decision-making through community-based organizations; and
- Fostering the development of sustainable and affordable information and communications technology focused on the needs of the poor.

1.18 Sound national policies favouring small farms and related rural industries are a necessary condition for rural poverty reduction, for coping with domestic and international competition in the home market, and for taking advantage of export opportunities. **Trade liberalization without these measures can aggravate poverty.** Agricultural sector is too vital for India's economy to be put on the back burner.

1.19 In poor rural areas, where agricultural productivity is low and unreliable and there is food insecurity, **better information and knowledge-exchange** can be important in lessening poverty. The World Bank (2003)²⁵ emphasizes the need an international assessment on the scientific, technical and institutional issues associated with agricultural production, food (systems, safety,

²⁵ World Bank (2003) "Multi-Stakeholder Regional Consultation For International Assessment on the Role of Agricultural Science & Technology in Reducing Hunger, Improving Rural Livelihoods and Stimulating Environmentally Sustainable Economic Growth", at National Academy of Agricultural Sciences, National Agriculture Science Centre, Pusa, New Delhi, 12-13 May 2003.

quality, security) and enhancing livelihoods **in order to improve the quality of the information available** for decision makers on these issues at the national and international levels as well as information useful to farmers and consumers.

2. Reaching the Rural Poor (“Un-Reached”) - How? When? With What? By Whom?

2.0 Over the next 50 years, the global population will increase to 8-10 billion, requiring advances in scientific knowledge across a broad range of agricultural endeavors (i.e. developing more productive food and commodity cultivars, improving nutritional quality of crop and livestock products, reducing food and commodity yield losses due to pests and diseases, ensuring healthy livestock, developing sustainable and responsible fisheries and aquaculture practices, optimizing the use of forests, managing water more efficiently, protecting and improving land productivity, and conserving and managing genetic diversity).

2.1 Rural Development is a process of sustained growth of the rural economy, which can be segregated into five categories: **agriculture, industry, construction, transportation and commerce**. India’s economic growth and industrial growth are

dependent on **production and productivity** in agriculture, which is the largest private sector. The **existing food security** has been mainly brought about by the increase in irrigated agriculture and the introduction of high-yielding varieties of crops. **Current stability** in production has been through wheat, which is largely a winter crop. However, the rainfed areas, which account for 70% of the Net Cultivated Area of the Country, have not benefited from modern developments in agriculture. Of this 70%, about 30% area is under dryland agriculture, wherein the annual rainfall is up to 400mm only. **The lesser the rain in an area, the greater the adverse impact on the farmers and villagers there.**

2.2 Despite 50 years of development planning in India, **Rainfed agriculture** continues to be the largest and the most important segment of crop production. Indian Agriculture is now on the threshold of the 2nd Phase of Green Revolution, as the agricultural growth in India, as of today, **is constrained**, due to the limited scope for increasing area under cultivation.

2.3 The growing demand for foodgrains, vegetables, fruits, milk, poultry, meat and cash crops present **greater and newer** challenges to agriculture, due to the "peri-Urban" development

phenomena. **The locus of agricultural growth has since been shifted from production front to the processing and marketing front.** Cooperatives once again emerge as an alternative for making rural economy vibrant, as this sector has done during green revolution and white revolution during 1960s and 1970s.

2.4 Agriculture has undergone several fundamental changes during the 20th Century, including extensive dependence on farm machinery, intensive fertilizer and agrochemical management, crop breeding, high yielding hybrid varieties, and genetic manipulation. Agricultural development requires resources, infrastructure, technology, and institutions.

2.5 Farmers in rural areas continue to experience great disparity in income compared with other sectors, and revert to natural resources as the most accessible sources of livelihood. Higher per Capita consumption of natural resources in several developed countries threatens global sustainability. Degradation of natural resources is a key threat to socio-economic development, and to global environment (e.g., climate change and loss of biodiversity).

2.6 Reaching-the-Rural-Poor makes broad-based economic growth its primary objective. To reduce rural poverty, rural areas are to be addressed in their entirety: all of rural society and every economic aspect of rural development, social aspect of rural development, and environmental aspect of rural development. "Reaching the Rural Poor" treats agriculture as the leading productive sector within the rural economy and closely linked to non-farm activities.

2.7 Sustainable rural development requires approaches to poverty reduction, social & gender reduction, local economic development, natural resources management, and good governance. Good governance and institutions are indispensable for sound rural development. As the development progresses, all countries undergo a transition from a "predominantly" rural to a more "heavily" urban economy. Urban and Rural areas are a continuum, but they are also internally heterogeneous.

2.8 The production of staple foods is the main source of income for many rural households, but that to get out of the "poverty trap" - they must diversify into livestock, higher value crops, and non-farm activities. To bring new technology to farmers,

agriculture extension services are crucial and can also play an important role in delivering information on rural development, business development, and marketing. **Markets are now the driver for agricultural growth.** Marketing today depends on information system, i.e. on adequate information about what people want, at what price, and who can supply it (<http://www.Agmarknet.nic.in>). Farms, households, and other components of rural systems need a minimum bundle of **rural infrastructure services** to function efficiently, which include:

- An adequate supply of safe drinking water;
- Health and education infrastructure;
- Transportation infrastructure and services;
- Information systems; and
- Adequate and dependable energy supplies

2.9 Adequate infrastructure of every type is imperative for agricultural and rural development. Agricultural Development induces economic growth in other rural sectors by generating demand for inputs and providing materials for processing and marketing industries. The renewed strategy of the World Bank (2002) is as follows: -

- Providing an enabling policy and institutional environment to foster agricultural growth;
- Supporting Sustainable intensification of production through the use of new technologies;
- Enhancing the quality of food produced;
- Encouraging, partly through demand-driven extension services, more efficient use of from inputs and reduction of post-harvest losses;
- Increasing the productivity of water use;
- Supporting agricultural diversification, especially into high-value products;
- Strengthening farmer-to-market linkages;
- Enhancing food safety and addressing competitiveness through quality control and supply chain;
- Applying differentiated strategies to fit various farm types;
- Supporting the development of physical and services infrastructure.

2.10 Harnessing the information revolution for **economic development, social cohesion and poverty alleviation** in the 21st century is the theme for various National and International Conferences. The present day Digital opportunities (0s and 1s) will assist us in realising the concept of “**sustainable communities**”, which is one where all stakeholders, as partners in progress on the road to economic development, will be enabled to achieve “**sustainable production**” and “**sustainable consumption**”. **ICT Diffusion and Infusion in agricultural sector provide the necessary “digital opportunities” or “advantages” for productivity increase, income generation and decrease in**

regional disparity. Agriculture (genetic modification), Medicine (genome research and bioinformatics) and Information & Communication Technologies (ICTs) are the three fields where **diffusion of technology** holds particular promise for the poor (The Economist, November 2001). Fusion of technologies for stimulating growth and technological development in agriculture is the need of the hour.

3. Globalisation: A Theoretical Model of the Developed Countries for Development and Poverty Reduction in Developing Countries

3.0 Globalisation means the growing economic integration among nations and larger flows of trade, services, foreign investment, technologies, people and information. Key aspects of the globalisation are essentially irreversible, particularly those associated with information, ideas, and communication. 1990s saw a remarkable acceleration in the pace of globalisation and also particularly in Information & Communication Technology (ICT), of which the advent of the Internet has been the most visible. The **"Everything But Arms"** initiative approved by the European Union

- which removes virtually all barriers to exports from the least developed countries - is a welcome step (Nicholas Stern, 2001)²⁶.

3.1 Reduction of public investment in rural areas and the attempts to cut subsidies leading to higher input costs actually worsened the conditions of cultivation, in fact **crisis in agriculture**. Liberalization of World Trade Organisation (WTO) has, of course, opened up new vistas of growth, but it is expected to enhance competition in "resource use" and "marketing of agricultural production". There are empirical evidences, which force the small and marginal farmers (who constitute 76.3% of total farmers in India) to resort to "distress sale" and seek for off-farm employment for supplementing income. But The U.S.A adopts the policy of "**Closing the Open Markets - BPO of IT Jobs and Opening the Closed Markets - Agriculture in developing countries**".

3.2 Research reports reveal that the benefits of the globalisation for the poor are particularly strong in the cases where inequality is stable or declining. Michael Bailey (2000)²⁷

²⁶ Nicholas Stern (2001) : "Building a Climate for Investment, Growth, and Poverty reduction in India", speech delivered at EXIM bank, Mumbai(India).

²⁷ Michael Bailey (2000): "Oxfam Policy Papers - Oxfam GB discussion paper - 3/00 - "Agricultural Trade and the Livelihoods of Small Farmers".

suggests **long-term domestic strategies and policies** that would **enable poor farmers** in developing countries to benefit from international trade, thereby contributing to rural poverty reduction and achievement of international development targets.

4. Sustainable Development - Priorities and Responsibilities

4.0 The **existence (or absence)** of favourable natural resources can **facilitate (or retard)** the process of economic development. Professor W.A.Lewis writes: "**Natural resources determine the course of development and constitute the challenge which may not be accepted by the human mind**". Developing countries, embarking on programmes of economic development, "usually have to begin with and concentrate on the development of locally available natural resources as an initial condition, for lifting local levels of living and purchasing power, for obtaining foreign exchange with which to purchase capital equipment, and for setting in motion the development process" (Fisher, 1964)²⁸. The search for socially desirable, technologically appropriate, economically viable, and ecologically sound pattern of resource

²⁸ Fisher, J.J (1964): "The Role of Natural Resources in Economic Development: Principles and Pattern" in (Eds) H.F. Williamson and J.A. Buttrick, 1964, pp 32

use and ways of life, to **promote sustainable development**, has been going on, ever since its most popular exposition in the well-known Brundtland Report entitled "**Our Common Future**" in 1987.

4.1 Sustainable Development is the management and conservation of the Natural Resources Base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for the present and future generations (see **Figure-1 and Figure-2**). The Agenda-21 of the Rio Earth Summit (1992), the UN Convention to Combat Desertification (**CCD**), the UN Convention on Biological Diversity (**CBD**), the UN Framework Convention on Climate Change (**UNFCCC**) and its Kyoto Protocol, and the **Habitat Agenda** adopted by the UN Conference on Human Settlements in 1996, **directly or indirectly**, suggested **integrated planning and management** of Water, Land, Minerals, and Biota resources (that land comprises), for sustainable development and use.

4.2 According to Food & Agriculture Organisation (FAO)'s definition, such sustainable development (in the agriculture, forestry and fisheries sectors) conserves Land, Water, Genetic

(plant, fish & animal) Resources, and is environmentally **non-degrading**, technologically **appropriate**, economically **viable** and socially **acceptable**. The Agenda-21²⁹ recommends major adjustments in agricultural, environmental and macro-economic policy to create **conditions for Sustainable Agriculture and Rural Development**, and its recommendations on "Information for decision making" were as follows: -

- Development of indicators for sustainable development,
- Promotion of global use of indicators for sustainable development,
- Improvement of data collection and use,
- Improvement of methods of data assessment and analysis,
- Establishment of comprehensive information framework,
- Strengthening of capacity for traditional information,
- Production of information usable for decision making,
- Development of documentation about information,
- Establishment of standards and methods for handling information,
- Establishment and strengthening of electronics networking capabilities, and
- Making use of commercial information sources.

²⁹ Agenda 21 - Recommendations of the United Nations Conference on Environment and Development (1992)

The Chapter 14 of Agenda 21 has brought out that "agricultural policy review, planning and integrated programming be carried out in the light of the **multifunctional aspects** of agriculture, particularly with respect to food security and sustainable development". The Emerging new paradigm for sustainable development demands "informatics" as the appropriate tool.

4.3 Sustainable Development depends on the prudent use of natural resources (i.e. Soil, Water, Livestock, Plant Genetic, Fisheries, Forestry, Climate, Rainfall and Topography), in an acceptable Technology Management Framework. Ecological restoration and sustainable development are in fact, closely interlinked with the interplay of **ecology, sociology, economics and culture**. Lester Brown (2002)³⁰ suggests an economy for the Earth - "**Eco-economy**" - that respects the principles of ecology, which can be integrated into eco-systems, in ways that will stabilise the relationship between the economy and the earth, enabling economic progress to continue.

³⁰ Lester R. Brown (2002) : "Eco-Economy : Building for the Earth", Orient Longman private Limited, India, 2002

5. Rainfed Farming: A Step towards Blue Revolution to usher in Sustainable Agriculture and Rural Development

5.0 Rainfed Agriculture is crucial to India's economy and food security because 67% of the net sown area is rainfed and about 44% of the total food production is contributed by rainfed agriculture. Attempts to improve the scenario of rainfed agriculture (i.e. fragile eco-system) were initiated in the early 1920s. For scientific utilisation of natural resources base, it is considered that product of interaction of rain with land; in other words, **watershed** is the ideal geographical unit. Each watershed contains a complex mixture of: **soil types, landscapes, climatic regimes, land use characteristics, and agricultural systems, and** can be subdivided into Agro-Eco-Regions having similar soil types, landscapes, climatic regimes, crop and animal productivity, and hydrologic characteristics. Basic Components of the Watershed Approach consists of following components: -

- a. Community Development (Human Resource Development),
- b. Soil and Land Management,
- c. Water Management,
- d. Afforestation,
- e. Pasture/Fodder Development,
- f. Livestock Management,
- g. Rural Energy Management, and

h. Farm and Non-Farm Value Addition activities;

5.1 Watershed³¹ projects, launched during 1984 in India, have contributed significantly to the evolution of rainfed technologies and approaches to implementation. In the words of eminent Indian economist, C.H.Hanumantha Rao, "Watershed development has been conceived basically as a strategy for protecting the livelihoods of the people inhabiting the fragile ecosystems experiencing soil erosion and moisture stress". The Nagpur Declaration (2000) on **"Natural Resources Planning and Management for Sustainable Development"** suggested that both **"river basins management"** at the macro level and **"watershed management"** at the micro level should mutually complement each other, for integrated water resources planning and management.

5.2 Integrated Watershed Development and Management have been recognized as **an effective strategy for sustainable agricultural & rural development** in the country. This strategy

³¹ A watershed is a piece of land that drains at a defined outlet. This natural unit evolves through the interaction of rainwater and landmass and normally comprises arable and non-arable land, non-agricultural land, and natural drainage systems. Watershed areas are typically delineated on the basis of the distribution and flow of rainwater up to the defined outlet.

has been designed with the objectives of public participation for conservation, upgradation and utilisation of natural endowments (i.e. land, water, animal and human resources) in a harmonious and integrated manner, generation of massive employment in rural areas, **improved standard of living of millions of poor farmers and landless labourers**, restoration of ecological balance through scientific management of land and water, reduction of inequality between irrigated and rainfed areas. As per the AISLUS (All India Soil and Land Use Survey) categorization, India has been divided into **six river resources** regions, **35** basins, **112** Catchments, **550** sub-Catchments and **3,237** Watersheds. FAO Reports on Soil Series have recommend that each watershed should have information on the following parameters:

- (a) **General data** (watershed name, location, boundaries, size, shape, elevation, slope, the presence of streams, tributaries, etc.)
- (b) **Physical data** (geological data, soil data (soil texture, depth, soil series, physical and chemical properties), geomorphologic data (drainage patterns, stream density and order, channel profiles etc.)
- (c) **Climate, Hydrology and Water Resource data** (precipitation, evaporation, wind, temperature, humidity, rainfall, stream flow, surface water, ground water, water quality, etc.)
- (d) **Land Use, Land Cover, Land Capability data** (land use by classes, ownership, land capability, etc.)
- (e) **Cropping pattern**, irrigation requirements, agricultural inputs availability, etc.

- (f) **Erosion data** (kinds of erosion, extent, causes, etc)
- (g) **Infrastructure data** (transportation networks, housing, public services, survey of agro-industry, etc.)
- (h) **Socio-economic/Demographic data** (population, rate of growth, composition, migration, employment, and other demographic factors affecting rate of resource use, etc.)
- (i) **Minimum needs of the farmers** (more roads, domestic/irrigation water, housing, marketing arrangements, recreation facilities.)
- (j) **Awareness of farmers** about the causes and problems facing the watershed.
- (k) **Economic data** (farms production, farms income, farm models, farming systems, land use patterns, employment, labour demand and supply, rural enterprises, marketing, etc.)

5.3 It is essential to make a reference to the potential impacts of the process of economic globalisation and liberalisation with their enhanced primacy of market forces in the future development of fragile ecosystems. There is no doubt that the fragile ecosystems, like the rainfed areas, are likely to face their destructive onslaughts in a big way in this 21st century. To combat the consequences here, some vital changes in the roles of the state, market and civil society, and the rapid growth of Information and Communication Technologies (ICTs), are essential. This "**Blue Revolution**" is a step towards water conservation and management, smallholder irrigation, drainage and waste water reuse, to achieve sustainable public health and food

security, and ushering "2nd Green Revolution", "Gray Green Revolution", or "Evergreen Revolution" in India.

5.4 To achieve quick and spectacular results, it is necessary to establish models of appropriate transfer of technology at District, Block, Panchayat and Farm levels, spread over the entire country. Watershed development has become a trusted tool for the overall development of the village and people living within a watershed area. What will be the role of Departments of Geography, which are spread through out the country and educating more than 15000 students every year? Will they involve themselves in developing "knowledge Information System and Management" on watersheds, as a part of "ICT Diffusion Developmental Action Research"? (Moni and Sundaram, 2003)³².

6. Informatics and Productivity: A Complementarity Relationship

6.0 Research studies reveal that "there exists a **complementarity** relationship between productivity and sustainable development", and also "trust-worthy information

³² Moni. M and Sundaram. K.V (2003): "Rainfed Agriculture: A Step towards Blue Revolution To usher in Sustainable Agriculture and Rural Development", Presented at the XXV Indian Geography Congress, held on 27-29 December 2003, Ghaziabad (Uttar Pradesh), India.

system & communication system **reinforces commitment** for productivity". Information Technology, in **its convergent form**, is recognised as the vehicle for social, economic, and cultural transformation of a society. **The Internet** (i.e. network of networks based on TCP/IP communication protocol) is the driving force of convergence of technologies and services industries. Bridging "**the last mile**" involves technology, economics and geography. The Home Network of the Future will ultimately serve a multitude of appliances with a voracious appetite for content, for which the obvious answer is "**broadband connections covering the last segment of the data pipeline**", known as "**the last mile**". The available technologies for transmission are **Wireless Technology, Cable Connection and Dial-Up Connection**.

6.1 **Geomatics** is the synergy of multiple disciplines namely Information Technology, Communication Technology, GIS, Remote Sensing, Image Processing, GPS, Cartography, Database technology, Statistics, Operations Research, AI, and other Geo-related sciences. Information Technology (IT) is a multidisciplinary field emerging from **computer technology, software technology, database technology, and Internet Technology**.

6.2 Development of **Metadata** (data about data) is required, as overall rate of collection of data increases rapidly with advances in technologies such as High resolution satellite-borne Imaging systems and Global Positioning System (GPS), and with the growing number of people and organizations who are collecting and using data (Ground Truths). Synchronization of Geo-processing Technology (GPS - Global Positioning System and RS - Remote Sensing), with the emerging Information Technology Standards based on "**Open Systems**", "**Distributed Processing**", and "**Component-ware Frameworks**" provides OpenGIS Architecture³³ to facilitate Information Systems and Solutions, over INTERNET/INTRANET for developing DSSs (or GDSSs) on Sustainable Development issues. The Pluggable Computing Model (Component-ware) include GIS Tools, Imaging Tools, Expert Tools, and RDBMS Tools; and each Tool has algorithms, data and interfaces to services in the distributed computing environment.

6.3 One of the central innovations of the World Wide Web (WWW) was the advent of a platform-independent graphical user interface Markup Language. Modern markup languages, such as

³³ see <http://www.opengis.org>

SGML (Standard **G**eneralized **M**arkup **L**anguage) and *XML* (**eX**tensible **M**arkup **L**anguage), which were initially conceived for modeling texts, are now receiving an increasing attention **as formalisms** for data and knowledge modeling. Geography Markup Language (*GML*) is an XML encoding for transport and storage of geographic information (both spatial and non-spatial properties of geographic features) is a significant milestone in the development of **truly interoperable architectures** for the use of spatial information between commercial applications. The **progress of GML 2.0** is an example of the growing momentum for the acceptance and use of Open GIS Consortium (*OGC*) specifications around the world, and represents one of the most visible steps taken by the geo-spatial community towards the creation of widespread spatial interoperability.

6.4 Emergence of Information Technology on the national agenda and the announcement of IT policies by various State Governments have recognized the "**Convergence of Core Technologies and E-Governance**" as the tool for **sustainable development** and **globalisation of economy**. Developments in e-Governance provide opportunities to **harness** the power of Information Technology (IT) to make the business of governance

inexpensive, qualitatively responsive, and truly encompassing. The **e-Governance Concept** is marching towards the development, deployment and enforcement of the policies, laws, and regulations necessary to support the functioning of a digital society and economy. Indian Information Technology Industries play **tremendous and pivotal role** for growth and productivity improvement in India, with the special emphasis on **multi-lingual** (Tamil, Telugu, Kannada, Malayalam, Marathi, Gujarati, Assamese, Oriya, Hindi, Bengali) technologies.

7. Models of Digital Governance (e-Governance)

7.0 Models of Digital Governance (e-Governance) are continuously evolving and improvising to harness the potential offered by the Information and Communication Technologies (ICTs) and deal with new realities in the area of governance. **There are no rigid and finite models of Digital Governance.** In fact, several developing countries are putting into practice innovative e-Governance models that may be technologically simple but are changing the way information is distributed in the society.

7.1 Based on primary experimentation and secondary research, **a few generic models** (http://www.digital_governance.org), which have emerged and are being practiced, have been identified, on the basis of: emergence of knowledge societies and knowledge networkers, role of information in governance process, and link between ICT and governance, **are as follows:** -

- **Broadcasting / Wider-Dissemination Model:** National and Local Governments in developing countries need to aggressively adopt this model if they want to enhance participation of citizens in the governance processes.
- **Critical Flow Model:** Different organizations can use it differently depending on the aspect of governance they want to address. By focusing on the critical aspect of information and locating its likeable users, the model corrects information failure, raising awareness about the bad governance practices, and acts as a hindrance to bad governance practices.
- **Comparative Analysis Model:** Developing countries could very effectively use this comparative model as ICT opens their access to the global and local knowledge products at a relatively low-cost. The model however becomes ineffective in absence of a strong civil society interest and public memory that is essential to force decision-makers to improve existing governance practices.
- **E-Advocacy/ Lobbying and Pressure Group Model:** The model enhances the scope of participation of individuals and communities in debates, which affect them and help them, build a global alliance.
- **Interactive-Service Model:** The potential of ICT for the governance is fully leveraged in this model and leads and can bring lead to greater objectivity and transparency in decision-making processes. This Model facilitates establishing decentralised forms of governance (*G2C2G* or *G4C4G*).

7.2 All these models share in common, the inherent characteristics of the new technologies, which are: (a) enabling equal access to information to anyone who is linked to the digital network, and (b) de-concentration of information across the entire digital network. Designing of e-Government for Poor should benefit from any one or combinations of more than one model, the poverty reduction is a multifaceted and complex one.

8. Geometry of Information Flows: An essential step towards identifying the missing element

8.0 Geometry of Information Flows is a detailed human-centric picture of information flows in a society. It focuses on "***Who are the people***" getting connected and are benefiting when there is an increase in information access and flow. Studying and influencing "Geometry of Information Flows" is important **because the aim is to use ICT for development purposes--- those that bring real, significant changes in the lives of disadvantaged communities** rather than simple embedding of ICT in the society. Somewhat detailed steps, as available from published materials, **for e-Governance projects** are given below:

-

- Who are our Target groups that we want to reach out to, through ICT for Development projects?
- What are the key information needs of the disadvantaged community?
- What are the existing channels by which information reaches to the disadvantaged community?
- What is the weakest link in the chain of information flows: from source to the disadvantaged community?

8.1 Guiding principles of designing ICT for development projects are: -

- Focus on the Disadvantaged Communities, who otherwise will be excluded
- Provide that information or service which otherwise will not be provided
- Focus on utilizing and where possible building upon what is existing rather than thrusting a new intervention
- Create an outcome which in absence of ICT, will not be produced efficiently or timely
- Understand the difference between direct benefits and trickle-down benefits for the disadvantaged community.

8.2 Geometry of Information Flow for ICT for Agriculture Development Projects is suggested to be as follows:-

Who are our Target groups that we want to reach out to, through ICT for Development projects?

- Small farmers with less than 1 acre of land
- Farmers who have land away from roads and markets
- Farmers farming in ecologically fragile areas
- Newly turned farmers, young and women farmers (for instance in HIV/Affected villages)
- Farmers lacking credit, tools to enhance land productivity

What are the key information needs of the disadvantaged community?

- Information on identifying and dealing crop pests and livestock diseases
- Technical inputs on how to carry contour bunding, land-leveling, water harvesting activities, composting to increase productivity
- Information on government and NGO subsidies and schemes on seeds, fertilizers, horticulture and minimum support price
- Information on new crop varieties, irrigation frequency, setting up farm-based enterprises
- Information on market prices of the crops, availability of credit, agriculture fairs, soil-testing labs and training programmes

What are the existing channels by which information reaches to the disadvantaged community?

- Through other farmers, progressive farmers, money lenders, teachers, public phone operator, postman and health workers
- Through government officials, agriculture extensionists, agriculture fairs, agricultural universities and NGOs
- Through radios, televisions, folk songs and newspapers

What is the weakest link in the chain of information flows: from source to the disadvantaged communities?

- Information may be available at local agricultural centres or in markets but these are not easily accessible by farmers.
- High levels of illiteracy prevent farmers to benefit from available information.
- Agriculture extensionists are knowledgeable but do not visit farmlands away from roads or in remote areas.

- Agriculture extensionists and local agricultural centres do not have updated knowledge of new crop varieties, pest control and government schemes and subsidies.

9. "e-Government for Poor": Information, Communication and Poverty Reduction

9.0 E-government is more about putting together the IT infrastructure to make the average citizen's interface with the government easier, while e-governance has more to do with the laws and regulation of the Internet. E-government differs from the basic tenets of ICT (computerization and connectivity) by adding an element of interaction with citizens or the private sector, enhancing transparency, and providing "voice" for those outside the government. Initially it was referred to as G2C (i.e. Government to Citizen) and now is defined as G4C (i.e. Government for Citizen). The famous voice of Abraham Lincoln runs like this: "Government of the People, Government for the People, and Government by the People". This is the appropriate definition for "e-Governance" / "e-Government".

9.1 According to the World Bank, "**e-government**" is defined as "government-owned or operated systems of information and communications technologies (ICTs) that transform relations with

citizens, the private sector and/or other government agencies so as to promote citizen empowerment, improve service delivery, strengthen accountability, increase transparency, or improve government efficiency”.

9.2 The DOT Force of the UN (DOT Version 3)³⁴ concentrated on areas where initiatives might be taken to encourage greater access to and use of ICTs in ways that would genuinely improve the livelihoods of poor people, whether through enhancing economic growth and social equity in ways which bring benefit to the poor, especially in rural areas where 70% of the world's poor live.

9.3 The World Summit on the Information Society (2003)³⁵ has emphasized that ICT applications are potentially important in government operations and services, health care and health information, education and training, employment, job creation, business, agriculture, transport, protection of environment and management of natural resources, disaster prevention, and

34 DOT Force: Digital Opportunities for All: Meeting the Challenge, Draft Report of the DOT Force Version 3.0.

35 WSIS (2003): "Building the Information Society: a global challenge in the new Millennium", World Summit on the Information Society, Geneva 2003 - Tunis 2005.

culture, and to promote eradication of poverty and other agreed development goals.

9.4 Information, knowledge and communication are the lifeblood of economic and social interaction. Developing appropriate ICTs (i.e. a framework) for sustainable development and sustainable livelihoods is, therefore, essential. Poverty has multiple and complex causes, which are mutually reinforcing³⁶. **These deprivations are compounded at the societal level.** The Poor lack:

- Access to information that is vital to their lives and livelihoods:
 - About market prices for the goods they produce,
 - About health,
 - About the structure and services of public institutions;
 - About their rights.
- Political visibility and voice in the institutions and power relations that shape their lives.
- Access to knowledge, education and skills development that could improve their livelihoods.
- Access to markets and institutions, both governmental and societal, which could provide them with needed resources and services.

³⁶ (i.e. there is a strong correlation between access to education and knowledge, and key poverty indicators as infant mortality, family size, and women's health).

- Access to, and information about, income-earning opportunities.

9.5 The potential impact of ICTs on poverty reduction can be seen at the micro, intermediate and macro levels. At the intermediate level, ICTs can help a range of intermediary institutions and agents work more effectively and be more responsive to the needs of the poor:

- Health workers can access the latest information; get assistance with diagnosis, and more effectively target interventions and resources with the help of ICTs.
- Agricultural extension agents can more effectively access and share local and global knowledge on crops, pest management, irrigation and other aspects of small-scale agriculture relevant to the needs of the poorest.
- Teachers can access and share new training materials, continue their own training, and expose their students to the ideas and experiences of children elsewhere.
- Local government officials can get better information about the needs of the poor, communicate those needs more effectively to other levels of government, and be held more accountable by the local people they serve.
- ICTs can help local businesses be more productive, and more responsive to their customers.

Improving information flows and communication services is **a necessary but not sufficient condition** to eliminate poverty. One of the major problems of using ICT for poor is language barrier.

"Networking of People" and "Networking of Information" are essential.

10. Digital development in Rural Areas: A Journey started in 1985 with the establishment of NICNET in districts of India

10.0 In India, "district" is the basic administrative unit at the sub-state level and also consistent with the decentralized planning process prevailing at the grass-root. With the establishment of NICNET in districts numbering about 520 in 1985-87, National Informatics Centre (NIC) has launched its "district information system (DISNIC)³⁷" in about 28 sectors viz., agriculture, animal husbandry, education, health, industries, rural development, micro-level planning, etc., as an informatics tool for development planning and responsive administration.

10.1 Indian village is a cognizable unit located in a specific agro-ecological and sociological environment. Its potentials and constraints for development are well known. As of today, the development planning is a highly compartmentalized activity

³⁷ DISNIC - District Information System Programme of NIC, National Informatics Centre, Government of India, 1987.

managed by atomized government departments handling agriculture, rural enterprises, forests, fisheries, water, health, education, culture, technology and livelihoods - almost in isolation of each other through different projects that rarely converge.

10.2 Village problems are inter-related and the resources (natural and human) are integrated. People are both the "end and means" of development and also bound by a common space, history, culture and know-how. Indian villages are still complex, intertwined and multi-faceted. The

database project to facilitate micro-level planning (**DISNIC-PLAN**) was one among the 27 sectors in 1990s. The DISNIC-PLAN new initiative, during 2004-07, will support building up databases & decision



support systems, and communication systems to facilitate: sustainability of resources, poverty alleviation, empowerment of women, full employment, production systems planning, infrastructure planning and habitat planning. Production potentials of village through "circular-flows" and "chain-effect" should be understood.

10.3 A decentralised agricultural planning system must concern itself with the following **four key dimensions** of agricultural development: -

- Organisational structure for planning and development administration;
- Planning process organised as a two-way interactive process;
- Organisation of agri-support delivery system; and
- Reach of benefits to the bypassed in society, especially small farmers and women farmers.

In order to support the various programmes of agricultural production and meet the demands of farmers, it is necessary to organise efficient **Agri-Support Delivery Systems (ASDS)** in the rural areas, taking into consideration the even distribution of such services and facilities and the problems of optimizing the provision of such services. Apart from extension services, other major services involved in the ASDS are:-

- Provision of agricultural inputs - seeds, fertilisers, pesticides;
- Provision of credit;
- Provision of storage and warehousing; and
- Provision of marketing.

A number of organisations including Public Sector Agencies, Cooperatives and farmer's organisations at the district level provide a variety of the above services, commonly referred to as

"**delivery systems**" (Sundaram, 1997)³⁸. "E-Government for the Poor" should include this "delivery system" as its component.

11. Digital Development in Rural Areas: Government's Initiatives and Agenda on Agricultural Informatics & Communication in India

11.0 According to the National IT Task Force (1999) recommendation (No.79), "**the Government shall take all necessary steps to boost IT for Agriculture and Integrated rural development**". The Ministry of Agriculture and National Informatics Centre (NIC) emphasized informatics for Agricultural development in the National Conference on "Informatics for Sustainable Agricultural Development (ISDA-95), Many follow up actions (ICT projects: AGMARKNET, DACNET, etc) were taken up, to provide relevant agricultural information in rural areas, helping farmers to improve their labor productivity, increase their yields, and realize a better price for their produce. India is expected to become a "**Knowledge Society**" by 2008 and by which time, any farmer in a remote village can demand and get the following information:

³⁸ Sundaram K.V. (1997): "Decentralized Multilevel Planning : principles and Practice - Asian and African Experiences", Concept Publishing Company, New Delhi, India.

- Landuse planning for cropping strategy for farmers fields based on integrated information on soil, water, weather, fertiliser and pest management models;
- How and where to get proper seeds or good quality nursery plants;
- Prevailing prices of farm equipments, agricultural produce, products and series of such set of information, which can lead to high productivity and optimum cost benefit to the farmers.

11.1 To achieve "**knowledge society**" in agriculture, the following things should happen:

- An agriculture information centre in each village;
- Interactive exchange of information for planning and day-to-day operations by farmers;
- Availability of all the extension and advisory services on demand;

The Vision (2020) Document of the Department of Agriculture and Cooperation envisages that "the tools of IT will provide networking of Agriculture Sector not only in the Country but also globally and the Centre and State Government Departments will have reservoir of databases"; and also "will bring farmers, researchers, scientists and administrators together by establishing "**Agriculture Online**" through exchange of ideas & information". Karnataka State Agricultural Policy (1995) and Gujarat State Agricultural Policy (2000) "Agrovision-2010" have

envisaged Information Technology applications to globalize their agricultural sector in a big way.

11.2 Various study results strongly support that the "**payoff**" effect of ICT on economic growth can be achieved only through a robust **National Information Infrastructure (NII)**, i.e., **AGRISNET for the agricultural sector** that supports ICT adoption and applications in Pre-Harvest and Post-Harvest Supply Chain activities. ICT diffusion derives economic force from the complementary development of a knowledge-intensive society³⁹. In the present "**crucial decade**" of this millennium, a high rate of investment in Information Technology capital and a supportive environment are expected to achieve "**digital economy**". Its rapid growth, however, depends on (M.Moni, 2000)⁴⁰: -

- ◆ A higher rate of productivity growth related to investment in Information Technology;
- ◆ A rise in Total Factor Productivity (TFP) growth due to Information Utilisation across the economy and resulting in "**spill-over**" effects;
- ◆ An increase in factor utilisation; and

³⁹ Eunice Wang (1999) : ICT and Economic Development in Taiwan : Analysis of the Evidence", Telecommunications Policy, 23(3,4), April/May 1999, pp235-243

⁴⁰ M.Moni (2000): "New Productivity Paradigms and Strategies in the e-Age - Government Initiatives on IT-led Development in India", International Conference on Productivity in the e-Age, Asian Productivity Organisation, 22-24 November 2000, New Delhi.

- ◆ A decline in the non-accelerating inflation rate and rate of unemployment.

11.3 ICTs Diffusion and Infusion have many potential applications spanning the breadth of the agricultural industry, at all scales of organisation from farmer, to cooperative and professional bodies, from farm machinery vendors, fertiliser and chemical companies, insurance, regulators, and commodities, to agronomists, consultants, and farm advisors. This facilitates farming systems to change in response to economic, technological and social needs. The proposed strategy reinforces commitment for higher agricultural productivity in India, which has been blessed with excellent agro-climatic conditions and water resources. This **"informatics-led development"** in Agricultural Sector provides enough scope for reduction of new risks of marginalisation and vulnerability of small farmers, in view of the two on-going processes (i) economic reforms and liberalisation (1991) and WTO/GATT Agreements (1994) at macro level, and (ii) decentralization reforms at micro level, operating in India.

11.4 As a step towards "reaching" technology to the small Holders (Resource-Poor-Farmers) of the Country, the Central Ministry of Agriculture have taken initiatives to build up an

Informatics Network - **AGRISNET: A NICNET based Agricultural Informatics & Communication** - during the Tenth Plan. During the Ninth Plan, this proposal did not materialize due to bureaucratic entangle. This ICT Network envisages to facilitate an integrated approach of 'Internet Technology' and "Sustainable Agricultural, Rural and Backward Area Development" with its farm and non-farm linkages. During the Ninth Plan, the AGRISNET was suggested to have nodes upto "block level", as "block" is the planning unit for agricultural development. However, in the Tenth Plan, the AGRISNET has been envisaged to have Server Access nodes at 35 State Agricultural and Cooperative Departments, and 600 District Agricultural and Cooperative Offices. To usher in "agricultural Governance" in the country, it is essential to make the AGRISNET as the "rural infrastructure" reaching upto 6.5 lakhs villages.

11.5 This Initiative is based on the recommendations of ISDA-95 Conference (Informatics for Sustainable Agricultural Development), which includes, among the others, the following Informatics Networks: -

- **AGRISNET** - an Infrastructure network upto block level agricultural offices facilitating agricultural extension services and agribusiness activities to usher in rural prosperity
- **AGMARKNET** with a road map to network 7000 Agricultural produce wholesale markets and 32000 rural markets
- **ARISNET** - Agricultural Research Information System Network
- **SeedNET** - Seed Informatics Network
- **CoopNet** - to network 93000 Agricultural Primary Credit Societies (PACS) and Agricultural Cooperative Marketing Societies to usher in ICT enabled services and rural transformation
- **HORTNET** - Horticultural Informatics Network
- **FERTNET** - Fertilisers (Chemical, Bio and Organic Manure) Informatics Network facilitating "Integrating Nutrient Management" at farm level
- **VISTARNET** - Agricultural Extension Information System Network
- **PPIN** - Plant Protection informatics Network
- **APHNET** - Animal production and Health Informatics Network networking about 42000 Animal Primary Health Centres
- **FISHNET** - Fisheries Informatics Network
- **LISNET** - Land Information System network linking all institutions involved in land and water management for agricultural productivity and production systems, which has now evolved as "**Agricultural Resources Information system**" project during the Tenth Plan being implemented through NIC.
- **AFPINET** - Agricultural & Food Processing Industries Informatics Network
- **ARINET** - Agricultural and Rural Industries Information System Network to strengthen Small & Micro Enterprises (SMEs)
- **NDMNET** - Natural Disaster Management Knowledge Network in India
- **WeatherNET**- Weather Resource System Information Network of India

11.6 It has been proposed to use "**Broadband Satellite Technology**", which is the revolutionary satellite based IP solution

built upon a new geo-stationary satellite technology, has now emerged as a cost-effective, easily deployable, and maintainable technology worldwide, to solve both “**first-mile**” and “**last-mile**” problems (Figure-3). According to Pioneering Consulting, a leading market research firm, there will be nearly 40 million users for satellite broadband worldwide by 2007. A VSAT based countrywide Network creates a highly reliable, Cost-effective, error-free and flexible information highway compared to terrestrial alternates available in the country. AGRISNET Nodes can be established in Agri-Clinic locations as given Figure-4.

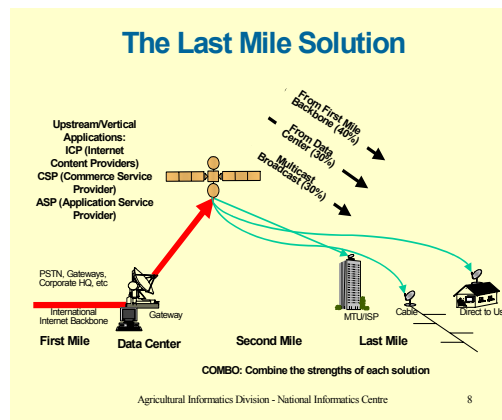


Figure-3: Broadband Satellite Technology: A state-of-the-art and cost-effective Technology Broadband Solution to establish AGRISNET in the Country

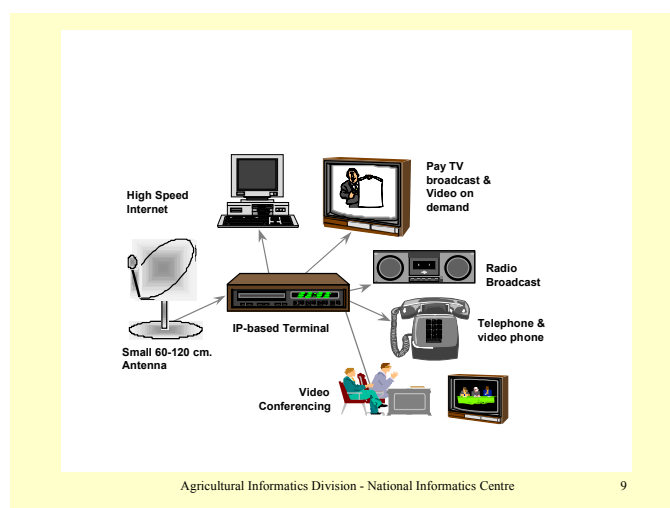


Figure-4: Stand-alone User Terminal linkages with various devices or appliances to facilitate agricultural extension/ advisory services

11.7 National Information Centre (NIC) of the Ministry of Communications and Information Technology - through initiatives such as the **DISNIC-AGRIS** Project, and **AGRISNET** (a NIC-net based Agricultural Informatics and Communications Network) - seeks to reach all agricultural districts and blocks through its massive "Gateway Networks" (R.B.Singh, P.Kumar and T.Woodhead, 2002)⁴¹. Through these networks, **farmers will have opportunity** to learn of and benefit from new and improved agricultural practices, to have weather-forecast-based guidance for timely agricultural operations, to be alerted by satellite

⁴¹ R.B.Singh, P.Kumar and T.Woodhead (2002): "Smallholder Farmers in India: Food Security and Agricultural Policy", FAO Regional Office for Asia and the Pacific (Bangkok, Thailand), March 2002, RAP publication: 2002/03

surveys of pests and diseases, and to access crop-output forecasting and marketing strategies for domestic and for export trade.

12. Agricultural Resources Information System - A Needed Domestic Strategy for Sustainable Rural Livelihoods

12.0 The scientific management of Agricultural Resources becomes a very important part of modern agricultural production in the 21st Century and is a new direction in the domain of agricultural engineering. Agriculture is highly dynamic in nature, because of the changing phenomenon of agricultural crops, which is further complicated by the interaction of crops with environment. A wide range of agricultural practices could be effected including potential environmental benefits that could come from minimizing adverse impacts, by reducing external inputs and greater use efficiency. **Precision farming** is one of the most scientific and modern approaches to sustainable agriculture that is gaining momentum in the new millennium. This approach serves the dual purpose of **enhancing productivity** and **reducing ecological degradation**, as it deals with the question of *where* and *when*. Farmers, Land and Natural Resources (supported by

the Land) have *intrinsic* and *dynamic* relationship. **Resources Application and Agronomic Practices are to match with soil attributes and crop requirements, as they vary across a site**⁴².

12.1 The real value from Precision Farming is that the farmer can perform more timely tillage, adjust seeding rates, fertiliser application according to soil conditions, plan more crop protection programs with more precision, and know the yield variation within a field. **The site-specific management (or Precision Farming) is farm-size and production-system neutral.** Precision farming will make agriculture "information intensive", which will impact rural economies. Despite potential of economic and ecological benefits, **adoption of precision technologies is very slow** through out the World. The reasons for limited implementation of Precision farming in Asian Countries are as follows:

- Small land holdings
- Cost-benefit aspect
- Heterogeneity of cropping system
- Lack of local technical expertise
- Knowledge and technological gaps

⁴² McBratney and Pringle (1997): Spatial variability in soil-implication for precision agriculture. In J.V. Stafford

Out of these, the two major problems for implementing Precision Farming in India are **small land holding size**⁴³ and **cost of Precision Farming System**. In India, about 57.8 per cent of operational holdings have size less than 1 hectare. With this field size and the farming being mostly subsistent farming, it is a difficult task to adopt the techniques of Precision Farming at individual field level. In view of this, Precision Farming can be adopted as "**Information Based Agricultural System**".

12.2 Agricultural planning and development⁴⁴ require (a) knowledge about recent progress in agriculture, (b) the existing situation (especially the main problems impeding development), and (c) the potentialities for achieving agricultural objectives. This information is needed for re-assessing current investment and other development activities as well as for planning new measures, setting benchmarks against which to monitor progress. Proper analysis of the agricultural sector requires that it be seen as a system of functionality inter-related and inter-dependent elements, each of which contributes to the existing and potential

(ed) Precision Agriculture? 97. Bioss Scientific Publ. Ltd., Oxford, United Kingdom. Vol. I: 3-31.

⁴³ Holding Size : Marginal Holdings (in hectare): (Below 0.5 ; 0.5 - 1.0), Small holdings (in hectare): (1.0 - 2.0), Semi-medium holdings (in hectare): (2.0 - 3.0;3.0 - 4.0), Medium holdings (in hectare): (4.0 - 5.0; 5.0 - 7.5;7.5 - 10.0), Large holding (in hectare): (10.0 - 20.0;20.0 and above)

⁴⁴ **Mollet, J.A:** "Planning for Agricultural Development", Croom Helm (London & Canberra), St.Martin's Press, New York, 1984

level of performance of the sector. A **stocktaking and diagnostic survey** is needed early in the planning process to provide information about the wide range of factors, among the others, influencing agricultural performance:

- Agro-climatic data
- Agro-economic data
- Agro-forestry Resources
- Animal Resources
- Capital Resources
- Climate Resources
- Crops and Cropping Systems
- Environment data
- Fisheries Resources
- Forestry Resources
- Institutional Resources
- Land owners data
- Plant Resources
- Socio-economic & Infrastructure data
- Soil Resources
- Spices Resources
- Water Resource

12.3 Zhu Zesheng and Sun Ling (1996)⁴⁵ proposed a **seven-layered architectural model** for agricultural resources management: **application layer, management layer, decision models layer, decision data layer, production data layer, weather data layer, and environmental data layer**. DSSs, Group DSSs, ESs, and components of ESSs and MISs primarily support the decision making process. A complete set of enhanced DSS together with an Idea Processing System (IPS) constitutes a Decision Technology System (DTS), which provides complete, integrated support for all phases of the decision-making process and delivers the complete technology of management for full

⁴⁵ Zhu Zesheng and Sun Ling (1996) : "GIS Implementation of management System of Agricultural Resources" in <http://www.esri.com/library/userconf/proc96/TO350/PAP341/P341.htm>

decision support. Decision Technology System (DTS), **built upon the Agricultural Resources Information System**, is what required for undertaking:

- Crop Suitability based on factor endowment
- Land Suitability Assessment;
- Land Productivity Assessment;
- Population Supporting Capacity;
- Land Evaluation and Land Use Planning;
- Land Degradation Risk Assessment;
- Quantification of Land Resources Constraints;
- Land Management;
- Agro-ecological Characterization for Research and Planning;
- Agricultural Technology Transfer;
- Agricultural Inputs Recommendations;
- Farming Systems Analysis and Development;
- Environmental Impact Assessment;
- Monitoring of Land Resources Development.
- Livestock (cattle, buffalo, goat, & sheep) Farming Systems
- Water allocation in an irrigation system
- Fodder Resources Development
- Water Bodies (Basin) Planning Systems using Watershed and Agro-Eco Region Planning Concepts

12.4 Mollet (1984)⁴⁶ provides details on the contents of Agricultural Resources Information System and **recommends data and information** on basic resources such as (i) soil resources, (ii) water resources, (iii) climate resources, and other data sets (collated from Remote Sensing as well as conventional means) such as (iv) basic data on crops, (v) animal husbandry and fisheries, (vi) genetic (plant, animal & fisheries) materials, (vii) land ownership, (viii) Socio-economic data, (viii) infrastructure for agricultural

⁴⁶ Mollet, J.A : "Planning for Agricultural Development", Croom Helm (London & Canberra), St.Martin's Press, New York, 1984

development. Report of the Core Group-V⁴⁷ of the Standing Committee on Agriculture and Soils suggested strengthening "**Agricultural Resources Information System**" in all districts (regions) of the Country, "**irrespective of past or future growth regions**"⁴⁸ (Figure-1). The Report also recommended pilot projects on the basis of Agricultural Production Systems (viz. Arid Agro-Ecosystem, Coastal Agro-Ecosystem, Hill & Mountain Agro-Ecosystem, Irrigated Agro-Ecosystem, and Rainfed Agro-Ecosystem), for which the typologies considered to be:

- **A tribal district**
- **A hill district**
- **A dry-farming district**
- **A socially backward district**
- **A green revolution district**
- **A district dominated by cash crop district**
- **A coastal district**
- **A district in a mining/ industrial belt**
- **A district dominated by forest economy**
- **A dairy-farming district**
- **A district dominated by one or two urban centers**
- **A district in arid-zone**
- **A district, which is flood prone but having vast wasteland that could be used to generate forest cover.**

12.5 The Pilot project demonstration, one district of above mentioned typologies, in each state, will facilitate development of **decision support systems** on "production practices and systems"

⁴⁷ Report on Agricultural Resources Information System of the Core Group-V, Constituted under National Natural Resources Management System, Standing Committee on Agriculture & Soils, Department of Agriculture and Cooperation, Ministry of Agriculture, 2000

⁴⁸ National Centre for Agricultural Economics and Policy Research (NCAP), Indian Council of Agricultural Research, New Delhi

which need to be adapted to respond to new market demands and export opportunities, poverty alleviation or growing labour shortages, depending on the setting [NATP98]⁴⁹. (Moni, 2000)⁵⁰ suggests development of a comprehensive **Agricultural Resources Information Systems** using *Geomatics Technology* in districts **with public funding**, facilitating sustainable agricultural development, and also suggests the need for development of metadata and application of OpenGIS model for optimal utilisation of agricultural resources in India.

13. Agricultural Extension: An Agricultural Knowledge & Information System for rural empowerment and improved livelihoods

13.1 Agriculture is different all over the world and hence the 'one-size-fits-all' model (i.e. "**Green Revolution Model**") of agriculture is inappropriate and cannot reflect the environmental, social and cultural diversity that exists around the world. **Extension strategy for rainfed farmers and farming is different than irrigated rich resource and progressive farmers**

⁴⁹[NATP98] National Agricultural Technology Project Document, 1998

⁵⁰ Moni.M (2000) : "**Impact of Economic Reforms on Indian Agricultural Sector: Application of Geomatics Technology to Reduce Marginalisation and Vulnerability of Small farmers in India**", presented at International Conference on Map India 2000, New Delhi (India) and http://www.gisdevelopment.net/application/agriculture/m_moni1

(Prasad & Das, 1991)⁵¹. Societies have also different attitudes to intensification and new technologies, and with regard to traditional forms of farming, e.g. maintaining small-scale mixed farming, specific types of produce, knowledge and skills etc. Agricultural research, education, extension and training are the essential **four pillars** of sustainable Agriculture.

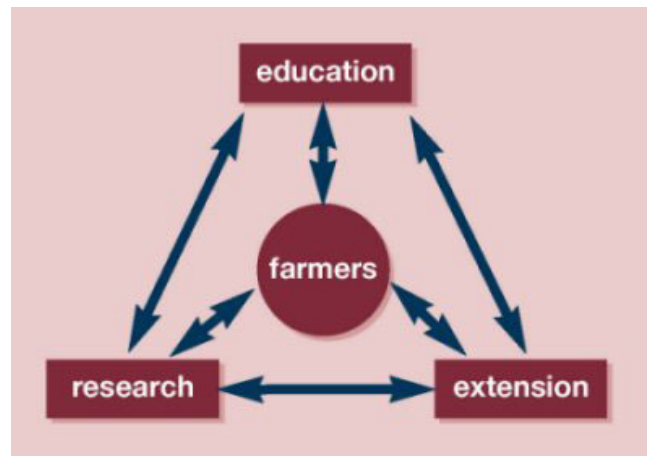
13.2 Information and Communications Technologies (ICTs) have tremendous role to play in these four components. Competent techniques of transferring technologies to the farming communities are of prime importance towards all round development of the agricultural sector. Rural households at various agro eco-regions practice several farming systems. **While each system might bring benefit to an individual household, the conflicts in resource utilization often nullify the effort of the whole community.** Agricultural practices have, however, a major impact on the use of natural resources, ecosystems and biodiversity. Therefore, a better approach to sustainable natural resource management must be designed to help small and marginal farmers (SMFs) in less privileged, fragile areas.

⁵¹ Prasad, C and Das, P (1991): "Extension Strategies for Rainfed Agriculture", Indian Society of Agricultural

13.3 In developing countries, the productivity and incomes of the SMFs have stagnated or even decreased. SMFs, traditionally the backbone of much of developing countries agriculture, are under threat (IFPRI, 2002)⁵². Farmers, in particular SMFs, must be able to choose agricultural practices and technologies from the full range of approaches available for tackling their problems: **agro-ecological** methods, **conventional research** methods, and **molecular biology research** methods. The slack in adoption of technology by Small and Marginal Farmers (SMFs) is largely due to inaccessibility or unavailability of credit, extension, and information rather than any inherent incapability in them. **Converting millions of poor farmers to the use of new technologies has been a colossal task.** Agricultural extension services, which could help reduce the risk of on-farm investments, do not reach the poor systematically.

Extension, New Delhi, India.

⁵² International Food Policy Research Institute (2002) : "Achieving Sustainable Food Security for All by 2020 - Priorities and Responsibilities", May 2002



(Source: www.fao.org - Knowledge Triangle)

13.4 With the agriculture becoming competitive under the new economic order with decreasing subsidies, **Weather Forecasting and Agromet Advisories** need to be improved and made accessible to small and marginal farmers at their doorstep, through the modern Information and Communications Technologies (ICTs). Demands for agricultural technology are changing and diversifying (Rita Sharma, 1999)⁵³:

- technologies to break the stagnation in the yield growth in intensive irrigated agriculture,
- technologies for dryland farming which accounts for 2/3rd of the country's cultivated land,
- technologies for diversification of farming systems for employment and income generation and in high value commercial crops, and development of sustainable

⁵³ Rita Sharma (1999) in 18th National Workshop on Planning and Management of Agricultural Extension Training, 5-6 March, 1999, Ministry of Agriculture, New Delhi

agricultural practices that preserve natural resources while enhancing the productivity.

13.5 The farm is a business and the farm manager (farmer) needs to optimise the returns from their agricultural investment. **The interactions between agricultural systems and practices, economics, society and the environment are highly complex.** The Agricultural Extension is medium-term and long-term investment in the same way as education and research. Resource commitments for agricultural extension, research and education have been diminishing over the years (<http://www.fao.org>), and **especially the public spending on extension is shrinking.** There is ample room for improving productivity, as shown in the **Table-3.**

13.6 There are four types of actors involved in the agricultural extension: public agencies, private agencies (input suppliers etc), production organisations (POs), and NGOs. Agricultural Extension and its services involve basic functions such as informal, dissemination, advisory, and educational. The **Agricultural Extension System Infrastructure in India** includes: -

- Agricultural Extension Officials (Full time) in States (approximately) - 90000
- Extension Education Institutions (EEIs) including MANAGE - 5
- Krishi Vigyan Kendras (KVKs) in 252 Districts (Proposed to have one KVK in every district) - 261

• Advanced Training Institutes (ATIs)	- 15
• Farmer Training Centres/Kisan Vidyapeeth	- 137
• Rural Development Institutes (mainly in the State of Uttar Pradesh)	- 52
• Trainers Training Centres	- 8
• ICAR Institutes	- 48
• State Agricultural Universities	- 30
• Agricultural Colleges	- 205

13.7 The **ATMA** (Agricultural Technology Management Agency) **Model, which was the extension component of NATP** implemented in 7 States, during the Ninth Plan period (1997-2002), was considered as a “**way forward**” to increase farmer’s input with respect to the followings: -

- Farming system innovations (intensification or diversification)
- Farmer organisations
- Technology gaps both in crop production systems and livestock production systems
- Natural Resources Management (Soil conservation and Water conservation, Reduction of Pesticides use through IPM Programs), and
- Marketing and Agro-processing linkages

13.8 Various review reports suggest that the existing government extension services machinery is incapable of transfer of technology and providing agricultural advisories at the door steps of farmers, especially the SMFs. Human Resources Development among farming communities is very essential, as they have to face the challenges at ground level: **creation** of technology (**IPR Divide**), **diffusion** of recent innovations (**digital**

divide), diffusion of old innovations (**extension divide**) and diffusion of human skills (**educational divide**). What the farmers require is discernible from the agro-advisories in farm operations being offered from the Gujarat Agriculture University (GAU) - Anand, as follows:

Sl.No	Farm operations	Percentage
1.	Pest & disease Information	32.4
2.	Sowing time information	22.7
3.	Crop information	16.3
4.	Weather information	13.1
5.	Irrigation Scheduling	4.4
6.	Tobacco crop Information	4.3
7.	Rice Crop Information	2.3
8.	Potato Crop Information	2.2
9.	Harvesting Information	1.2
10.	Fertiliser Application	1.1

13.9 The DUTCH-assisted Farm-woman Development Programs in the States of Andhra Pradesh⁵⁴ and Gujarat⁵⁵ and DANISH-assisted Farm-woman Development Programs in the States of Karnataka⁵⁶ and Madhya Pradesh⁵⁷, and the UNDP Project for Food Security Programme⁵⁸ were in operation in the States of

⁵⁴ DUTCH Assisted Farm Women Development Programme: The districts covered in **Andhra Pradesh** are Rangareddy, Nalgonda, Khmmam, Warangal, Kurnool, Ananthapur, Cuddapah, Chittoor, Prakasam, Vishakapatnam, Vizianagaram, and Srikakulam.

⁵⁵ DUTCH Assisted FarmWomen Development Programme: The districts covered in **Gujarat** are Amreli, Bhavnagar, Bhuj, Dahod, Deesa, Junagadh, Khedbrahma, Navsari, Rajkot, Rajpipla, Surendranagar and Vyara.

⁵⁶ DANISH-assisted Farm Women Development Program in **Karnataka** (all districts except Bidar)

⁵⁷ DANISH-assisted Farm Women Development Program in **Madhya Pradesh**: The Districts covered are: Jabalpur, Mandla, Narsingpur, Chindwara, Rewa, Shahdol, Raisen, Katni, Umaria, Satna, Seoni, Balaghat and Dindori.

⁵⁸ The Government of India and the UNDP have signed an agreement on 13th February 1998 for five years starting from 1st April 1998, was operational in the States of Orissa, Andhra Pradesh and Uttar Pradesh. Districts covered in Orissa are: Baudh, Bolangir, Gajapati, Koraput, Kondhamal, Narsingpur, Rayagada, Khurda, Puri, Ganjam,

Orissa, Andhra Pradesh and Uttar Pradesh. These programmes sought to empower the SMFs through better access to the knowledge, skills and services in agriculture and allied activities ([http:// www.dacnet.nic.in](http://www.dacnet.nic.in)). The ongoing scheme of "**Agri-Clinics**"⁵⁹ intends to advise farmers on cropping practices, marketing their products, technology dissemination, crop protection from pests and diseases, market trends and prices of various crops in the markets. Agri-clinics is expected to augment the existing agricultural extension network, which continues to be the only farm support facility in most areas in India. Establishment of a "**Network of Agri-Clinics and Agri-Business Centres**" is a new dimension in agricultural extension services to farmers.

13.10 The Government initiative of AGMARKNET⁶⁰ Programme during the Ninth Plan with the roadmap to network 7000 Agricultural Produce Wholesale Markets and 32000 rural markets is a step towards "**market-led extension**" in India and is **expected to have impact** on the supply-chain of pre-harvest and post-harvest segments of agricultural operations. **This has**

Jagatsinghpur; Districts covered in Andhra Pradesh are : Medak, Mehboobnagar, Adilabad, Karimnagar, Nizamabad; and Districts covered in Uttar Pradesh are Chitrakoot, Varanasi, Saharanpur, Tehri Garwal, Unnao, Rai Bareli, Sidharthnagar and Bagpat.

⁵⁹ a one-stop shop for all services for the agro industry and also see (www.agricoop.nic.in)

definite impact on farm investment. This Government initiative (**AGMARKNET**) and Private initiatives (**e-chouhal** by **ITC Ltd.**, **Agriventure**, and **Mahindra Krishi Vihar (MKV)**⁶¹) ushers in “**market-led extension**” in the country, facilitating farmers to (i) enhance farm productivity, (ii) improve farm gate price, and (iii) cut transaction cost. Demonstrations of **Mahindra Krishi Vihar (MKV)** at Madurai district in Tamilnadu have shown a significant increase in productivity (as against an average paddy yield of 1.8 - 2 Tonnes per acre, farmers have achieved yield ranging from 3 - 3.6 Tonnes per acre). The consultancy and technical support package was at a cost of about 10 % on the increase in productivity achieved (Balaji, 2001)⁶². Community Agro-biodiversity Centre (CAbC) of the M.S.Swaminathan Research Foundation (Chennai) aims at protection of livelihood and biodiversity in villages.

13.11 Agriculture if given the status of industry in post WTO era, the literacy among farmers and training in ICT to extension personnel, is essential. There are about 600 million farm workers,

⁶⁰ <http://www.agmarknet.nic.in>

⁶¹ Mahindra Shublabh Services Limited (MSSL), which is a private sector initiative, have planned to open Mahindra Krishi Vihar (MKV) in about 180 districts to facilitate bridging the lab-to-land gap in TOT for enhancing productivity, and also by tapping the as-yet-unexploited-potential of available technologies. Each MKV would be equipped with a VSAT for information exchange.

⁶² Balaji R (2001) : “Mahindras Foray into farm Consultancy”, Business Line, October 22, 2001

most of who are not agricultural science graduates, yet possess **inherent knowledge** to carry out commercial activities. What they lack is capital, access to trade, agricultural resources, market information system, connectivity among others of their ilk, decision-making support systems and market mechanisms to convert their labour into profitability. A **catalyst effect on farm productivity through Agri-Clinics** should not turn out to be a dream.

13.12 According to Preeti Ramanathan (2002)⁶³, **Agri-Clinics**, in its present form and without the supporting commercial and legal mechanisms, **would remain** yet another well-intentioned government intervention in agriculture and rural development, without sustainable growth and without any relations to **macro level planning**, for development. The rural economy is larger than the yearly 12000 graduates or so in agriculture and related subjects, and **the ills** are far beyond and over encompassing. The Government expects that "**Dial 1551 Call Centre**" which rides on the fact that six lakh villages have phone connections, could bypass a clearly inadequate system of extension workers and NGOs.

⁶³ Preeti Ramanathan (2002): "Commercial Support Vital for Agri Clinics Role in Rural Development", Financial Express, 1 April 2002

13.13 Mohan and Moni (2001)⁶⁴ proposed an exclusive Agricultural Extension Information System Network (**VISTARNET**) to reach Technology to the Small Holders (Resource-Poor-Farmers) in India, by networking the existing Agricultural extension infrastructure, given above, and also undertake "**capacity building**" through human resources development programme for using ICTs. With the implementation of **DACNET Infrastructure** (An e-Governance Infrastructure for development information exchange - eGOV4D and also see <http://www.dacnet.nic.in>) in all Directorates of the Central Department of Agriculture and Cooperation (DAC), and the **AGMARKNET**, the **VISTARNET** has been realised in India.

13.14 Agriculture in India needs a productivity and quality revolution i.e. a Total Quality Management (TQM) and a Total Factor Productivity (TFP), which can be brought out through the much-needed agricultural reforms. **Agricultural reforms mean land reform plus a package of support services** such as credit,

⁶⁴ Mohan .A and Moni .M (2001): "**VISTARNET - A NICNET Based Agricultural Extension Information System Network** to reach Technology to the Small Holders (Resource-Poor-Farmers) in India", presented at the National Workshop on "**Cyber Extension: Application of Information & Communication Technology in Agriculture**" held at National Institute of Agricultural Extension Management, Hyderabad (India), February 21 - 22, 2001.

marketing, pricing, and rural infrastructure (water, roads, bridges, hospitals and schools). India has concrete policies for the provision and maintenance of rural infrastructure such as roads, bridges, hospitals, and schools. This leaves the agrarian reform program to take care of the more direct agriculture land and water issues. These are the problems that the farming households are constantly in conflict with each other, when it comes to sharing common resources such as land and water. Strengthening small-scale agriculture and related rural industries bring vital benefits for rural economy.

13.15 Agricultural Extension programmes need to be oriented towards enhancing the decision-making abilities of rural people, especially farmers, by expanding their exposure to effective organization and management skills, not just new agricultural production technologies alone i.e. **"knowledge-intensive"**. The task of extension would become more challenging in the wake of post WTO era, which demands a **"system of market-led extension"** with specific focus on diversification, post-harvest management, and export orientation. The

Department of Agriculture & Cooperation (DAC, 2002)⁶⁵ proposes **"reforms in agricultural extension"** on wider-scale as follows: -

- Policy reforms
- Institutional restructuring
- Management reforms
- Strengthening Research-Extension linkages
- Capacity building and skill upgradation
- Empowerment of farmers
- Mainstreaming of Women in Agriculture
- Use of media and ICT
- Financial sustainability
- Changing role of Government

13.16 In the Indian context, **emergence of an e-Farmer⁶⁶** is the need of the hour. Synergetic collaborations among Cooperatives, Agricultural Produce Markets, Agri-Clinics, Agri-Business Centres, and AGMARKNET could become the **"pathways"** to rural prosperity. **The Agricultural Extension System is expected to be "an Agricultural Knowledge & Information System using Geomatics Technology" in India.** Development of Agricultural Extension XML (AeXML) is an essential requirement. The proposed VISTARNET of NIC is based on this proposition.

⁶⁵ Department of Agriculture & Cooperation: "Policy Framework for Agricultural Extension", Extension Division, Ministry of Agriculture, New Delhi

⁶⁶ e-Farmer : A farmer, who knows the market situation world over, has unhindered access to the markets and technology and also possesses access to meteorological information, and extension advice can be considered as adequately equipped to enter the world of global partnership. He will then be free to deal with the problem of, at least operative consolidation of fragmented land holdings, backlog in technology and feeble infrastructure.

14. Conclusion

14.0 This paper draws input available from published documents as well as from Internet resources. Good Governance and institutions are indispensable for sound agricultural and rural development in developing countries. Models of e-Government (i.e. digital government) are continuously evolving and improvising to harness the potential offered by the Information and Communication Technologies (ICTs) and deal with new realities in the area of governance, through out the World. Design of an e-Government for the Poor should encompass an integrated model of the Generic Models of e-Government viz., Broadcasting / Wider-Dissemination Model, Critical Flow Model, Comparative Analysis Model, E-Advocacy/ Lobbying and Pressure Group Model. An appropriate "Geometry of Information Flows" will facilitate direct benefits rather than trickle-down benefits for the disadvantaged community (i.e. the Poor). **This model should be based on what Abraham Lincoln said: "Government of the People, Government for the People, and Government by the People".**

14.1 The rural poor are not a homogeneous group. Poverty has multiple and complex causes, which are mutually reinforcing. If poverty is to be reduced, a flourishing agricultural sector is essential in most developing countries. "Reaching the Rural Poor" makes broad-based economic growth its primary objective, and treats agriculture as the leading productive sector within the rural economy and closely linked to non-farm activities. Non-farm activities, often with linkages to agriculture and natural resources, have important multiplier effects. **Rural poverty reduction** requires **multifaceted policy efforts** that recognize the linkages among household asset access portfolios, household income strategies and macro-structural changes. Poverty reduction is associated with Social Development and Infrastructure Development.

14.2 There have been both national and international efforts (DOT Force of the UN, the UN/ESCAP Committee on Poverty Reduction, the Millennium Development Goals, **PovertyNet** of the World Bank, etc) to improve information flows and communication services to eliminate poverty (ICT for Poverty Reduction), which are a necessary but not sufficient condition. In poor rural areas, where agricultural productivity is low and unreliable and there is

food insecurity, better information and knowledge-exchange can be important in lessening poverty.

14.3 The PovertyNet in India takes the form of the Government's Digital Initiatives and Agenda (viz., **AGRISNET**, **AgRIS**, **AGMARKNET**, **DACNET**, **VISTARNET**, **APHNET**, **FISHNET**, **HORTNET**, **SeedNET**, **PPIN**, **COOPNET**, **FERTNET**, **ARISNET**, **AFPINET**, **ARINET**, **NDMNET**, etc), as a step towards "reaching" agricultural knowledge and technology to the rural Poor.

14.4 To usher in "agricultural governance" in the country, **the establishment of AGRISNET as the "national information infrastructure" is emerging as a pre-requisite.** As "resources application and agronomic practices" are to match with soil attributes and crop requirements, the Agricultural Resources Information System (AgRIS) is a **"way-forward"** to improve agricultural productivity in rural areas, and a much **"needed domestic strategy"** for sustainable rural livelihoods. Digital development in rural areas, through various Government Programmes viz., **DISNIC**, **AGRISNET**, **AgRIS**, **AGMARKNET**, etc, are providing a broad base for upliftment of the rural poor in

India. This is a step towards establishing a **location-specific e-Government model for the Poor in India**, at grass-root level.

14.5 Developing countries, which are agrarian in nature, are expected to gain from the "lessons learnt" and the "best practices adopted" in India. Development and Use of ICT in Agriculture has a promise in ushering agricultural growth, "**but still miles to go**". This digital agenda is a positive force for fostering Agricultural Growth, Poverty Reduction and Sustainable Resource Use in India. What was a "technology push" in 1990s is taking the shape of "consumer pull" at grass-root level in India to usher in agricultural governance in the country. **The Digital Initiatives** provide resources for people and organizations working to understand and alleviate poverty.

Annexure-Tables

Table: 1 Rural Public Investments that increase agricultural productivity the most, in descending order

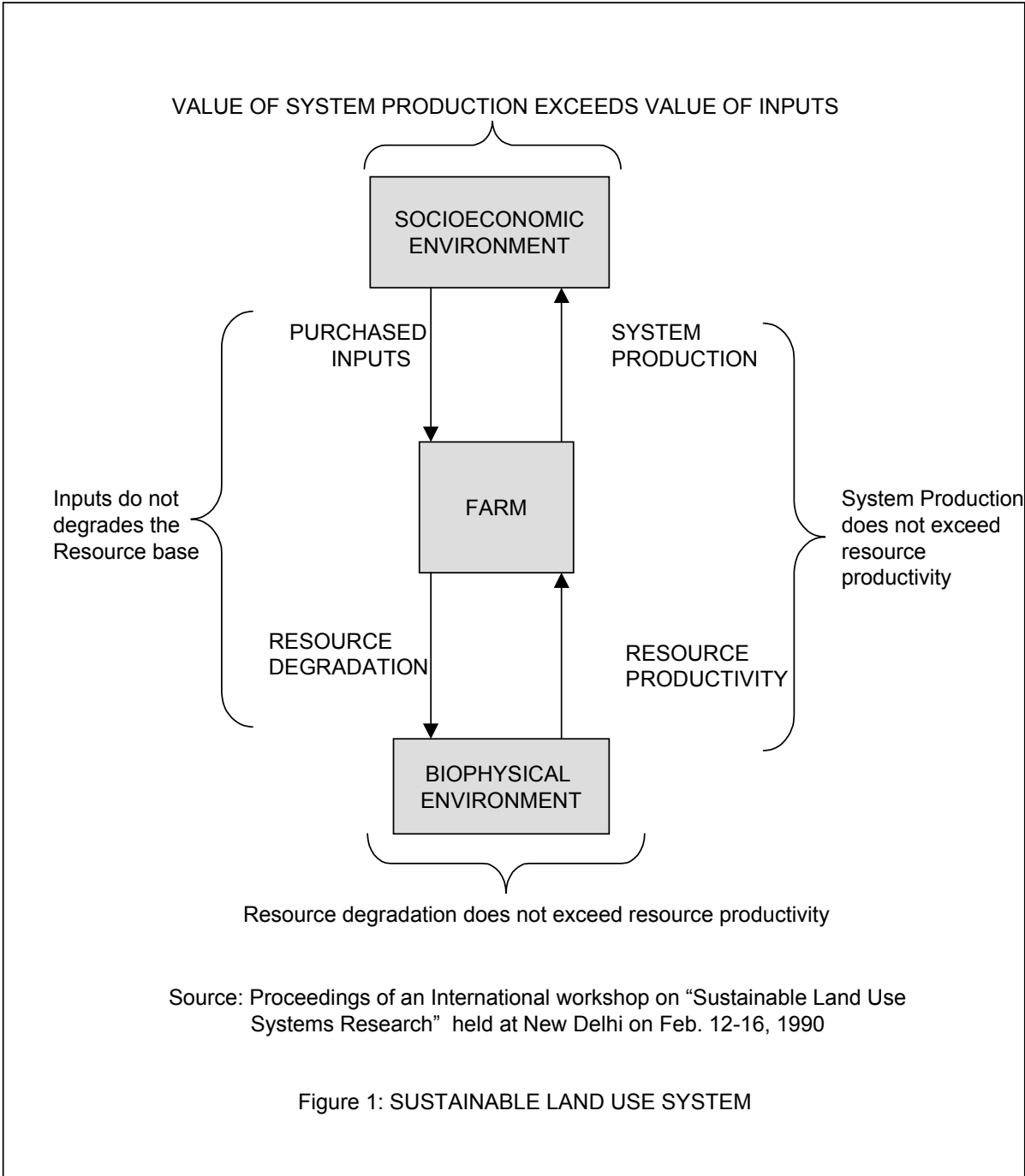
India	China
1. Agricultural R&D	Agricultural R&D
2. Roads	Education
3. Education	Roads

Table: 2 Rural Public Investments that decrease poverty the most

India	#Poor lifted Out of Poverty Per Rs 1 Million (1993 prices) prices)	China	#Poor lifted Out of Poverty Per Rs 1 Million (1997
• Roads	123.8	Education	8.80
• Agricultural R&D	84.5	Agricultural R&D	6.79
• Education	41.0	Roads	3.22
• Rural Development	25.5	Electricity	2.27
• S&W Conservation	22.6	Telephone	2.21
• Health	17.8	Irrigation	1.33
• Irrigation	9.7	Poverty Loan	1.13

Source: (Shenggen Fan, Peter Hazell, and Sukhadeo Thorat, 2000); (Shenggen Fan, Linxiu Zhang, and Xiaobo Zhang 2002)

Table-3: Productivity Profile of Traditional Crops					
Kg / Ha	India	Best In Class		Other Comparable	
Rice	2890	6220	Japan	4170	Indonesia
Wheat	2580	7600	France	3670	China
Cotton	300	1520	Australia	530	Pakistan



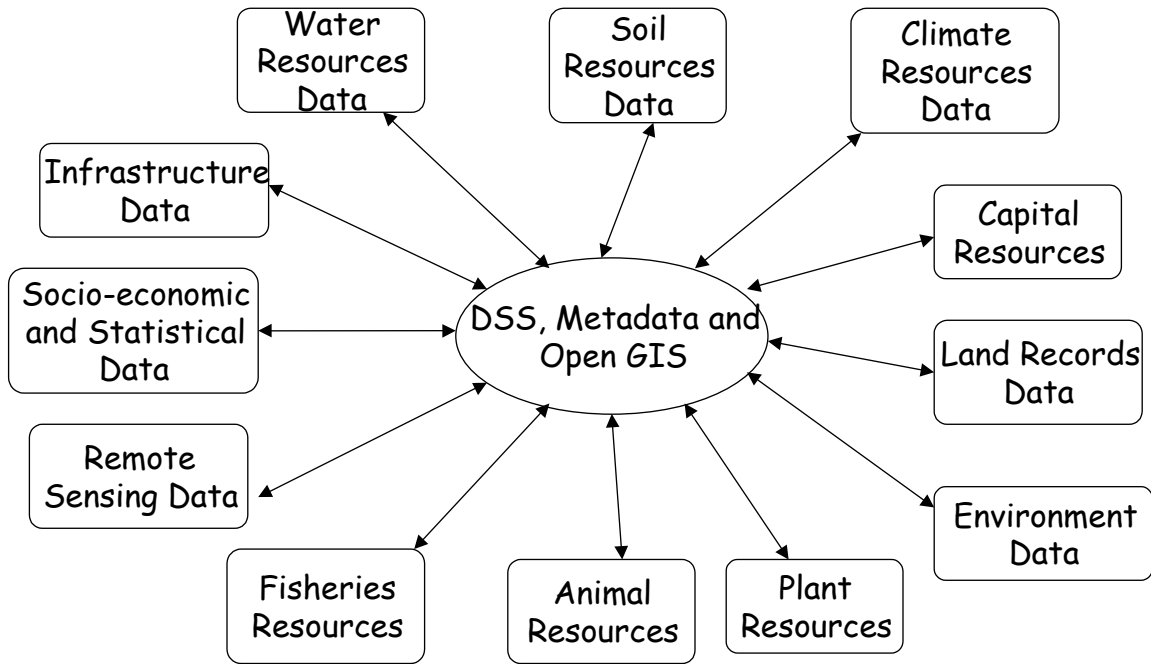


Figure2: Components of Agricultural Resources Information Systems

