

# TECHNOLOGY TRANSFER IN ARID REGION

## Issues and Approaches

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Approach Paper

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This approach paper on 'Technology Transfer in Arid Region' is based on the Panel Discussion of 13 pannelists and 125 delegates during National Symposium on "Livelihood Security and Diversified Farming Systems in Arid Region" held at Central Arid Zone Research Institute from 14-16 January 2006 and subsequent interactions and discussions.

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## Executive Summary

Like monsoon clouds, green revolution seems to have bypassed arid region and drylands. A majority of farmers in these resource poor regions have not been adequately benefited from green revolution technologies, either due to technological limitations or their slow dissemination. A greater focus is therefore necessary on arid regions and drylands to realise the national target of attaining four per cent growth in agriculture. Constraints in technology dissemination need a critical review and possibly major policy changes are warranted. The following approaches were considered important to ensure effective transfer of technology in these areas:

1. Integrated production and knowledge centric approach in farming systems perspective rather than dissemination of sectorial technologies for individual commodities.
2. Technology generation as per farmer's needs. The technology should take into cognisance indigenous know-how, adapted biota and should be developed in participatory mode for ready conviction and adoption.
3. Prioritisation of location specific technologies as per sub-agro-ecological regions through a state level coordination committee. Technologies need to be pooled at a level of state department of agriculture and then routed to farmers by different agencies in coordinated fashion with people's participation.
4. Minimising overlaps and enhancing output of extension agencies of different ministries/ departments synergistically.
5. Judicious use of relief wherein a part of aid may be used for meeting immediate needs of farmers but a larger part of it should be utilized for creating permanent land based resources to enhance productivity through community participation adopting sound technology transfer approach.
6. Simplification of procedures to promote organic farming and export with formation of farmers' co-operatives and self help groups to withstand market competition and adoption of technology.
7. Policy shift coupled with scientific checks to stop breeding of low productivity animals and promotion of multiple use of livestock.
8. Policy intervention of state to remove stumbling blocks in process of transfer, insurance of crop and animals to induce self dependence and risk bearing capacity.
9. Partnership of NGO's, government, R&D institutions, extension agencies, bankers and farmers for technology transfer and adoption.

10. Community mobilization and active participation of youth and women in decision-making and TOT. They are required to be trained and educated through agri-clinics and involvement of bank, line departments, R&D institutions and NGO's.
11. Knowledge connectivity and creation of village knowledge centres for education, training, demonstration and credit etc. Use of IT for quick response time to market changes and weather.
12. Increased coordination among different organisations right from single window outlet to adoption, dissemination, assessment, feedback, refinement and effective dissemination.
13. Soil and Animal health card system, crop planning and preventing epidemics during drought years. All relevant departments shall be in networking and information be transmitted to Panchayat Samiti/village/individual level.
14. Some pockets of arid region are highly specific and have great potential for growing crops like Isbgol, Maithi, Condiments, Henna, cut flower, etc. Education of farmers and declaration of crop zones /organic zones will go a long way in establishment of industries and creation of suction at grass roots for fast mobility and dissemination.
15. Market intelligence in perspective of national and international scenario in conjunction with development of infrastructure and market facilities.

#### ***Immediate Action Points***

- Coordinated mission approach
- Convergence amongst related Ministries/ Departments/ R&D institutions
- Capacity building and feedback mechanism for technology refinement
- Creation of IT based Village Knowledge Centres
- Development of proper infrastructure and marketing facilities

*... whenever the users, knowledge and skill possessors and implementers are linked and networked, success comes effectively and multiplies.*

**Dr APJ Abdul Kalam**

Inauguration of the National Virtual Congress  
of Farmers, Hyderabad, 5 January 2006

The success of technology does not lie only in its content but also in its adoption and popularity. Generally the former is overestimated while the latter is under played. Growth in the agricultural sector is crucial for India's development. About two-third of the national workforce still depends directly or indirectly on agriculture, which generates about 22% of GDP. At present the growth rate of agriculture is less than 2% per annum. Dr Manmohan Singh, Hon'ble Prime Minister of India during his inaugural address at National KVK conference on 27<sup>th</sup> October 2005 at New Delhi stated that if we have to achieve our ambitions of growing at a rapid pace of over 8% per annum, then we must aim at an agricultural growth rate of over 4% per annum on a sustained basis. He emphasized that we need to usher in a second green revolution. The agricultural sciences would have therefore to work towards providing the technological basis for new breakthroughs. They will have to look at providing crop specific, region specific, resource specific and farm specific solutions to our problems. It will require all out efforts in agricultural technology generation, dissemination, adoption and marketing in rainfed areas.

Increased agricultural productivity and profitability, especially in resource-poor areas, is crucial to rural poverty alleviation and welfare of rural women and other disadvantaged groups. R & D institutions have generated a storehouse of technologies and innovations in past few decades, but a vast yield gap still exist between technologically achievable productivity and the yields actually obtained at farmer's field. Bridging this yield gap between research station/ demonstration and the farmer's field is the only way to alleviate rural poverty and achieve social justice.

During her visit to CAZRI on 16.12.2005 H.E. Pratibha Patil had desired to identify constraints and gaps of present extension system and suggest solutions so that technologies may percolate down to arid zone farmers. To address this important issue, a panel discussion was organised at CAZRI, Jodhpur on 16<sup>th</sup> January 2006 during the National Symposium on "Livelihood Security and Diversified Farming Systems in Arid Region" in which policy makers, officers of line departments like agriculture, animal husbandary, forestry, DRDA, ATMA, SAU, NGO's, farmers and scientists brainstormed the issues of technology dissemination at length. Subsequent interactions were held in house and with the people who matter. The outcome of the entire exercise is presented in this approach paper.

The Arid ecosystem covering about 12% geographical area of the country manifests insurmountable challenges due to inhospitable climate, vast livestock and human population surviving on limited and fragile natural resources. The region receives very low erratic rainfall of

<400 mm with high temperatures and wind velocity leading to high evapo-transpiration (>2000 mm) and extremes of aridity. Permanent negative water balance hampers biomass production of any kind. Besides, frequent droughts, posing serious threats to survival, tend to remain permanent feature of arid region. The arid region of India is spread over in 38.7 million ha, of which 31.7 m ha is under hot arid and 7 m ha in cold arid region. The hot arid region occupies major part of North-western India (28.57 m ha) mainly in western parts of Rajasthan (19.6 m ha), Gujarat (6.22 m ha) and South-western part of Haryana and Punjab (2.75 m ha) and small pockets (3.13 m ha) in Southern peninsula. The cold arid zone is spread in the states of Jammu & Kashmir and Himachal Pradesh.

Sustainable upward growth requires sound science based policies. It is commonly said that India has a good store of agricultural technologies that have not reached the end users fully. This calls for a critical analysis to find out bottlenecks of technology dissemination and limitations confronted in adoption. Immediate questions are: Are these technologies really perfect or near perfection stage? Do these technologies match with the farmer's needs under his socio-economic conditions? Is there some inadequacy in our transfer mechanism? Today's agriculture is not subsistence farming for meeting two ends meal, but aims to produce more marketable surplus and to make higher profits in a competitive national/international market to meet the diversified ever-growing needs born out of modernization. The farmer's expectations are changing fast. To live up to his expectations is the challenge before all of us.

### **Lessons of Green Revolution - Appreciation of Reality**

The impact of green revolution was limited to irrigated Indo-Gangetic plains of Punjab, Haryana and UP that too on large farms and not visible with small and marginal farmers, particularly in rainfed region. This "*technology adoption gap*" was earlier attributed to (i) the inadequate support systems for small-farm agriculture, such as extension services, credit, rates of available credit, input supplies, machinery, etc., which are well appreciated and recognized but address only a part of the problem and (ii) attitudinal constraint on the part of small-farmers, such as innate conservatism, ignorance, resistance to change besides a resource crunch. This perception of the problem was largely the product of basic assumption that the technology was scale neutral and a good technology is appropriate in all farming situations. However, field investigations in past decade have questioned the basic assumption of scale neutrality of the technology and clearly suggested that many modern technologies are simply inappropriate for the specific conditions of low input small-farm production systems, which are diverse in nature and are influenced both by socio-economic as well as bio-physical factors.

In rainfed arid region there is vast indigenous knowledge on biota, animal and management practices, etc., which has withstood the test of time. This endemic knowledge should be the base of innovations to develop suitable technology. Therefore, a holistic approach in terms of diagnosis of problems, identification of technological interventions based on farmers knowledge and innovations for various production systems is called for to generate appropriate technologies which will have immediate adoption.



## **Beyond Green Revolution- Shifting Focus Towards Drylands**

Developmental agencies in arid region continue to focus on production and remain wishfully oblivious to the fact that higher production is not consistent in rainfed areas and does not always mean more profit. In green revolution areas higher production was backed by higher input use and purchase policy (minimum support price) of the government that ensured profit. But in arid areas climatic constraints can impair the translation of high input use in to profit and therefore the green revolution model may not work in the arid areas. Besides, high input may not be suitable for arid region having fragile natural resources and inadequate water.

The country may be self reliant in food production but growing concerns are about nutritional security as well as economic security. Also, the opening of various economies around the world i.e. globalisation will bring number of changes in Indian Agriculture. Thus, focus has to be on cost effective, high production technologies backed by value addition, quality control, price competitiveness, marketing strategies, etc. All of this will require well-developed and properly connected infrastructure.

A spectrum of technologies both indigenous or improved are available for irrigated and rainfed areas due to dedicated efforts of agricultural scientists over half a century across the agro-climatic regions in these areas, but their slow dissemination and low adoption has set a new agenda for the generation, assessment, refinement and dissemination of agricultural technologies. Policy makers and administrators are equally concerned about weak adoption of these technologies. Blaming extension mechanism for non-adoption and counter blaming R&D institutions for certain deficiencies in these technologies does not help any one.

### **Introspection**

India has invested heavily in its public agricultural research and extension system, which is a major contributor to success in raising food grains production from 51 million tonnes in 1950-51 to over 200 million tonnes today, thus providing much needed food security in the face of a huge increase in population. Country could make strides in agricultural development through green revolution but in this the major contribution so far had been from irrigated areas which is plateauing on account of second generation problems. The benefits of this growth did not percolate down to the farmers in rainfed areas, especially the small and marginal farmers. Hence, it is the right time to analyse causes or constraints, rectify and evolve suitable strategies to boost the returns matching the population growth and national needs like higher production of grain legumes, oilseeds, etc., particularly in arid region.

The potential of rainfed areas, which constitute 2/3<sup>rd</sup> of cultivated land, is still not fully explored. One of the main reasons for this is that after the green revolution our priorities seem to have suddenly changed. In a number of agricultural universities only about 5% of staff is deputed for extension work and about 5% of the total expenditure is incurred towards extension activities. A study carried out a decade ago showed that the actual cost of operating T and V based

extension services in 17 states of the country was about Rs.4000 million which works out to be merely Rs.50 per agricultural farm holding or about Rs.27 per hectare cultivated area.

Our huge extension system, created during green revolution is suffering from major fund scarcity in rainfed areas. Further, it is being increasingly realized at the highest level that our future lies in the strategy of maximizing out put of the system through low input technologies. This new strategy is just opposite to the strategy of maximizing out put of specific commodities like wheat and rice with high input technologies practiced during green revolution. Suddenly our extension system that is already suffering from "green revolution-fatigue" is being asked to follow a diametrically opposite approach. This new approach has seldom been successfully tried in other parts of the world, especially never in developed world. Possibly the only model available with us is that of Agricultural Technology Management Agency (ATMA) tried under NATP in selected districts of seven states of the country during 1999-2004. However, the agricultural scenario and problems of arid zone receiving less than 400 mm rainfall per year are inherently different from the other rainfed regions. Here, drought is not an aberration but a normal feature, the economic and education status is a cause of worry, drinking water quality is poor and availability is low, soils are sandy and livestock population is higher as compared to other parts of the country. ATMA has been a district level registered society with District collector as chairman of the governing body and Project Director of the Society as chairman of the management committee of ATMA. In western Rajasthan size of a district is much larger than in other states. Problems are highly location specific. This means that we have to devise models of technology dissemination suiting to geographical and administrative needs. As agriculture is a state subject, the priority it enjoys may vary from state to state. In most of the places it is not getting the priority it enjoyed during days of green revolution despite rhetoric statements at all levels to the effect that agriculture is most important for balanced growth of the country.

Even on technological front, shifting from traditional to modern agriculture in the days of green revolution was a major shift and the dramatic yield improvement that followed had caught the imagination of extension workers and masses alike. But now changes in technology are more subtle and one need to be meticulous and methodical in approach to reap full benefit in high producing irrigated areas as well as in dry regions. The extension agencies have not been trained in this approach and thus seem to have developed neutral to disparaging attitude.

The functionaries at various levels in the extension setup, do not always appreciate the ground realities of risks involved in arid farming, low input availability, poor socio-economic status of farmers and almost total dependence on rain. Some of the uncomfortable questions that need to be asked and analyzed are:

- Do extension agency officials feel that they know enough or even more than required by the farmers and hence hardly feel any need for regular interaction with farmers at grass roots and research organizations at the top?
- Are extension officials adequately motivated or are allowed to interact frequently with research organization for undergoing adequate trainings at regular intervals?

- Are state government's relying more on SAUs and central research organizations are becoming less relevant?
- Do extension agencies feel that farmers are not receptive/interested in what government agencies advocate (loss of faith) and farmers are preferring private media, TV/radio, etc.?
- The workers are motivated, but with the existing resources and infrastructure made available to them, do they find it difficult to motivate small farmers suffering from poverty and resource constraints, etc.?
- Are the extension workers being asked to do all miscellaneous works in villages and hence are not able to focus on specific goal of holistic technology transfer?
- Both farmers and extension workers are interested, but do the extension workers possess expertise/qualification to refine or advise on location specific technologies as per land holding, socio-economic status and needs, land use, access to resources like water and approach to market and other facilities.

## The Approach Domain

The demands for agricultural technology are now changing and diversifying. Factor productivity growth in India's well-endowed green revolution areas does not match with that of some of the East Asian countries and is plateauing or declining. New emerging second-generation issues viz. efficient management of resources and marketing strategies are required to be addressed in erstwhile-designated food basket regions of the country. Therefore new approaches involving frontier sciences such as biotechnology, efficient use of inputs, renewable sources of energy and nanotechnology need to be integrated with production systems to break through yield plateau in green revolution areas. At the same time India must – both for economic and social reasons – invest more in technology development and dissemination for under-endowed arid areas where a large population of the rural poor lives and has potential to enhance productivity with relatively less efforts. The technology has to focus on Low Input Sustainable Agriculture (LISA) approach for raifed areas. As agricultural demands on the resource base intensify, greater attention is needed to sustainability and the containment of potentially adverse environmental impacts. Some of the important issues and desired approaches are as below:

## The Approach Perspective

### *Simple and easily monitorable model*

A model that is devised for fragile ecosystem of arid region has to be simple, flexible, widely applicable, easily implementable and monitorable. One of the models tested under NATP in seven states of the country, commonly referred as ATMA, has proved to be successful. We can analyze it and modify as per state/district needs. The model has clearly demonstrated the value of multi-agency extension arrangement that in addition to various government departments included NGOs, farmers' groups and women. Whatsoever model we may adopt, it has to be ensured that fund transfer is rapid and direct to

district or the village functionaries and also guarded against misuse. While selecting eligible people for the team, the out performers should be given incentive. It is important that we not only create groups of diverse people, but also ensure adequate delivery through communication and coordination among them.

*Inter-ministerial  
coordination*

At present, there exists various channels to reach the farmer, each ministry/department approaching the farmer independently with plethora of schemes; there being loss of coordination leading to duplication or overlapping schemes. There is need to identify weak links in the chain and strengthen these. Or if need be, removal of some of the links can be considered to make the chain shorter as well as more effective. The subsidy as incentive to win over the farmers does have initial gains, but in the long run it is the knowledge centric approach that will be more suitable and sustainable. Primarily we suggest two approaches:

*Unified production  
and knowledge  
centric approach*

**Production centric approach** in which work of different agencies is unified at state government/ district level before extending it to farmers for increasing economic productivity.

**Knowledge shield approach** in which farmer is adequately trained by various extension agencies keeping in view his diverse needs with the support of state government institutions, agricultural universities and R&D institutes through intensive monitoring. It is the farmer who has to imbibe the knowledge, take well-informed decisions and compete with others, with extension agencies always standing behind for eventualities.

At present individual institutions tend to play a production centric role by concentrating all efforts to increase the production at the farmer's field. The vicious cycle of low income-low input-low production needs to be broken. The government agencies have been making efforts in this direction by attacking the problem at various levels (Fig.1). However, their integrated efforts with people's participation are likely to yield much better dividends. Sometimes high production causes a glut and farmers get frustrated on account of market complexities or lack of facilities of conservation of some high value products. The farmer is a part of the village society where he has to be concerned about social responsibilities, about paying back the loans, worry about the market uncertainties, profit/losses, off season employment etc. Knowledge in all aspects will act as a protective shield and will help him in making informed decisions and encourage him to try newer techniques (Fig. 2).

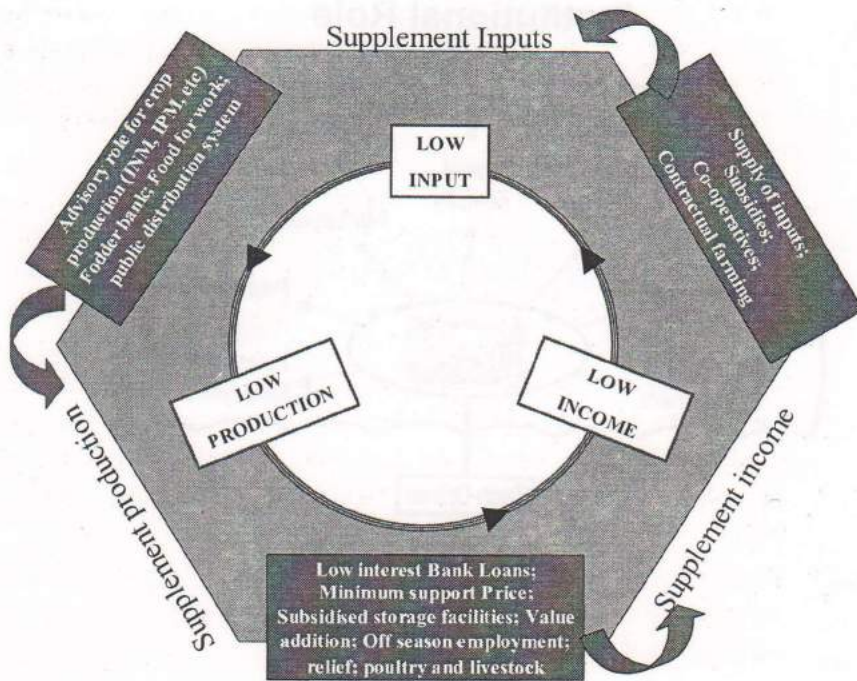


Figure 1. Breaking poverty nexus

## Research-Extension-Farmer Interface

### *Strengthening existing research and extension systems*

Our planners are aware that our public research and extension systems at present are insufficiently geared up to face the new set of challenges under changed paradigm. We tend to use our extensive infrastructure and staff at less than optimum efficiency. The functions and modes of operation of public research and extension institutions must incorporate a greater proportion of location-specific activities into their programmes with sharp focus on well being of local community.

### *Interactive dissemination of knowledge in farming systems mode*

The contribution of frontier agricultural sciences to development must be strengthened; and the balance of programmes must be shifted towards improvement of entire production systems rather than following commodity or disciplinary approach. To realise these aims, the links between research and extension will have to be strengthened, farmer's participation in programmes will have to be increased and financial sustainability will have to be improved. We need to critically analyse our research methodologies, priority areas and focus at grass root level. Higher interaction by personal contacts, interactive programmes through TV/radio or use of IT enabled devices may help in achieving the desired interaction. The state extension network is and must remain a major link between researchers and the farmers at all levels.

### *Mass media support*

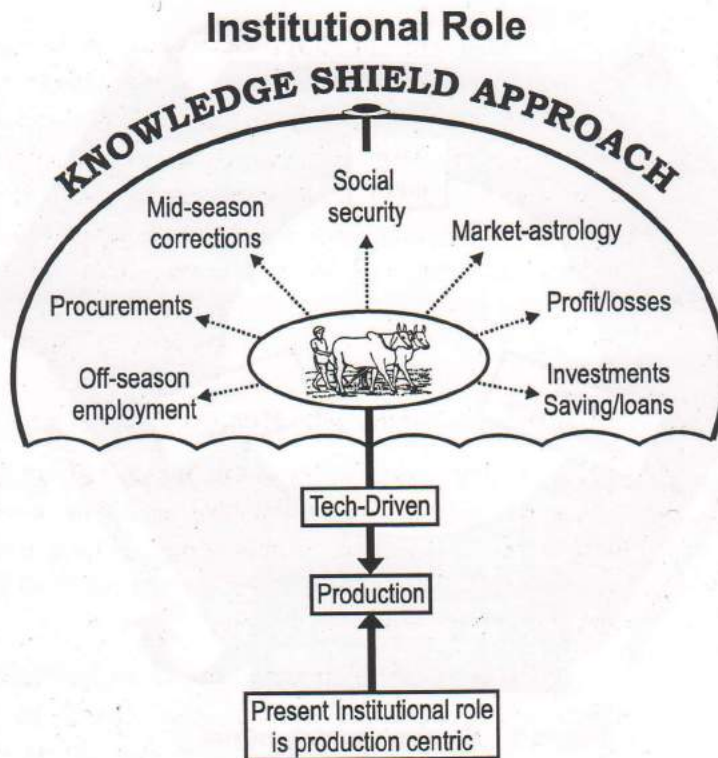


Figure 2. Knowledge shield approach

**Multifaceted problems  
require coordination  
at all levels**

Even though our goal for rural up-liftment is clear, the lack of coordination among ministries/ departments at centre and line departments at state level is apparent in the number of similar schemes operating in the villages under various departments. Similarly interaction among research and development organisations, KVKs, zonal research stations, state extension machinery, NGOs, various government undertakings working for the rural areas, and private sector is inadequate and at places non-existent. Many independent agencies are implementing similar schemes with varying norms. Lack of coordination and feedback results in injudicious use of funds, duplication/overlapping and confuses farmers. Hence, proper coordination and interaction is a prerequisite for the technology transfer perspective. This interaction is not only necessary at policy planning level or at the level of selection of technologies, but is also crucial at the operational level. To ensure this, new partnerships must be forged between public institutions, technology users and corporate sector. Involvement of NGOs and private sector would ensure less reaction time to meet the farmer's need and would evoke better response. For

**Development of  
private public  
partnerships**

effective execution of the programmes, it is necessary that the implementing officials from various departments like agriculture, horticulture, watershed, rural development, etc work in unison and also involve NGOs and the people (Fig. 3). Compartmentalisation of various departments may be required for work distribution, monitoring and accounting purposes, but for technology transfer to poor and marginal farmers and overall development of rural areas, it is necessary that all technological interventions and funds should flow through single channel that should be short and fast. Flexibility in planning the use of these funds, if done by active participation of self help groups, can further help in consolidating the gains.

### ***Active participation of farmers and NGO's***

In district/ state level meetings, the participation of NGOs and farmers should be made more productive and not treated as a formal requirement. Many a times people participating in such meetings are not true representative of farmers, as a result of which the objective of having a farmer member is defeated.

To enhance visibility and make the interaction meetings more effective and fruitful, such meetings should be held in different blocks/districts in rotation and a time slot can be reserved for direct interaction with farmers/businessmen, exporters, etc.

The extension officials at different levels on one hand need to develop effective linkages with farmers and NGOs and on the other hand should play a proactive role in developing linkages and coordination with research organisations.

## **Peoples Participation and Women Empowerment**

### ***People/community involvement in developmental programmes***

People will not only have to be involved as individuals but as a community so that they are not only ready to participate, but are motivated to develop and execute sound program as a team/group. One example has been the scheme for participatory infrastructure development like making of roads, linking the villages with highways where government paid for the materials and villagers contributed in terms of labour by way of *shramadan*, and locally available inputs. Similar model can be extended to other community related works like cleaning of water bodies or construction of water resources for communities, dairy co-operatives, health services and custom hiring services for costly machinery, development of silvi-pasture and protection of orans, gochars and CPRs. A sense of belonging has to be provided for, with adequate transparency, equity and sharing of conserved resources both by land owners and landless people.

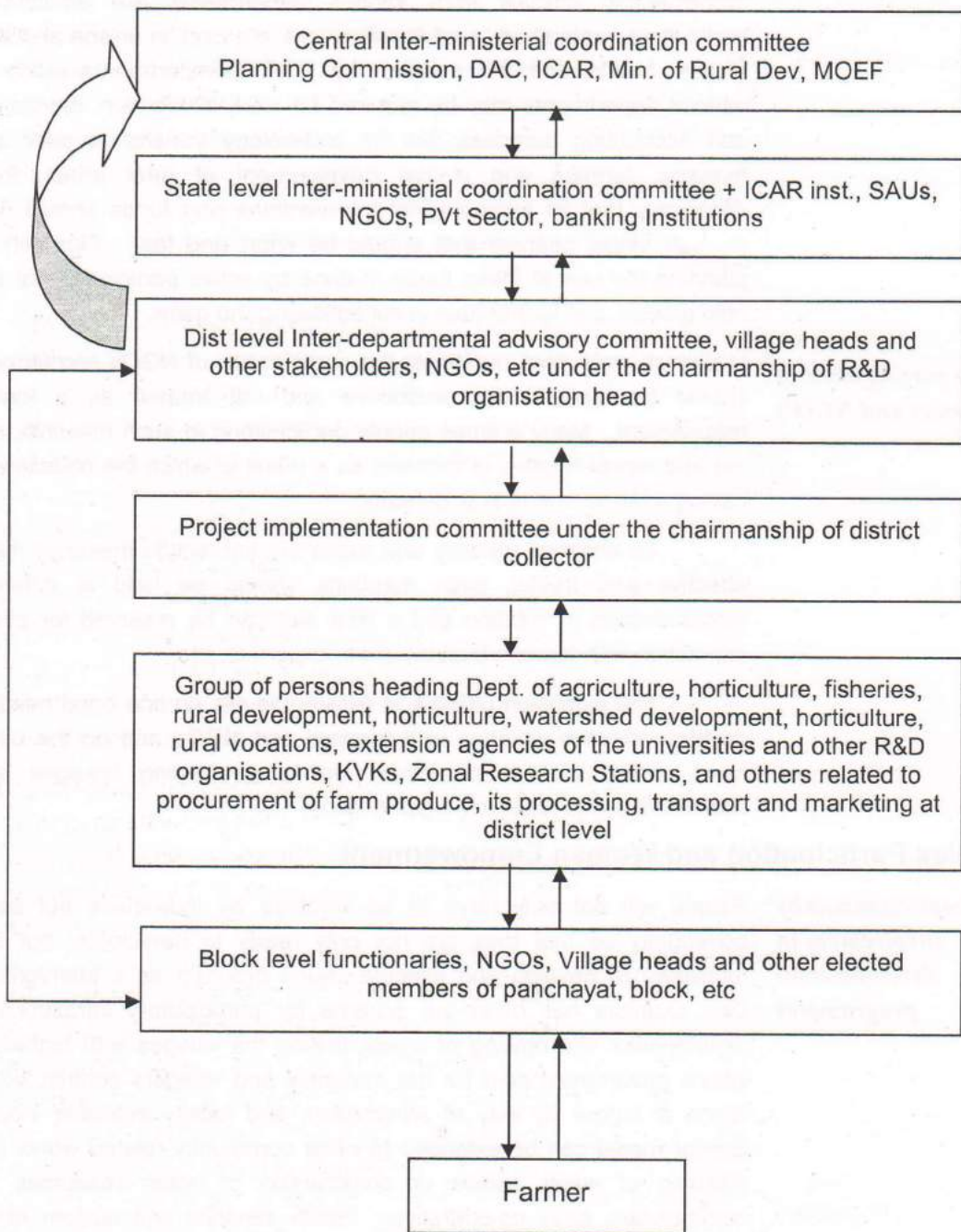


Figure 3. Coordination and feedback mechanism at different levels



**Values and ethics -  
focus on  
endogenously  
generated cooperation**

The people from rural area are able to innovate by making best use of the limited available resources. *Khadin* system of cultivation in hyper arid areas, traditional water harvesting systems, endemic breed and time tested practices of agriculture are fine examples in deserts. These strengths, however, remain unutilised due to limitation of resources and poor visualisation of their importance by researchers as well as policy makers. Emphasis should be on refinement of indigenous technologies. People understand and appreciate improvements in what they are already doing. Further, the feedback on such issues is also rapid and hence fine-tuning is easier.

Traditionally there have been well-defined systems of value and ethics to maintain common properly resources by invoking religious sentiments. But the value systems are eroding now due to modernisation as a result of which orans, *gochars* and water bodies at many locations are becoming casualties of this shift and becoming defunct. External support may therefore be necessary to supplement the resources but the secret of success of any programme will be endogenously generated cooperation amongst stakeholders. Many a times this type of cooperation that was *in vogue* in all villages is affected by external/political influences. To attain highest degree of sustainable success, the grass root system will have to resist such external forces. So any plan to involve the stakeholders in policy planning and execution should not be a function of political affiliations.

**Consortium  
approach**

There is an urgent need for consortium approach in research and extension programmes as well as in all the other components of chain from production to consumption (Fig. 4). The social goals of livelihood improvement, equity, empowerment etc. need to be addressed by ensuring profitability to our farmers that in turn will depend upon competitiveness of our products across the world market. The products of small and marginal farmer can also attain this by better quality control or innovative approaches like projecting the distinctive folk art of a particular area, handicraft items, novel musical instruments, unique food items, etc. On one hand, country is aiming at global leadership, and on the other, is trying to uplift the poorest of the poor. The former can only be achieved through collective and balanced upliftment of all sectors where every one has a role to play. Women empowerment and involvement in decision making can play a major role in meeting our objectives. Recruitment/involvement of women functionaries can be highly productive for better interaction.

**Women  
empowerment**

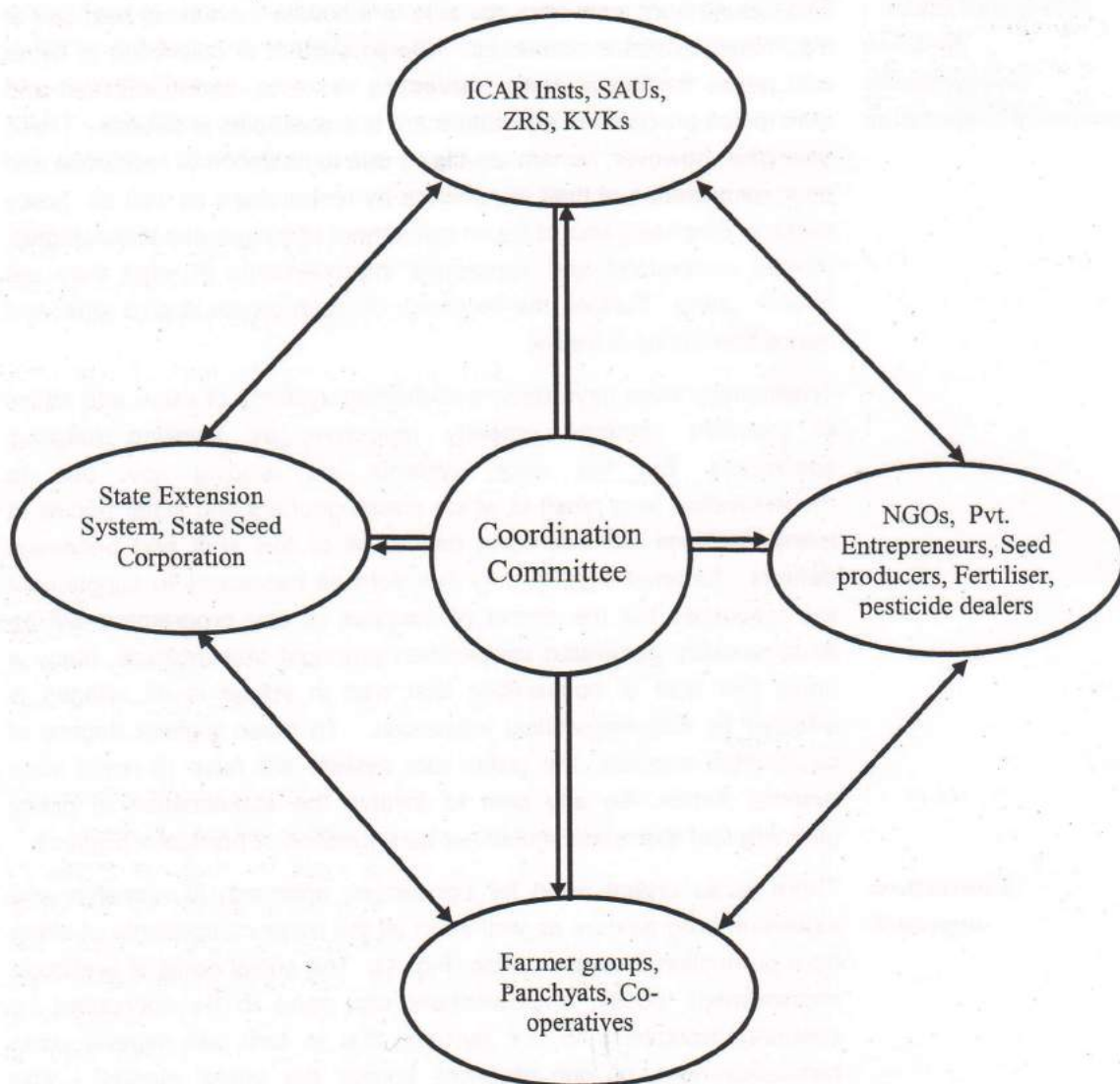


Figure 4. A consortium approach - interaction and coordination among various organisations

## Crop Diversification and Livestock

***Profit linked production systems through mission mode approach*** Profit linked production systems need to be developed through mission mode approach. These will require market, industrial and export linkages as well as diversification and value addition. (Caution: a fallacious thrust can hit the fragile rainfed system much harder with irreparable losses than irrigated system). There is need for regional plans for collection, processing, value addition and marketing so that

***Communication and market intelligence for economic gains***

the diversification gets translated into net financial gains. In cash crops too, there is need for better communication for passing on the market intelligence to the farmers for preparing sowing plans and marketing of farm produce. Wherever possible, it may be apt to promote non-agricultural income generation activities to supplement income under risk-prone arid and semi-arid environment.

***Diversification and value addition***

In addition to high value cash crops, horticulture is another commodity capable of increasing farm income provided value addition proper transport, value addition and marketing infrastructure is ensured.

***Proper crop planning***

Issues of diversification have great bearing to sustain economic productivity in dynamic global scenario. Farmer has to make quick productive shifts with respect to quantity, value addition and quality. Market fluctuations have to be anticipated and imbibed at crop planning stage to reap benefits at harvesting. *Bajra* continues to occupy about 60% area in Kharif for grain, but more for fodder, when the crop fails. Reducing about 20% area of *bajra* and replacing it with legumes, oilseeds and fodder crops will provide better nutrition and improve health of animals and soil. This will also create a buffer for drought years and save hassles of transportations from neighbouring states. This approach needs to be promoted.

***Crop zoning for organic farming***

Some pockets of arid region are highly specific have great potential for growing crops like Isbgol, Maithi, Condriments, Henna, cut flower, etc. As fertilizer application is very low in arid areas, the region is organic by default, such inherent characteristics may be encashed for benefit of people by turning a locality organic for specific product. Again fast dissemination of information through IT, training, education of farmers and declaration of crop zone will go a long way in establishment of industries. Once the industry is established, the dissemination of technology would be automatic by suction mechanism from top to fields.

***Promotion of livestock and multiple animal productivity***

Focus has to be on raising economic status by integrating cultivation of conventional crops with livestock based farming system which is a proven sustainable model advocated since long in arid areas. It appears that we have not given the right priority to translate it into a profitable model by giving much needed emphasis on fodder, pastures, cooperatives for milk collection, value addition to milk and animal products, etc. Only by making the system more profitable we can ensure its adoption. Initially, profitability may have to be enhanced by providing facilities or a subsidy as was done for crops like wheat and rice. Meeting the fodder demand will require appropriate land and water

***Appropriate land and water use policies*** use policies for higher efficiency and revival of traditional value systems for resource conservation. The principle of fewer productive animals than rearing large number of low productivity animals should be propagated. Multiple use of animals instead of rearing them only for milk can further help in transforming the income structure. Impediment and social stigmas have to be overcome through education and training.

***Improvement of degraded lands*** About 1/3<sup>rd</sup> area of arid Rajasthan is wasteland. Revegetation by trees for fuel, fodder, energy, oil etc. trees is the demand of the day. All self-help groups, NGO's and farmers should be mobilized to reforest such degraded land in a participatory mode. Joint forest management is required to be practiced. This can be done under National Rural Employment Guarantee programme and Bharat Nirman Yojna with a focus on dissemination of technology.

## **Educational Issues**

***Capacity building, and monitoring*** Farmers spread over large landmass in different regions have highly diverse needs, and have different land holdings/economic status, etc.

***Mobilizing finance through better interaction with bankers*** The primary goal is to bridge the knowledge gap and ensure dissemination of knowledge on wide spectrum of issues concerning the rural masses in the desert. This requires concerted and well-planned efforts for capacity building and mobilizing finances through transparent interactions with lead banks/NABARD. This implies that besides farmers, we may have to educate bankers to make them better equipped to help the farmers. The mass dissemination of information available at the sight of demonstrations (on-station/on-farm) will require

***Create opinion builders by arranging visits*** arranging visits of demonstrations and success stories for enthusiastic people from various walks of life and far off villages so that they act as our opinion builders. The fact is that our investments for feedback and its analysis, public awareness, monitoring and evaluation, and capacity building are far from the actual needs. We also need innovative communication techniques like printing important phone numbers (Farmers Call Center, Advisory services, Agricultural extension officials of the district/state, etc) on electricity or telephone bills, seed packets, and utility items of common usage. For example when a farmer is purchasing seed, fertilizer or pesticide, details can be provided along with it.

***Innovative communication technologies***

***Trained man power and use of IT*** There is a feeling that the people dealing with technology transfer are also not sufficiently educated/ trained for transfer of system-based technologies. There is need to create a cadre of strong committed force to avoid loss of information when it passes through many

channels. Hence direct regular interaction with the farmers may prove better. Powerful IT tools like TV, CD and published material may prove more effective in dissemination of knowledge. Market rate, weather forecasts, state launched/ state sponsored program, new technologies, most wanted agricultural operations can be broadcasted on local radio network. The use of IT is necessary to induce interest in people and ensure bottom up farmer driven participatory approach.

Self-help groups, Farmer's knowledge clubs, Farmers Field Schools for hands on training and capacity building which have proved highly successful in technology transfer have to be created.

***Professional education of youth***

The youth is required to be trained and educated through agri-clinics and involvement of bank, line department, R&D institutions and NGO's. This channel will not only disseminate, technology at a faster rate but check migration from rural to urban areas in near future. A knowledge connectivity channel should be created between knowledge centre and villages.

***Safe guarding farmers from irrelevant information***

In the fast changing global scenario, it is not only important to educate farmers about technologies, but is equally important to protect them from using technologies and unsuitable products for their purpose. Spurious seed, plant protection chemicals and exotics may prove counter productive and deterrent for extension workers. Many times farmers adopt high input technology for maximizing productivity in areas needing low input for optimizing production. Therefore, extension workers should also be trained to communicate with farmers for sustainable production. For example avoiding high water requiring crops and increasing water use efficiency in arid region would protect fast depleting ground water.

***Proper choice of the technology/ planting material***

Many a times wrong choice of technology for a wider area wastes the efforts as well as limited resources. We all know that *P. cineraria* (*khejri*) is the most important multipurpose tree of the desert, but it is rarely included in the afforestation programmes. We have chosen the easier way out by selecting exotic plants having higher survival and growth rate for better demonstrative value. Efforts are required for genetic improvement of *Khejri*, increasing its growth rate and foliage so as to popularise it in afforestation programmes.

***Involvement of youth and children in knowledge dissemination***

Youth and children constitute a significant part of population and can be an important resource for execution of many community based developmental programmes. This group is more receptive and committed, full of energy and mostly averse to the malpractices/

corruption, etc. Women that form half of the population and are primary doer of all agricultural activities can also play a dominant role in technology adoption and various other developmental activities.

***Social stigmas- role of education***

Sometimes, there is talk about fish, piggery etc. as a component of diversified farming system, but the social issues don't allow it. In many cases, it may be worthwhile to educate/train the people so as to remove unwanted social stigmas.

**Policy Issues**

***Setting realistic goals***

There is no denying that to avoid skewed growth in the country, a major emphasis on agriculture is a must. However, it has to be kept in mind that rate of growth and output of arid zone agriculture depends on natural cycles of rainfall and it is not comparable to high rainfall areas. We have to live with Deserts and Drylands rather than make efforts to combat and modify the eco-region. Continuous efforts and highest degree of commitment are required to optimise productivity of arid lands without disturbing fragile ecosystem. A strong zeal to serve the people and approach well supported by scientific analysis and free from short-term narrow political gains is to be adopted. Appeasement policies, which degrade natural resources, are required to be discouraged.

***Greater involvement of R&D organisations in policy planning***

At the policy formulation stage it is not just enough to invite/ involve technocrats/ researchers merely as spectators. Policy planners have to ensure that knowledge-rich organizations lead such endeavours. Higher degree of involvement will mean better understanding of issues, understanding each other's views and enhanced accountability on both ends. Strong policies need to be supported by good science. Better interaction among scientists and policy makers require understanding problems of each other (e.g. fodder prediction equation under different rainfall amount and patterns; drought prediction using scientific methods and fixing targets for cultivated fodder). A net work approach is required for drought prediction, drought proofing in management across arid environment of continent.

The technology adoption by resource-poor farmers is low and social and biological scientists have been making concerted efforts to understand the reasons for non-adoption. Based upon analysis, they have emphasized the need for participation of farmers in generation of appropriate technologies in farming system mode. This approach takes the farming as a system and not merely as an activity. Further, the farmers and researchers are actively involved in the technology

generation process as partners. This approach encompasses an understanding of farmer's resources, their requirements, and goals in the technology generation process so that it can lead to wider adoption.

***Farmers' limitations  
and micro-farming  
situations***

In the past the strategy followed in designing and implementing transfer of technology projects has been based mainly on the supply of technological information without adequately considering limitations of the end users. The premise has been that an improved technology, which produces the best results at the experimental level, is superior, and that is what should be offered to the farmers. Failure to consider the actual circumstances under which small farmers operate has seriously affected the appropriateness of these technologies. What is needed is a technology generation and transfer mechanism with active participation of the farmers themselves with due consideration of various micro-farming situations and farm size. Greater involvement of R&D organisations will help in taking care of such and other related scientific issues. Well defined policies are necessary for involvement of small and marginal farmers.

***Prioritising  
technologies and their  
transfer in integrated  
manner***

There is no panacea approach for technology transfer as each technology may need a different approach for effective dissemination. However, transferring technologies in integrated manner becomes slightly complex and difficult process. One of the possible solution can be to prioritise technologies for each area, select one or two most promising technologies and focus all energies on their transfer. One of the view is that many times excessive knowledge imparted to trainers/farmers leads to confusion and lesser returns. At our level we may select one or two technologies from the following areas:

- i. crop related technologies (seed, agronomy etc.)
- ii. animal based technologies (fisheries, honey bee)
- iii. soil-water related technology (input use efficiency)
- iv. tree/Horticulture based technology (value addition)
- v. non-agricultural technologies for out sourcing (agri-tourism & handicrafts)

The dissemination of various agronomic practices like summer ploughing, water conservation measures, etc. is also important. There is need for policies for reward for effective implementers of agricultural policies. There are a few technologies like quality seeds and planting material that are easily accepted and spread like wild fire even at exorbitant cost. Policies need to be in place for timely supply of adequate amount of seed of promising varieties.

- Intensive vs. extensive agriculture*** Our effort to develop every part of land and unsuitable land use plans, targeting more area under crops is many a times counter productive. Often cited 'Israeli technology' need to be verified in our agro-climatic situations. *Khadin* cultivation around Jaisalmer, wherein water from a large area is collected and utilized for agriculture in a limited area is an example of innovative thinking of efficient use of limited water resource. This concept needs to be taken a step further by promoting green house cultivation where we make best use of limited water. Such an approach may initially need more inputs, but in the long run will be cost effective, more productive, sustainable and eco-friendly. While cultivation of quality crops can be done in limited area, the remaining area can be brought under grasses/shrubs/trees. It will help in stabilizing the system and meet the needs of livestock. IGNP area can be a promising area for intensive agriculture, however excess use of water should be avoided to save water logging and land degradation.
- Simplification of certification procedures*** Simplification of certification and other procedures to promote organic farming and export while formation of farmers' co-operatives to withstand market competition is required. Crop insurance where nominal contribution by people during better years should be promoted.
- Judicious use of relief*** Judicious use of relief wherein a part of aid must be used for meeting immediate needs of farmers but a larger part should be utilized for creating permanent land based solutions to enhance productivity
- Checking financial seepage and avoid appeasement policies*** The technology transfer is eventually a management issue. Many a time the appeasing policies of government and advertent or inadvertent financial seepage act as a stumbling block. In the former, there is generally short term gain, whereas in the latter, the stakeholders don't benefit from the funds allocated for their welfare. Tractorization and excess tubewelling, have induced fast depletion of native vegetation, increased wind erosion and fast decline of ground water. In addition to this direct loss, the skewed approaches and myopic vision demoralize the sincere workers on one hand and loss of credibility on the other.
- Feedback is the key to refinement to further adoption*** The most important aspect for ensuring effective dissemination of technology is feedback. Proper feedback becomes the basis for technology assessment and refinement, and its subsequent adoption. To have multiplier effect and reach all strata and gender, it will be necessary to train key person including women leaders and functionaries in dissemination of technology as well as provide accurate feedback. This requires leadership, communication skills (including internet), team spirit, conflict management, using banking services/ financial management, etc.



*Integration of frontier and conventional sciences* To cope with a greater diversity of agro-ecological settings and producers, attention should focus on individual production systems. Technology should integrate contributions of frontier sciences as well as conventional disciplines and indigenous knowledge in augmenting productivity, stability and sustainability. In contrast to the blanket green revolution recommendations appropriate to the needs of the past, the new technologies will increasingly have to be tailored to specific locations. A decentralized approach is, therefore, needed. Producers themselves will need to participate more in setting the technical agenda, contributing their own ideas, as well as assessing and disseminating results. Many technologies are not being commercially marketable particularly those dealing with management of natural resources. Therefore, it will still be necessary to have them fully or partly publicly funded or highly subsidized on easy terms. But pressure on government expenditure means that public funds will have to be more carefully targeted and more efficiently utilized. Where opportunities exist like in high value export crops or in development of new commercial inputs or machines, transfer of extension costs to corporate sector or to users themselves must be explored.

*Public funding of NRM technologies*

The natural resource management is far beyond infrastructural development. Supply of subsidised electricity, tractors and machinery and many of other these appeasement policies may prove counter productive in conservation of resources and sustainable increase in productivity.

## **Rainbow Revolution**

Arid region is still waiting for a revolution in agriculture. But in arid areas where water scarcity is perpetual and 70% ground water is saline, the colour of green revolution may not be so green as in Indo-Gangeatic plains but will be a mix of white, blue and yellow for overall livelihood security of desert dwellers. Extension agencies in other parts of the country have often dealt with only one colour of revolution but extension agencies of arid region will have to deal with the multi coloured rainbow revolution of a unique kind. Green revolution dealt with one or two commodities like wheat and rice. Research and extension in arid areas will necessarily have to deal with multi commodity approach. Hence, technology transfer efforts need to be equally variable and flexible. This implies much better understanding of system and continuous interaction with farmers. The package transfer approach of green revolution has not worked in arid zone. Hence, there is need for changing the mindset of extension agencies and higher level of HRD to meet the challenges these workers are likely to encounter. While doing this, it must be understood that we are dealing with fragile ecosystem with high degree of variability over the years. The targets of higher

productivity levels must conform to the needs of maintaining ecological stability. This implies that the extension worker in the region should be fully conversant both with economic and ecological situations and methods to improve and sustain them in a balanced manner.

The concerns of the government on the issues and approaches of research and technology transfer in today's perspective are evident in the speech by Hon'ble Prime Minister Dr Manmohan Singh at the International Conference on Agriculture for Food, Nutritional Security and Rural Growth on May 27, 2006 at New Delhi, where he said that to usher in a second green revolution the benefits of research must reach farmers to improve yield and enhance production; there had to be an improvement in soil health, water conservation, credit delivery system, infrastructure and regulation for marketing of produce, the application of science and biotechnology to the improvement of seeds, plants and animal husbandry; and scientists must work with the government, NGOs, local bodies and corporates to enable farmers to benefit from technological and scientific advancement in the field. While the credit system had to respond to the needs of farmers, greater public private partnership is required to help revitalise public institutions and programmes.



