Linkage between Indigenous Agriculture and Sustainable Development – Evidences from Two Hill Communities in Northeast India

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Abstract: Sustainable food production system is the key to sustainable development especially for hill communities where agriculture is the mainstay of economy. History shows that human societies that can protect their livelihood-based natural resources are able to sustain themselves. So even today we find several indigenous communities obtaining sustained and adequate income/returns from their agriculture because of sustainability inbuilt in it. Besides production of food, proper protection of the environments through sustainable practices is always the inherent accompanying objective of agriculture in such communities. The paper argues that indigenous knowledge and practices formed the basis of sustainable development particularly in hill agrarian communities. The paper draws evidences from the cases of the Apatani and the Angami tribal communities of the Northeastern Region of India. Using interview schedules, data were collected from practising farmers and government officials working in the areas concerned. Over the years, the Apatani farmers are able to obtain sustained agricultural yields from their terrace wet rice fields by following their indigenous agricultural practices and community traditions. Their agricultural production is also strongly linked to the proper management of the forests around them. The Angami community, by utilising their traditional knowledge on alder trees, are able to rejuvenate their degraded *jhum* (slash and burn agriculture) lands and put them into more productive and sustainable uses. It is also revealed in the paper that organisational innovations are required as well to make use of the technical innovations already present.

Keywords: Indigenous agriculture, Northeast India, Terrace wet rice, Shifting cultivation, Alder.

1. Introduction

Economic development does not necessarily entail sustainable development. The meaning of economic development has undergone three important shifts over the post-war period. The first phase (1950 to early 1960s) equated economic development with economic growth. The second shift (late 1960s to early 1970s) emphasized “growth with redistribution”. A more radical shift being witnessed from late 1970s was the “basic needs” approach. A concern for ‘sustainability’ represents the most recent shift in development thinking (WCED, 1987a). Besides the emphasis on improving the livelihoods of the poor, this approach additionally argues that lasting improvement cannot occur in the Third World countries unless the strategies which are being formulated and implemented are environmentally and socially sustainable; that is they maintain and enhance the natural and human resources upon which development depends.

When society, economy and environment are viewed as separate, unrelated parts of a community, the community’s problems are also viewed as isolated issues. Economic, social and environmental needs tend to be addressed independently by separate agencies or departments. This piecemeal approach can have a number of ill side-effects such as solutions to one problem

can create another problem, they tend to build opposing groups and piecemeal solutions tend to focus on short-term benefits without monitoring long-term results. Rather than a piecemeal approach the links between the economy, the society and the environment have to be considered. Understanding the three parts and their links is the key to understanding sustainability, because sustainability is about more than just quality of life. It is about understanding the connections between and achieving balance among the social, economic, and environmental pieces of a community.

As early as the 1970s, 'sustainability' was employed to describe an economy "in equilibrium with basic ecological support systems" (Stivers, 1976). Using the well-known and worldwide respected definition of the Brundtland Commission as a starting point, van de Kerk and Manuel define a sustainable society as a society that meets the needs of the present generation, that does not compromise the ability of future generations to meet their own needs, in which each human being has the opportunity to develop itself in freedom, within a well-balanced society and in harmony with its surroundings.

The report of the World Commission on Environment and Development – the "Brundtland Report" argues for "environmentally sustainable economic growth" for the Third World and stress that, "although the agricultural resources and the technology needed to feed growing populations are available", global food security requires "increasing food production to keep pace with demand while retaining the essential ecological integrity of production systems" (WCED, 1987a). The arguments in favour of promoting a more sustainable development approach, particularly the dismantling of policies and incentive structures that stand in its way, are also slowly being accepted by the international donor community (Davies and Schirmer, 1987; WCED, 1987b).

Taking examples from the Apatani and Angami hill communities from Northeastern region of India, the paper argues that the indigenous agriculture being practised by these communities have been able to sustain the communities and thereby contributes to sustainable development. This could happen because sustainability elements are inherently embedded in the indigenous farming systems. The indigenous knowledge and local inputs are being utilized to make the farming systems conform to the requirements of sustainable development. Elsewhere it is also shown that these traditional systems based on technology developed over many generations are often energy efficient, at the same time providing high economic returns to the farmers, as shown through many studies subsequently synthesised in a UNESCO-MAB volume (Ramakrishnan, 1992).

2. Methodology

The Northeast India region comprising of the eight states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura lies between 21.57 and 29.30 N latitude and 88.00 and 97.30 E longitude. It covers a geographical area of about 0.26 million sq km accounting 7.9% of India's total geographical area. About 70% of the region is hilly, and the topography varies within each state. In 2001, the population of the region is 38.98 million (3.75% of India's total population) and the population density is 149 per sq km. The population comprises of several communities and tribal groups of people. It is a home to over 200 of the 635 tribal groups in India speaking a variety of Tibeto-Burman languages and dialects with a strong tradition of social and cultural identity marked by diversity in customs, cultures and traditions.

Richly endowed with natural resources, the region is identified as one of the world's biodiversity hotspots; it hosts species-rich tropical rain forests that support diverse flora and fauna and several crop species. The average annual rainfall of the region varies from 200 to 12000 mm. The climatic conditions range from sub-tropical to sub-temperate types of climate.

Many sustainable indices have been developed over the years. The Sustainable Society Index (SSI) as developed by the Sustainable Society Foundation integrates for the first time sustainability and quality of life in an understandable manner. The definition of the Brundtland Commission is the solid foundation on which the SSI has been built. A sustainable society is defined, as a society that meets the needs of the present generation, that does not compromise the ability of future generations to meet their own needs, in which each human being has the opportunity to develop itself in freedom, within a well-balanced society and in harmony with its surroundings. No doubt the field of sustainable development can be conceptually broken into three constituent parts: environmental sustainability, economic sustainability and socio-political sustainability, in this paper we would be dealing more on the first two parts. Also it is not intended in this paper to provide sustainability index scores of the two communities concerned. It is rather aimed to relate the sustainable practices of indigenous farming systems to some of the indicators of a sustainable society. The sustainable indicators considered here are food sufficiency, air quality, land quality, good governance, waste recycling, forest area, preservation of biodiversity and ecological conservation.

The data on traditional practices of the indigenous agriculture are collected from published data in addition to primary data collected during June-July 2008 through semi-structured interview schedules and discussions with farmers and key informants who are located at different places in Northeast India. This information along with those obtained through interviewing personnel from the State agriculture departments and researchers are analysed to present the case.

3. Findings

3.1 Rice-based farming system of the Apatanis

The Apatani plateau occupies about 27 sq km area located at an altitude of about 1525 m above mean sea level in the humid tropic climate of the Lower Subansiri district of Arunachal Pradesh State. The Apatani community inhabit the plateau and their population density is 554 persons per sq km against an average of 10 persons of the state. The plateau has 21 villages with more than 30,000 families and an average of 6.6 persons per family (Mishra and Sharma, 1999; Mishra *et. al.,* 2004). The rice-based farming system of the Apatanis consists of wet rice terrace cultivation integrated with fish culture, finger millets and conservation of forest areas around them. The farmers rely on biodegradable waste and inputs. So without the aid of modern farm inputs such as chemical fertilizers and plant protection chemicals the farmers have been able to produce food crops on a sustained basis year after year keeping the ecological around them intact. They not only have food sufficiency but also are able to sell their surpluses to neighbouring communities. The air quality around them is not polluted due to burning of dried vegetation that has been cut down for *jhuming* as is practised in their neighbourhood. Land quality is maintained very well through environmentally sound and sustainable farm practices such as bio-waste recycling. The forest areas around them and biodiversity are conserved well as these have been linked to the sustainability of their indigenous agriculture. And because of the strong community traditional institutions we can see strict observance of tradition and social control, which are indicators of

good governance in the community. In the following section some of the indigenous practices of the Apatani community that have contributed to sustainable development in relation to the aspects just pointed out are highlighted.

(i) Land use and management: The economy base of the Apatanis comprises of the sustainable integration of land, water and farming systems. The farmers grow wet rice on terraces, integrated with fish culture in the terraces and finger millets on the risers/ terrace bunds. Early maturing paddy varieties are sown farther away from the village where disturbances by animals and poorer irrigation facilities could be major constraints. Lower nutrient status on plots farther away from the village is another consideration. Since kitchen waste, ashes, pig and poultry droppings from the village are emptied in the nearby terraces, the plots closer to the village are relatively nutrient and humus rich. The late paddy variety is preferred in these plots (Kumar and Ramakrishnan, 1990). The portions of area covered by different local rice varieties are *Emo* (68%) followed by *Pyaping* (15%) and *Payat* (10%) with corresponding yields of 5.2, 4.0 and 3.2 t/ha. The net per capita monetary return through agriculture is high (Kumar and Ramakrishnan, 1990). As much as 40% of the rice produced is sold to the economically weaker neighbouring tribes such as the Nishis and the hill Miris.

Risers or terrace bunds are used for growing finger millets (*Eleusine coracana*). Although the yield of finger millet is low, it strengthens the bunds by binding the soil and it also suppresses growth of weeds on the bunds. Millets are used for local breweries.

Usually common carps (*Cyprinus carpo*) are reared in the terraces after the transplanting of paddy. About 1750 – 2500 fingerlings per hectare are raised in the terraces along with paddy. The fishes in four months time attain the size/weight of about 200 gm and are then harvested. The fishes are not kept beyond four months in the terraces as larger size fishes can cause damage to the paddy crops. In terraces where late maturing paddy varieties are grown, there is sufficient time to take two harvests of fishes in a year yielding about 150 – 200 kg/ha/season. After keeping some amount for family consumption, each family is left with an average of 112 kg of fish per hectare for sale as surplus. There is no cost of maintenance as the fishes feed on naturally available organisms such as phytoplankton and other microorganisms. No additional feeding is done.

Water application is fully controlled. Application of too much water in the fields would destroy the crops. At the same time the fishes will not survive in too little water. This way of water application also control leaching and washing off of nutrients from the soil.

(ii) Nutrient management: Chemical fertilizers are not being used in the terrace fields by the Apatanis. Recycling of agricultural wastes is the main process of nutrient management of the terraces. The tall and traditional paddy varieties have high grain to straw yield ratio (1:2 to 1:3) and yield about 4-5 tons per ha. Paddy straw is kept in the field to be decomposed and finally incorporated in the soil during land preparation. Burning of undecomposed straw during January-February is also practised especially on dry terraces. Pig and poultry droppings (average 1.2 pigs and 9 poultry birds per household), rice husks, kitchen waste, ash (approximately 4 truck loads of wood is used for kitchen purposes per family per year), weeds removed during weeding, leaves collected from adjoining forests are recycled in the fields every year in order to replenish humus and nutrient in the soil (Mishra and Sharma, 1999). After the harvest of paddy crop, cattle are let

loose in the fields for free grazing and the cow dung is also recycled. Approximately 14,300 cattle and 5700 mithuns (*Bos frontalis*) graze in the surrounding upper ridges of the plateau and discharge around 26,000 tons of dung every year. Since the entire rainwater from the surrounding hills is tapped for irrigation, the nutrient from dung and forest humus is utilised through irrigation water. The villages are normally located at a higher elevation and the wastewater from the kitchens is directed to the fields. This adds organic matter to the soil in the terrace.

(iii) Harvesting and management of water: Every stream arising from the surrounding hills is tapped, channelised at the rim of the valley and diverted to the terrace fields by a network of primary, secondary and tertiary channels. The first diversion from the stream happens at a short distance above the terraces (Mishra and Sharma, 1999). Usually only a little water is allowed to flow into the first feeder channel while the stream continues its course. Bamboo and wood log pipes (*huburs*) of various sizes are made and used as prefabricated water management structures. Pegs of different sizes are used as energy dissipaters in earthen channels or at the outlets. The feeder channel branches off at angles, leading water through the series of terraces, so that by blocking or reopening the connecting ducts any field can be flooded or drained as required. The *huburs* are installed above 15-25 cm above the bed level of these fields in order to maintain proper water level. For fish culture, a vertical pit is dug in the middle of the plot, so that the water remains in these pits even when it drains away from the surrounding fields. This system of tapping natural streams, making water courses, application and harvesting of water behind the bunds on wet terraces, and safe disposal is a good example of the indigenous understanding of natural resource conservation and management. The Apatani farmers drain off water from the paddy fields twice during tillering, once during flowering and finally at maturity. On an average, a 10-cm water table is maintained in the plots by adjusting the height of the outlet pipes.

(iv) Forest management: In order to maintain and regulate water supply to the fields, the surrounding hills are covered with forests. Farm forestry or plantation forestry in the Apatani plateau has been an integral part of the local system, which is judiciously and meticulously tended by all community members as it fulfils various basic needs. The rich natural resources combined with the traditionally conservationist attitude of the Apatani community provide solutions to the many of their economic needs. The Apatani have a natural inclination towards plantation and ecological conservation. Restrictions and imposition of severe punishments and hefty fines to defaulters also deter them from destroying the forests. The traditional knowledge and skill related to the management of natural resources by the Apatani is immense. Farmers have taken up plantation of *Terminalis myrinalia*, *Ailanthes excelsa*, *Michelia* sp., *Mangolia* sp., pines (*Pinus* sp.) and bamboos (*Bambusa* sp.). The forests are classified into five based on intensification of management (Anon, 2009). The *Bije* Bamboo grove is highly intensively managed and is located nearby homestead. In this plantation, pine and other tree species are less in number so as the growth of bamboo is not retarded/ suppressed. The second forest type is called *Sansung* where pine and other mixed plantation areas with or without bamboos are mainly raised for construction purposes and is located little far away from the village. *Kiira Sanii* (*Castapnopsis* sp.) is also raised and tended for construction purposes. The next type of forest is *Morey* which is the least intensified manage forest and regeneration come up naturally and is located far away from the village. The plantation is mainly for firewood or other construction works besides collection of cane and bamboo. Medicinal plants and wild eatables are available here. Another is *Myodi*, the forest not managed at all and kept for big game hunting only and

located very far off from the village. Finally, *Ranthii* (sacred grove), a small plot situated nearby every village usually covered with pine and other trees like Piita is also present. Ceremonies and rituals are performed here and the forest is not utilised for any other purposes because it is believed that these are the abodes of many gods. On the basis of ownership, there are Private Owned Forests (*Bije, Sansung* and some forests), Kinsmen Owned Forests (immediate cousins/brothers owned common *Bije, Morey, Sansung*), Clan Owned (only *Morey*) and Village Owned (forests owned by villagers).

Thus the forests in the entire hills, surrounding valleys and the uplands around the villages are conserved even today. As a result of this, soil erosion, drying of water sources, silting of rivers, loss of nutrients from the soil, loss of flora, fauna and forest resources are insignificant in this area.

(v) Enabling cultural institutions: The Apatani wet rice cultivation system in which the terrace plots are intrinsically connected in terms of their dependence on maintenance of water sources, on irrigation water and management of water channels would certainly require community action and support. This requirement is met through the spirit of communal work that has been well developed in the culture of the Apatani community. A well-defined distribution of labour is generally followed. Men generally take care of works that require more strenuous labour such as building terraces and irrigation channels, fencing, removing earth and planting trees. Women, on the other hand, look after nurseries, transplanting, weeding, fish rearing, threshing, and drying and storage of grains. The Apatanis with cooperative efforts under the overall supervision of the village headman, performed many big operations such as fencing and maintenance of irrigation channels. They also maintained optimised water use along with nutrient use in their paddy fields. The community collectively maintains a disciplined schedule and scale of water distribution among the beneficiaries. A proper code is followed for erection of risers as well as maintenance and release of water for irrigation.

The Apatanis have certain social and cultural institutions that have contributed significantly in maintaining law and order in the village and community life. The community courts in the village immediately settle cases of theft, strife and other social disorders. You can hardly find black sheep among the community. And these institutions are so efficient in solving the cases that the formal governmental judiciary courts located in the areas seldom have any case to take up. The social control exerted on the community members by these social institutions has immense contribution towards the maintenance of balance among land, water and forests in a sustainable manner.

3.2 Alder-based jhum system of the Angamis:

The alder-based *jhum* system, a unique and highly productive form of *jhuming* (shifting cultivation or slash and burn agriculture) has been developed in Khonoma village located about 20 km west of Kohima, the capital town of Nagaland State. The system provides at least 57 food crops to supplement the rice grown in nearby wet terrace rice cultivation (NEPED and IIRR, 1999). Normally a *jhum* farmer cultivates the *jhum* fields for two years within a nine-year cycle (1:4 ratio of cropping to fallow). But the alder system allows two harvests in two out of every four to five years (1:1 ratio of cropping to fallow). The farmers are able to improve the already declining jhuming system through the incorporation of a component, alder tree which is native and indigenous to the community. This intervention results in minimised soil erosion, availability

of more productive land, increased soil fertility and sustainable food production. Al these lead to the growth of sustainable communities with sustainable development as the target towards which the community has to move.

(i) Shifting cultivation is economically unviable and ecologically unsustainable: *Jhuming*, the main method of agriculture in the hills was productive and sustainable in the past. But with increasing population pressure on land and the subsequent shortening of *jhum* cycles (5 years on an average), it is now economically unproductive and leads to ecological degradation due to excessive soil erosion and destruction of forest flora and fauna. The soil, especially in the hill slopes, is subject to massive topsoil erosion from March to May when the first monsoon rains occur and the crops have not grown sufficiently to cover and protect the topsoil. As per some estimates, up to 40 metric tons of topsoil per hectare per year is eroded from a *jhum* plot. Under one cropping cycle, the *jhuming* system loses something like 600 kg of nitrogen per hectare in one year of cropping. Under short agricultural cycles of 5 to 6 years, not more than 300 kg per hectare of soil nitrogen alone is put back into the system during the five-year period. With increasing food demand and shortening of *jhum* cycles the soil fertility diminishes leading to decrease in crop yields. This necessitates bringing larger areas of land under *jhum* cultivation. The contribution of air pollutants due to burning the vegetation during *jhum* cultivation would also be substantial. In Nagaland alone, out of the total geographical area of 7000 sq km of *jhum* land, around 500 sq km is cleared of vegetation and burned annually for *jhuming*. About 70% of the rural families subsist on *jhum* cultivation.

(ii) Indigenous agricultural practices of tribal communities: Certain indigenous knowledge and practices for soil fertility management (Ramakrishnan, 1992) that are still being in vogue among the traditional tribal communities are briefly pointed out here so as to suggest the possibility of scaling them up or incorporating them with modern agricultural practices with the aim of sustaining the system. The traditional tribal communities in Northeast India organise nutrient-use efficient crop species on the top of the slope and less efficient species along the bottom to match with soil fertility gradient on a steep slope. With shortening of *jhum* cycle the farmer tends to emphasis more on tuber and vegetable crops, as compared to their emphasis on cereals under longer cycles. Under a mixed cropping system, the farmer harvests crops sequentially as and when the crop matures over a period of a few months; after harvesting the economically useful component, he recycles the biomass into his agricultural plot, which decomposes rapidly. Weed biomass pulled out of his plots is put back into the system for similar reasons; about 20% biomass of weeds, which he leaves in *situ* without being pulled out serves as important nutrient conservation role on the hill slope, which otherwise could be lost through erosive/ leaching process. Socially selected and/or valued species of indigenous agricultural systems and those from natural systems often have ecologically significant keystone value; these keystone species often play a key role in nutrient enrichment of the soil; such species helps in redeveloped land use systems with community participation. Traditionally eco-technologies, such as water harvesting systems and their use have been shown to be of value in altering soil biological processes and thus improving soil fertility, under a monsoonic climate. Apatanis manipulated sub-specific crop biodiversity (rice varieties) to capture nutrient differentials in the soil and optimise production from the agro-ecosystem. Elaborate water management and nutrient recycling strategies represent a highly complex form traditional ecological knowledge and technology linkages. The project implementation of alder-based *jhum* system aims at augmenting the traditional shifting cultivation through the use of the indigenous knowledge and practices,

rather than attempting to radically change it by bringing in some inputs that are external to the local environment and are also alien to the community.

(iii) Description of alder-based jhum system: In a *jhum* field located in hills above 1000 m the alder saplings collected from nursery or from the wild are planted maintaining a spacing of 3-4 m between plants and 5-6 m between rows. The trees are allowed to grow for 10 years or until they attain rough fissures on the bark after which the initial pollarding is initiated. In the first year in a *jhum* plot, alder trees are pollarded (cut off from the main trunk) at a height of 2 m from the ground before or after the slash and burn operation. Primary food grain crops and secondary crops such as vegetables are grown as mixed crops in the burned fields. The cropping operation is repeated in the second year. The field is left fallow for two to four years to allow the alder trees to grow for pollarding and cropping in the subsequent cycle.

The practice of pollarding of alder trees is done in two phases – initial pollarding and cyclical/subsequent pollarding. Young trees are pollarded for the first time when the bole circumference reaches 50 to 80 cm and bark develops rough fissures, usually at the age of 7 to 10 years. The next pollarding is after four to six years. When the main trunk is cut horizontally at the height of 2 m or above from the ground care is taken that the pollarded stump head is not split. The head is covered with mud/straw to prevent it from drying. A stone slab is placed on the head to facilitate the uniform sprouting of new shoots around the stump. During the cyclical / subsequent pollarding, the pollarded stumps that coppices profusely are allowed to grow till the harvest of the first year's crop. On the second year, some 4 to 5 selected shoots are retained and the rest removed. These shoots are allowed to grow till the next *jhum* cycle and the same process is repeated. Thus with the incorporation of alder trees in their *jhum* lands, the farmers are able to obtain higher productivity while at the same time avoid loss of soil fertility.

(iv) Advantages accruing from incorporating alder tree in jhuming: The alder is a non-leguminous, large deciduous tree that grows well on cooler parts of the northern temperate region at high altitudes ranging from 800 to 3000 m. It is a pioneer species of degraded lands and does not require fertile soil. It is a rapid coloniser of gravel-lands and old cultivated lands that are frequently unstable. The alder tree has root nodules, which improve soil fertility by fixing atmospheric nitrogen into the soil. The tree sheds its leaves to retain moisture and mulches and add abundance of humus to the soil. The wood is used in various domestic needs such as fuel wood, charcoal burning and construction. The mature wood is used for making luxury furniture.

The Angami community extensively used Nepalese alder (*Alnus nepalensis*), a socially selected and ecologically important species for soil fertility management. Alder trees are grown in most parts of Nagaland. It has been a traditional tree among the Angami community as evident from the fact that some of the Angami villages are interspersed with alder trees, some of which are more than 200 years old but are still healthy. This early successional tree species in the Northeastern region of India, which is traditionally conserved in the slash and burn plots conserve up to 120 kg nitrogen per hectare per year. Introduction of Nepalese alder into the plot could recover all the 600 kg nitrogen during the five-year period. Recovery of all the 600 kg would otherwise require a minimum of 10 years of recovery period through the natural process of forest succession. The introduction of alder into the *jhuming* system under a five-year agricultural cycle could stabilise the system, with adequate nutrient recovery and make the system sustainable. Apart from nitrogen fixation, the production of nitrogen-rich litter and

mineralization too contribute to biological build-up of soil fertility. The highly distorted shifting cultivation, which is basically an agro-forestry system, now operating at subsistence level is now being redeveloped, by strengthening the tree component. The whole foundation for this incremental build up is the rich base of indigenous ecological knowledge and practices of the hill community.

(v) Institutional and organisational innovations: the strategy adopted by the Nagaland Empowerment of People through Economic Development (NEPED) project was simple and straightforward. The jhum farmers were asked to plant another perennial crop (tree) in addition to the several annual crops in their jhum plots. The method to do this was the establishment of two "test plots" in each of the 1000 villages the project targeted at that point of time. The main thrust of NEPED project activities is on the test plot where farmers themselves would select, test and demonstrate agro-forestry with technical support from NEPED. For its implementation, a separate organisation was formed drawing officers from different departments in Nagaland. The Project Operation Unit (POU) was then formed which, in turn, is guided by a Project Steering Committee. Each PUO member is given the task of training village councils, rural development boards and farmers. In addition, they are responsible for monitoring the test plots and nurseries. They are the main links between insights collected from farmers and the technical expertise of agricultural researchers. In the second phase of the project, the strategy focuses on the Village Councils (VCs) and Village Development Boards (VDBs) as the mechanism of delivery. In each village the Government of Nagaland establishes VDBs with the specific purpose of rural development. The VDBs were established taking into consideration the traditional village organisation of a given cultural group. So the project of enhancing the traditional agriculture was implemented through this institutional mechanism. NEPED would capacitate theses institutions for village level interventions, instead of merely using them as entry points into local communities. Capacity is being enhanced in VCs/ VDBs in order for them to credit institutions, to utilise the seed money, provide support to the farmers for processing and marketing, etc. As compared to the first phase, there is a massive scaling down wherein the VCs and VDBs are the actual implementers and the POU, managers in the project. The approach has been decentralised to a bottom-up participatory approach and villagers are being consulted at every step.

4. Conclusions

Indigenous knowledge systems are seen today as crucial in all discussions on sustainable socio-economic development and poverty alleviation in developing countries. The focus on indigenous knowledge symbolizes a shift away from centralised and technically oriented solutions that failed to improve the prospects of most of the world's peasants and small farmers. It has been demonstrated that the exclusion of such knowledge from development activities has had disastrous consequences in every region of the world where outsider knowledge has been imposed without regard to traditional knowledge (Cashman, 1989). It was not until the mid-1980s, after recognising the shortcomings of Farming Systems Research and Development, it was argued that researchers would not need the knowledge generated but should concentrate more on complementing their technical innovations with the local knowledge of farmers, in a participatory research and development process (Chambers, 1983; Richards, 1985). This idea was supported by international research institutes, which already had a number of innovations that only needed minor adaptations by local farmers. The sustainable agricultural practices already discussed in this paper have their roots in the indigenous knowledge of the communities

concerned. No doubt, some of the practices offer room for improvement. This is where modern science can step in. The sustainable development can only be achieved by developing a science based on the priorities of the local people, and by creating a technological base that includes both traditional and modern approaches to problem solving. Sustainable development might be better served by a system that incorporates both indigenous and scientific knowledge systems. The expectation that traditional perspectives and perceptions should play an important role in planning and implementing socio-economic development programmes is yet to be fulfilled. This is mostly attributable to the failure to develop an adequate mechanism for integrating the indigenous knowledge with formal (scientific) decision-making practices.

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