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Indigenous Knowledge and Sustainable Agricultural Development: A Case History of the Indus Valley, Pakistan

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Abstract:

Indigenous knowledge system (IKS) is dealt on several levels, first as a means for sustainable and self reliant development, second as an alternate source of overcoming the current evils of modern world, third to preserve their own cultural individuality which has long been threatened by the capitalist ethos. Historical evidence reveals that all nations who prospered consulted their own wisdoms, their cultural strengths and their indigenous resources. This essay evaluates the development efforts in the Indus valley of Pakistan to find out the faulty vision along with over ambitious mission statements. Rethinking development from IKS has somehow proved to be essentially imperative development solution. Real development would be the process in which people would take a lead in determining their on-coming trends of life. The agricultural community has to start thinking of going back to the rich cultural heritage and contributing to *world's knowledge repertoire. It is concluded that sustainable agricultural development requires; optimal use of local resources and the meeting of basic needs, development of related indigenous manpower and human resources, and development of grass-roots institutions and participation along path of national development.*

Key words: Indigenous Knowledge, Sustainable Agriculture, Indus Valley and Agriculture, Green Revolution, Organic Farming

Introduction

The paper presents history of Indigenous Knowledge Systems (IKS) and Sustainable Rural Development in the ancient Indus valley of Pakistan. The purpose is whether in face of all modern developmental approaches experienced till yet, can IKS be utilized to an extent that it may become viable to achieve the sustainability in agricultural development in the Indus valley.

Indigenous Knowledge: The Concept

Sinha (2004) writes that "Indigenous Knowledge is local knowledge, derived from interaction between people and their environment, which is characteristic of all cultures. Its technical aspects include agriculture, medicine, natural resources management engineering and fishing. With farming system, indigenous technical knowledge (ITK) embraces people's transformation of tools and techniques for assessment, acquisition, transformation and utilization of farm resources which are specific to a particular location. ITK can encompass technical knowledge held by all or most individuals in a specific locality, e.g. knowledge of crop rotation, pest and weed control, soil regeneration etc. the literature on traditional farming system was work of anthropologists or social historians. Now

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ethno-biologists are showing great interest. There is ample documentation available on indigenous knowledge in farming".

He further states that indigenous knowledge of farmers plays an important role in the sustainable management of farm resources. There is general agreement that the concepts "indigenous knowledge" (IK), "traditional knowledge", "local knowledge", "community knowledge" and rural people's knowledge are all term for knowledge belonging to grassroots people. The term indigenous knowledge denotes a type of knowledge that has evolved within the community and has been passed on from one generation to another. In the area of research, farmer's knowledge, which they have been putting into practice for decades, encompasses not only IK, but also scientific and other knowledge gained from foreigners. Some of the knowledge has resulted from long experimentation and observation of their environment (Sinha, 2004).

Agriculture: A Retrospective Review

Swartz and Jordan (1976) analyzed the early origin and evolution of agriculture. They opine that for 99 percent of the period that humans have been living on this planet, they have been hunters. Human communities were limited to the number of people who could be supported by the animals living in the area and the plant foods naturally occurring around their home. Except in unusual cases (such as the northern European reindeer hunters of the later fishing tribes of the northwest coast of North America), the population that could be supported was very small, no more than one or a few families, and even then constant movement was necessary as the resources of the immediate area became exhausted.

Few inventions could have made more difference to the human career than one that would allow human communities to increase in size and to remain in one place indefinitely. Larger population size meant new and more specialized statuses and vastly more complex kinds of relations between people. Not having to move meant the possibility of permanent buildings (including and especially food storehouses) and construction of things too heavy to move, such as pottery, furniture, stone sculpture, or such industrial equipment as looms, pumps or milestones. Both larger population size per community and ability of communities to remain in one place resulted from practices of agriculture and, to a lesser extent, herding. Because of the dramatic effects that agriculture had on the possible human ways of life, the first appearance of agriculture in the archeological record is often called the agricultural revolution. New kinds of stone tools, many adapted to framing, appear in the archeological record, and the term “Neolithic” (new stone) is often applied to this period or stage in human history.

The Agricultural Revolution

It is probably not correct to think of agriculture as being “invented” by some Upper Paleolithic genius who suddenly one day decided to plant things. Instead, evidence suggests that the transition from a hunting way of life to an agricultural one was a very gradual process, one that went on more or less independently in several different parts of the world. Agriculture seems, from what we know, to have developed independently in the Near East, Mexico, northern China, and Peru. Quite possibly there was agriculture of sorts in other areas before the influence of these focal regions arrived and supplemented it. The Near Eastern development seems to have been the earliest, beginning some 10,000 years ago, or about 8000 B.C. the principal domesticate of this area in early times, as today, was wheat, and the story of agriculture begins with this.

Indus Valley Agriculture

The circumstances surrounding the development of early civilizations in south Asia are still unclear to archeologist. The ancient civilizations called Harappa appears in the archeological record of the valley of the Indus River in Pakistan around 3000 B.C. without any clear evidence of just how, if at all, it grew from earliest villagers represented at lower archeological levels.

One possibility is that the development of civilization followed after a new wave of people came from some unknown place and conquered the earlier villagers. If so, these people might have brought with them much of the knowledge and social structure that produced the products found in Harappan sites. Another possibility is that many of the ideas for Harappan development diffused in from Mesopotamia, so that the village people of the Indus valley knew what cities, for example, were like before they built their first one. Whatever the case, the Harappan civilization shows that these people had knowledge of working copper and bronze, firing brick, writing, and irrigation as they established themselves in the rich river valley. Like the Egyptians, they developed a canal system for irrigation of the fertile river basin where the river overflowed in the summer. We know from their engraved seals that these people had domesticated water buffalo, cattle, elephants and goats (Swartz and Jordon, 1976).

Agriculture in Ancient India

Agriculture was in practice in India since the times of *Vedas* (2500-1500 B.C.) and *Upanishads* (1500-600 B.C.). The *Vrikshayurveda, Agnipurana, Brihat Samhitha, Krishiparashara, Sarngadharpaddhati* and *Arthasastra* contain separate sections on Indian agriculture (Sinha, 2004).

Pre-Harappan cultures existed in North India before the Harappan or Indus valley culture slowly diffused from its nuclear area; (i) Harappan to Punjab, Haryana, Uttar Pradesh, and Rajasthan (Dikshit, 1980); and (ii) Mohenjo-Daro and Chanu-Daro to Kutch, Kathiawar, coastal flats of Gujarat and some areas of Maharashtra (Rao and Lal, 1985; Weber, 1991; Saraawat, 1992).

Among contemporary and post-Harappan cultures, the identification of plant remains from sites associated with Chalcolithic Copper Hoard or Ochre-Colored pottery cultures revealed that farmers practiced barley and rice rotation at Atranjikhera (ca. 2000-1500 B.C.) and Sringaverapura (ca. 1050-1000 B.C.) in association with grass pea and chicpea at Atranjikhera (Chowdhury *et. al.,* 1997), and seasame (*Sesamum indicum*) and cotton (*Gossypium arboretum* and *G. herbaceun*) at Sringaverapura (Saraswat, 1992). At Atranjikhera (ca. 1500-1200 B.C.), rice-barley rotation was followed (Chowdhury *et al.,* 1977). Rice, horse gram, and black gram were cultivated at Noh, Rajasthan (ca. 1100-900 B.C.) (Vishnu Mittre and Savitri, 1974), and Southwest Asian cereals and legumes were not yet introduced. Imprints of only wild rice (*Oryza rufipogon*) and cultivated rice have so far been reported from Sohgaura (Sharma, 1983)

Green Revolution: Lessons from the Past Experience

Science and technology have made enormous contributions to the growth of the agricultural sector in many parts of the developing world. As a result, global food production has increased by 80 percent since the mid-1960s. Africa, however, needs to double food production to accommodate population increase.

The green revolution, which took place in Asia (India, Pakistan, Indonesia, Taiwan, Philippines, China and Japan) during the 1960s, is a major global scientific and technological achievement towards increased food production. Improved crop varieties, irrigation, pesticides and mineral fertilizer were introduced, which contributed to substantial improvement of food production. With this technological advancement in agriculture it was possible to develop varieties, which have contributed to higher food production and improved the returns to costly resources used by poor farmers. Resultantly, increased productivity has decreased food costs, in general, and thus improved food security, particularly for vulnerable sections of society.

Irrigation, drainage and efficient rainwater harvesting to cope with rising water scarcity are critical in ensuring adequate food production and food security. There is high potential in Africa for increasing food productivity through better control of water and increasing the use of plant nutrients. The concern should be reducing irrigation costs to enable smallholder farmers to manage farms in a manner that minimizes resource degradation problems such as water logging and salinity.

A wide range of improved crop and resource management technologies were emphasized, which have improved environmental and resource sustainability. In this regard, it was possible to bring under cultivation less-favorable lands by introducing new plant varieties (e.g. drought-tolerant crop varieties), which in turn has also contributed to higher food production. This practice has reduced the conversion of forest, grasslands and swamplands for cultivation of food crops. For example, without advancement in agricultural technology, India would have cultivated nearly 60 million hectares of additional land to produce the quantity of wheat currently consumed. This scientific and technological advancement went hand in hand with investment in institutional infrastructure and continued research activities to raise food production and productivity. In China, for example, infrastructural investment continued alongside remarkable efforts and achievements in

the area of seed improvement. Consequently, combination of a decentralized research system and successful extension services replaced traditional varieties of rice and wheat with modern dwarf varieties by 80 percent at the end of 1970s. The Chinese experience, especially post-1978 reforms, demonstrates importance of incentives and a conducive institutional framework in maximizing effects of agricultural infrastructure, successful research on, and dissemination of new technologies.
Post-harvest technologies that encompass efficient crop handling, storage, processing, transportation, marketing and utilization need also to be promoted. These kinds of technology reduce food losses, add value to crops, facilitate efficient trade, generate employment and new products for the market and provide diversification of food (UNECA, 2003).

Scientific and Technological Ingredients of Green Revolution

The green revolution comprised of biological, chemical, mechanical and hydrological science and technology. The fundamental scientific and technological ingredients of the green revolution are illustrated by the case of rice. The rice component of the green revolution originated from the innovative rice technologies developed by International Rice Research Institute (IRRI), which was established in 1960 in Los Banos, Philippines. The first significant accomplishment of the green revolution was the development of semi-dwarf high yielding photoperiodic insensitive varieties of rice by IRRI scientists. The first release (IR8) by IRRI in 1966 caused a green revolution in rice production in Asia and South America. These helped breeders to incorporate them into high yielding modern rice varieties. The pest resistance in rice varieties of IR36, IR64 and IR72 led to their wide adoption by 96 % (1979) and 80 % (1987) of the farmers in Philippines (UNECA, 2003). At the same time, two other international agricultural research centers were established, namely: International Maize and Wheat Improvement Center (CMMYT) in 1966 in Mexico, and Centro Internacional por Agricultura Tropical (CIAT) in 1967 in Colombia for rice, beans, cassava and pastures.

The advanced fundamental scientific basis for green revolution was a combination of principles of biological sciences, genetic engineering, molecular biology and the applications of biotechnology with a broad genetic resource base of germplasm resources. Plant breeders used new tools of biotechnology such as *in vitro* production of haploids and somaclonal variation for plant breeding then used direct gene transfer technology to introduce in the rice plant the right attributes, e.g. producing a rice plant that is more resistant to diseases, insects, or more tolerant to salinity and drought. The semi drought genes were introduced in high yielding rice variety to prevent logging.

The chemical component comprised of the use of compound inorganic fertilizers. The mechanical engineering component comprised the use of improved farm tools (hoes, rotary weeders, hand tractors) to ease the field labor demands for farm operations like weeding, threshing, and transportation.

The hydrological component - irrigation -, which gave farmers a complete water control, was also a very important technological component of the Green Revolution. Farmers were able to grow crops in the wet and dry seasons. Besides it is estimated that the irrigated crops produced three times more than the rain fed ones.

The Socio-economic Ingredients of Green Revolution.

The socio-economic factors that contributed to green revolution in Asia are discussed below:

First, traditional land tenure system was that of share tenants who had no legal claim on the land they cultivated. Through the share cropping arrangements, tenure of the tenancy on that land was relatively secure and stable.

Second, was the change in the farming system from extensive or expansion of land under cultivation to intensive cultivation. This created an improved and more disciplined farming system, which increased land productivity. The intensive land cultivation was triggered off partly by high population pressure on land, which had created land scarcity, and partly due to adoption of improved farming practices.

Third, the increased public investments in irrigation systems enabled farmers to get a double crop that's planted in wet and dry seasons. The irrigation made agricultural production activities economically viable. Assured water supply reduced risks of crop failure. It made it profitable to invest in purchased inputs like fertilizers, encouraged use of improved methods like planting younger seedlings, and improved weeding using weeders.

Fourth, availability of credit facility for purchased inputs like fertilizers and seeds enabled small scale farmers to afford a high level of improved technologies, which caused a wide adoption of both improved crop varieties and accompanying management packages.

Finally, farming communities had already been well sensitized and ready to embrace new technologies (UNECA, 2003).

Objectives of Green Revolution

(a) To enhance the genetic potential of rice varieties to make the plant high yielding, resistant to diseases, early maturing, efficient in use of the water and fertilizers, tolerant to low temperatures, soil alkalinity and salinity.
(b) To disseminate widely rice related technologies information, knowledge and skills
(c) To maintain sustainable development of production systems for more efficient use of inputs, protection of water and biotic resources.

Methods of Implementation of Green Revolution

The first strategy that led to green revolution in Asia and South America was creation of network of international research centers (IARCs) by world community. In 1960, IRRI was established in the Philippines to focus on rice in Asia; CIMMYT, in 1966 in Mexico, to focus on wheat and maize globally; IITA, in 1969 in Nigeria, to focus on maize, rice, cassava, plantain, yams, sweet potatoes and sustainable production systems for Africa; and CIAT, in 1967 in Colombia, focusing on sustainable production systems plus rice, beans, cassava and pastures for South America and Caribbean.

The second implementation method was to identify breeding and research testing sites, so as to maintain the diversity existing in all agro-ecological zones and farming systems within Asia and South America.

Thirdly, the international centers identified collaborating local research institutions strengthened capacity of those national institutions through training and financial resources to conduct both basic and on-farm research and stabilize production in their respective areas.

Fourthly, international centers formed networking programs with national research programs. The regional networks aimed at making effective use of human resources in the national research programs. For example, IRRI networked with University of Philippines at Los Banos. Then international centers themselves, IRRI and CIAT, each served as a resource of advanced technology in the network.

The IARC major role was therefore to provide services in conventional and emerging technologies at the stages beyond scope of national programs. Examples of some of services of advanced technologies provided by IARCs were:

i. Genomic mapping of economically important traits made possible by restriction pigment length polymorphisms.

Then the genomic map would be used to enhance genetic diversity of cultivars in each region.

ii. The incorporation of genes for resistance to important pest and diseases.

The fifth implementation method of Green Revolution was conducting of on-farm research to test the adaptability and performance of improved varieties of both rice and wheat. For example IRRI and University of Philippines conducted on-farm research in Lagun province. About 2400 farmers participated in trials. The on-farm trials served as training and demonstration plots for other farmers. Those trials also helped in initial dissemination of improved planting seeds to neighboring farmers. In the process of trials, researchers interacted with farmers, thus making farmers more and more sensitized. Then there was promotion of the improved rice varieties through national extension service officers who were posted to every administrative unit of local governments in countries (UNECA, 2003).

Successes and Failures of Green Revolution

The green revolution successes include the first successful mass adoption of improved rice technologies by majority of the farmers, up to 80 % in Philippines. Farmers adopted high yielding rice varieties along with improved management skills. Most of farmers in Asia and South America learnt successfully the development of a good seed bed both for nurseries that produced the seedlings, and paddy fields with properly constructed canals for controlled irrigation. Farmers also learnt application of improved inputs on rice, in order to realize their economic potentials. As a whole, productivity was greatly increased.

Another success of green revolution was social transformation of farming communities. The green revolution activities necessarily demanded a lot of labor. They had now changed the traditional methods of work and traditional farming systems to modern production systems. The green revolution also in a way caused land reforms, thus transforming completely lives of poor landless tenants who now could claim economic returns on operational (fixed land) leaseholds. Above all the Green Revolution guaranteed land and cash income to grassroots farmers, considerably reducing poverty.

However, the green revolution had some failures:

It should be noted that designers of the green revolution did not address the issue of malnutrition. They concentrated on one or two crops either rice, wheat or maize. They overlooked the need for a complimentary crop for a balanced diet.

The second short coming of the Green Revolution was that the designers overlooked the impact of high levels of fertilizer inputs for rice on the soil structure, and eventually on the ecosystem. In this regard, they focused on irrigated rice, thus encouraging extensive use of the wetlands, which could create long term environmental adverse effects. However CIMMYT group that bred the improved wheat and maize bred for uplands which can use rain fed agriculture.

The most significant socio-economic constraint that remained unchanged by the Green Revolution forces was the rapid population growth. If the rate of population pressure on the land remains unchecked, experience has shown that the impact of Green Revolution can easily be eroded away by high populations. It is also argued that possibility of rice technologies caused rich farmers to buy off poor ones and put them out of land, because poor farmers could not sustainably afford high inputs (UNECA, 2003).

Curses of Green Revolution

Palanianppan and Annadurai (2003) described ills of green revolution as under:

1. Reduction in natural fertility of soil.

2. Destruction of social structure, aeration and water holding capacity.
3. Susceptibility to soil erosion by water and wind.
4. Diminishing return on inputs (the ratio of energy input to outputs halves every 10 years).
5. Indiscriminate killing of useful insects, microorganisms and predators that naturally check excess crop damage by insect pests.
6. Breeding more virulent and resistant species of insects.
7. Reducing genetic diversity of plant species.
8. Pollution with toxic chemicals from the agrochemicals and their production unit.
9. Endangering the health of farmers using chemicals and workers who produce them.
10. Poisoning food with highly toxic pesticide residues.
11. Cash crops displacing nutritious food crops.
12. Chemicals changing natural taste of food.
13. High inputs increasing agricultural expenses.
14. Increasing farmer’s work burden and tension.
15. Depleting fossil fuel resources.
16. Big irrigation projects often resulting in soil salinity and poor drainage.
17. Depleting the ground water reserves.
18. Lowering drought tolerance of crops.
19. Appearance of difficult weeds.
20. Heightening the socio-economic disparities and land holding concentration.
21. High input subsidies leading to inflationary spirals.
22. Increasing the political and bureaucratic corruption.
23. Destroying the local culture (commercialization and consumerization displacing self-reliance).
24. Throwing financial institutions into disarray (as impoverished farmers demand write-off of loans).
25. Agricultural and economic problems sparking off social and political turmoil resulting in violence.

Increasing Vehemence on Organic Farming

Need for more intensive and economic agriculture production led to wide use of high doses of concentrated chemical fertilizer but insufficient use of organics led to negative results, decrease in fertility and soil structure. Chemical fertilizers and pesticides pollute our air and water. Agricultural chemicals, including hormones and antibodies leave residues in food that may cause cancer or genetic damage. Soil and energy resources are being depleted. Instead of recycling our wastes back into land as fertilizer, we allow them to pollute our water. We use non-renewable energy resources to produce artificial fertilizer. In future we may be forced to make radical adjustments in such agricultural practices. Thus organic farming requires the total elimination of the most damaging chemicals. Such restrictions would presumably satisfy most concerns about pollution and human health. High yields of crops are heavily dependent on use of chemical fertilizers. But in the long run many problems are encountered. Organic farming techniques will help to increase the organic matter content of soils, thus reducing the bulk density and decreasing compaction. There can be effective conservation systems since they provide soil cover during most of the year and with the greater use of rotation and green manure as a source of soil fertility. So unlike under conventional and mono-cropping systems, due to maintenance of crop cover during greater part of the year there is little runoff and erosion. Modern concept of conservation tillage is effective to reduce erosion but it employs excessive use of herbicides which are hazardous to our environment (Palanianppan and Annadurai, 2003).

Anthropology and Agriculture

Chambers (1984) stated “anthropologists have come to an interest in agricultural development through their long experience in working closely with the horticultural and peasant communities of the third world. This involvement coincides with a national interest in improving the agricultural productivity of "food poor" countries. Although the objectives of agricultural assistance programs may vary from project to project, for instance, some programs have as their goals, the elimination of rural poverty, through the introduction of farming technology and techniques, new plant varieties, commercial fertilizers and similar innovations. Other programs are developed around attempts to improve the nutritional status of people. Still other programs might be directed to deal with problems related to capital improvements in lesser developed countries, such as encouraging agricultural self sufficiency and reducing the need for food imports, or helping a country develop foods for cash exports".

Cultural Dimensions of Development

The predominant emphasis in the development approach traditionally was on output goals: capital formation and raising of GNP were pursued with an all-consuming passion. In the process, cultural and societal goals suffered neglect. Erroneously, wealth came to be equated with happiness. While the mysterious 'hidden hand' and 'trickle down' effects were to direct distribution of the gains of development, its cultural objectives were either left undefined or stated in very general, often vague, terms. Economic affluence could never be an adequate goal for society, for while wealth has several instrumental roles, by itself it is not the only and major indicator of the quality of life.

Farming System Research (FSR)

Van Willigen (1993) states "technology development research is best represented by what is called FSR. This policy research tradition has emerged since the late 1970s as an important approach to rural development. It is the product of the work of agricultural economists, sociologists and anthropologists". He quotes Michel Collison and David W. Norman is often cited in discussions of the development of the approach. He further cites Deborah Sans, for example, that their work in Tanzania and Nigeria, respectively, demonstrated the complexity of small farmer resource allocation decisions. This implied "that farmers' management strategies and decisions could only be understood within context of whole farm system", and "that ideal management in any specific enterprise is not feasible in small farm situation" (Sands, 1985). Yet this agricultural research was usually based on the assumption of ideal procedures, and was usually achieved at an experiment station, under conditions very different from a real farm.

A useful definition of FSR is provided by Shaner *et al.* (1982):

> "FSR is an approach to agricultural research and development that views the whole farm as a system and focuses on (1) the interdependence between the components under the control of members of the farm household and (2) how these components interact with the physical, biological and socioeconomic factors not under the household's control. Farming systems are defined by their physical, biological, and socioeconomic setting and by the farm families' goals and other attributes, access to resources, choices of productive activities (enterprises), and management practices"

Van Willigen emphasizes that the definition shows FSR's emphasis on socio-cultural factors as salient features of farming systems. In this framework socio-cultural factors are not viewed as extraneous to the development process, but as essential components that must be understood if the development process is to work.

Technology and Rights

Weeramantry (2006) discusses that on 10 March 1986 the UN Commission on Human Rights adopted Resolution 1986/9, entitled "Use of Scientific and Technological Developments for the Promotion and Protection of Human Rights and Fundamental Freedoms" inviting "The United Nations University, in co-operation with other interested academic and research institutions, to study both the positive and negative impacts of scientific and technological developments on human rights and fundamental freedoms". As this study proceeded it became clear that three categories of human rights related to scientific and technological development should be developed:

i. The right of *protection* against possible harmful effects of scientific and technological developments.

ii. The right of *access* to scientific and technological information that is essential to development and welfare (both on the individual and collective levels).

iii. The right of *choice*, or the freedom to assess and choose preferred path of scientific and technological development.

Technology and Cultural Freedom

Chamarik (2006) cited that main concern of this paper is with infrastructure and social role of science and technology, with a focus on developing countries in their current efforts toward modernization and industrialization. For all the difference in emphasis and despite distinctive traits attached to each, science and technology are closely connected on both methodological and epistemological grounds. Together they are related to social and cultural problems (Rapp, 1982).

First, with respect to the physical world, advancement in science and technology can help bring about development in terms of increasing productive capability and greater freedom vis-à-vis the constraints of nature. Secondly, such advancement is also instrumental in producing societal change and transformation, with significant impacts on problems of human and social relations. Hence the specific human and social dimensions of science and technology need to be objectively perceived, quite apart from their technical and seemingly universal character.

The social and moral consequences of technological achievement were quite in contrast to what was optimistically expected before. At any rate, all the adverse phenomena serve to reveal the true nature, function, and results of science and technology. These still need to be objectively assessed and understood. As has been recognized, technology does not simply mean applied science culminating in an object, invention or even a mode of production that is to say, something autonomous and neutral. As Johan Galtung (1980) describes it:

> "Technology" carries with it a code of structures - economic, social, cultural and also cognitive. The economic code that inheres in Western Technology demands that industries be capital-intensive, research-intensive, organization-intensive and labor-extensive. On the social plane, the code creates a "centre" and a "periphery," thus perpetuating a structure of inequality In the cultural arena, it sees the West as entrusted by destiny with the mission of casting the rest of the world in its own mould In the cognitive field, it sees man as the master of nature, the vertical and individualistic relations between human beings as the normal and natural, and history as a linear movement of progress . . .

Implication for Human Rights

Chamarik (2006) stresses that at this point; the true nature of technological and industrial advance has to be set in a proper perspective of rights and obligations. In the past, colonial and semi-colonial countries and peoples were conquered and exploited as sources of raw materials and markets for manufactured goods. In the process, their traditional values and knowledge systems were transformed into a colonial culture that could not be much more than dependent and imitative (Goonatilake, 1984).

Notwithstanding all the nationalistic claims, however, the fact remains that these national elites' aspirations and goals are closely associated with and strongly inclined toward the western master culture (Rahman, 1981). It is through such socio-cultural processes and conditioning that modernization and modern scientific technology become the transmitter of hegemonic social relations, within and among nations.

If the western historical experience is to be any guide at all issues have to be traced back to the plight of those in the rural sectors who were forcibly dislocated and alienated in process of technological advancement and industrialization. So also must they be attributed to plight of the overwhelming majority in rural and traditional sectors of today's developing countries? Moreover, in addition to adverse impact on economic and social rights and civil and political rights, their traditional cultures and productive capability as a means of self-expression and creativity are being suppressed and disrupted.

In terms of right to development, specific attention has to be given to rural and agricultural sector that has been neglected, even oppressed, for so long. The fact is that no agrarian societies have ever been without technical knowledge and inventiveness. They have their own traditional means of learning and skills in technological adaptation and innovation. For all their seemingly non-scientific attributes, they are directly related to people's real and relevant needs and organizational and environmental conditions (Goonatilake, 1984). Prempridi *et al.* (1986) states, most important of all, they are expressed through free will and with a rationale of their own. Besides, for all their tradition-bound nature, peasants themselves are actually quite receptive to new and modern technologies introduced from outside whenever they are relevant and feasible and demonstrated to be so in practice.

Self-reliance in science and technology is thus to be perceived positively, in the collective sense of cultural creativity and interdependence (Oteiza and Sercovich, 1976). It follows that within each country itself, self-reliance needs to be conceived of in holistic and dynamic terms as social capacity to innovate and adapt existing and new technologies. This must be understood in a socially integrated sense, and not confined to any particular technology or sectors of economy.

Industrial and agricultural disparity continues to be taken for granted. Industry remains topmost priority and any hope of improving rural socio-economic conditions is made to hinge on further industrial expansion. In short, industrial sector remains sole answer as source of employment and the non-farm source of rural income (Ernst, 1981).

In truth, the real solution lies in technological and productive capability within rural communities themselves. Grass-roots participation is obviously a most meaningful way of mobilizing endogenous resources in process of long term growth and development, and should in last analysis have significant implications for developing technological and productive capability, and, indeed, for income redistribution (Chombart de Lauwe, 1986).

Role of IK in Development

It is encouraging to observe that, over the past ten years, there has been a dramatic increase of interest in the role that indigenous knowledge can play in truly participatory approaches to sustainable development. German immigrants from Cincinnati, Ohio, founded an agricultural community that traditional accounts credit with brining about an agricultural revolution in what had been a frontier area, in the best traditions of innovation in the New South (Davis, 2005). This interest is reflected in a myriad of activities generated within communities, which are recording their knowledge for use in their school systems and for planning purposes; within national institutions, where indigenous knowledge systems are now being regarded as an invaluable national resource; and within the development community, where IK provides opportunities for designing development projects that emerge from priority problems identified within a community, and which build upon and strengthen community-level knowledge systems and organizations.

The development of large-scale lettuce production in California's Salinas Valley illustrates the tensions between technology and nature (Petrick, 2006). He mentioned that the industrialization of agriculture was largely idiosyncratic, and the level of industrialization possible for any specific crop varied, depending equally on the nature of the commodity and the willingness of consumers to purchase it. The emergence of lettuce cultivation in the Salinas Valley highlights how early growers harnessed organizational techniques, transportation infrastructures, and technological and scientific knowledge to transcend both the ephemeral nature of lettuce and consumer taste.

Peters (2006) described that historians have portrayed the formative period of agricultural extension work in the United States as a search for the best method of convincing farmers to change their farming practices in order to improve agricultural efficiency, productivity, and profitability. However, one of the key leaders in extension's formative period, Cornell University's Liberty Hyde Bailey, articulated a different vision of extension's central purpose and promise. Drawing on his writings during the years in which he led the development of Cornell's extension program (1894-1902), this article argues that Bailey's vision of agricultural extension work was centered on the provision of education aimed at awakening farmers to a new point of view on life. The new point of view combined sympathy with nature, a love of country life, and a scientific attitude, expressed by a habit of careful observation and experimentation. The main purpose of awakening farmers to this point of view was not to develop a more efficient, productive, and profitable agriculture, but to advance the larger cultural ideals of a "self-sustaining" agriculture and personal happiness.

Conclusions

Indigenous knowledge system (IKS) refers to complex set of knowledge and technologies existing and developed around specific conditions of populations and communities indigenous to a particular geographic area. When a particular territory is intruded upon by conquerors, colonizers, travelers and others they bring with them foreign ideas, knowledge systems and skills. The later, however, get integrated with Indigenous system over a period of time and act as a source of innovation on one hand and reshaping IKS on the other. The host populations irrespective of their legal status - retain some of their own social, economic, cultural and political institutions.

An understanding of indigenous knowledge is required, and its role in community life from an integrated perspective that includes both spiritual and material aspects of a society as well as complex relation between them. At the same time, it is necessary to understand and to explore potential contribution of IK towards local development. The preservation of IK and its utilization for the benefit of a community where it is practiced requires research. The present status of IK is that these forms of knowledge have hitherto been suppressed. Therefore, IKS should be brought into mainstream of knowledge in order to establish its place within the larger body of knowledge. The economic potential of IK should be considered, as well as non-economic values, such as impact of IK on lifestyles and the ways in which societies are run. Research into IKS, should ideally be carried out with participation of communities in which it originates and is held.

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