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Evolution toward transdisciplinarity in technology and resource management research: the case of a project in Ethiopia¹

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1. Introduction

Development is a human problem and is aimed at changing man and his economic, social, ecological environment. Throughout history, man has acquired new knowledge to shape his future. As human needs multiplied and became more complex, science and technology – processes of systematic inquiry for acquisition and application of knowledge – have been exerting increasing influence on human life, society and the environment. To address the complexity and multiplicity of problems, scientific research has been divided into disciplines by problem areas, and into basic, strategic, applied or adaptive depending on whether the objective is to search for new horizons in knowledge or to adapt a known technology in a different situation. This has facilitated division of labour in knowledge production and application, and contributed to phenomenal increase in output, income and human welfare. In this paper, the limitations of disciplinary research to solve complex problems and the potential role of transdisciplinary research to overcome them are illustrated with the experience of a project.

2. Need for transdisciplinary research

The achievements of disciplinary research have accompanied some negative outcomes, e.g. environmental degradation, economic disparity and continuing food insecurity, that led to the realisation that ‘agricultural activities take place within a complex mess of multi-scalar, multi-dimensional interactions’ so the solution to any problem should be sought through multidisciplinary or interdisciplinary systems approach in education and research (Lipton, 1970; Epstein, 1975). However, talk/action ratio in systems research has been very high because of (a) lack of professional prestige in systems research as most distinguished experts have made reputation in disciplinary research, (b) time consuming and expert intensive nature of systems research, (c) reluctance of scientists to accept the need for crossing disciplinary boundaries to address complex problems. Lack of adequate progress in systems research has raised doubts about the socio-ecological sustainability of science based agriculture and agricultural communities in an age of increasing globalisation. It is increasingly recognised that for improving human wellbeing and promoting sustainable and convivial human communities, a holistic and integrated research

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approach that transcend disciplines will be required. Moreover, the people making the key decisions about technology and policy choices and their outcomes must participate fully in the research process alongside formal researchers rather than being mere recipients of research results.

Transdisciplinary research starts from the premise that any problem or complex reality can be viewed and interpreted from a variety of non-equivalent perspectives; within each perspective a problem or reality can be understood at a range of spatial and temporal scales (Rosenfield, 1992; Smit et al., 1998). For example, global warming as a phenomenon can be described and understood from different disciplinary perspectives at the global, regional and local levels over varying periods of time. Within each perspective and scale, stakeholders contributing to global warming and those suffering the consequences may identify different elements of importance, use different indicators and draw different conclusions about it. So whose perspectives are taken into account, how they are incorporated in the research process and the scale at which the research is done will determine the outcomes of research. Transdisciplinary research may help in integrating various perspectives and scales to understand and find solutions to such problems.

3. Problems of highland Ethiopia and some related research

Poverty, malnutrition, low crop and livestock productivity and resource degradation are major problems in rural East African highlands. These problems are highly interrelated; they reinforce one another and keep the rural population in a state of vicious cycle of underdevelopment and environmental degradation. In the Ethiopian highlands, population pressure pushed cultivation and livestock grazing to steep slopes and fragile lands causing serious devegetation and soil erosion, yet about 12 million ha of Vertisols remained underutilised because of poor internal drainage and resultant flooding and waterlogging during the rainy season. To avoid waterlogging, some farmers plough fields before and sow seeds towards the end of the rainy season, so crops grow on residual moisture giving low yields but exposure of bare soil to heavy rains cause serious erosion. So in food deficit Ethiopia, removing constraints to crop production in Vertisols areas was considered an important entry point. A consortium of national and international research centres developed a technology package composed of an animal drawn equipment called broadbed maker to drain excess water during heavy rains, higher yielding wheat varieties for early planting to take advantage of a longer growing season, and appropriate input and agronomic practices.

Indigenous knowledge and farmer preferences were considered in designing the package which was tested on-farm in selected sites with farmer participation, then development agencies have diffused it in wider areas. Yield of 2-3 t/ha of wheat compared to less than 1 t/ha with traditional technology, and early harvest was expected to address food security problems of poor farmers. Economic analysis showed significantly higher profit and employment. Adoption analysis indicated that farmer knowledge, capacity and incentives are important at every step in technology generation and diffusion, and technology adoption is not a one-off decision rather farmers move from acquisition of knowledge to adoption to continuous or discontinuous use. It was also observed that in some cases the technology created externality - water drained from plots on upper slopes created waterlogging in plots downstream. Solution of such problems required community involvement in watershed management. This hypothesis was tested in a pilot watershed where common main and subsidiary drains were constructed with voluntary participation of farmers. This involved water management, drainage technology and farmer organisation related research. It was found that

individual household's contribution in collective action for the common goods creation was influenced by the potential benefit to the participants.

Inadequate and poor quality feeds are major reasons for low livestock productivity. Given the scarcity of land, strategies were sought to increase both food and feed production in a complementary way by integrating food and forage crops, multipurpose trees, better utilisation of feeds and cycling. Research on feed production included selection of potential forages based on their adaptation to environment, feed quality and resource needs, integration of forages in various cropping patterns as inter-, relay or alley crops. Cereal grain yields have in some cases increased in association with forages but greater benefit was obtained in the amount of feed per ha. These studies also showed higher water use efficiency and better nutrient cycling (see below). Economic analysis showed that, compared to pure cereal stands, crop-forage intercropping significantly increased gross margin and cash income and returns were further enhanced when combined with crossbred cows for milk production. Several multipurpose trees suitable for different altitudes showing different attributes e.g. frost tolerance, growth rate have been identified through participatory on-farm testing. Through farmer-to-farmer diffusion and seed sharing, many more farmers in and around the original research sites have planted these trees.

Seasonality and inter-year variability in feed quality and quantity aggravate feed problem. To better utilise available feeds, on-station and on-farm studies were conducted with crossbred cows for milk production and traction, thereby reduce the need for oxen and additional feed for them. Results showed that with adequate feed supplementation, crossbred cows could be used for dual purpose, as little power requirement of small farms did not significantly affect milk yield and reproduction. Moreover, crossbred cows significantly increased cash income and household nutritional status, especially of pregnant women and children.

Soil fertility is declining because manure is principally used as fuel and chemical fertilisers are expensive. Efforts to improve soil fertility include livestock production, efficient use of crop residues and manure, and introduction of herbaceous/tree forage legumes that can fix atmospheric nitrogen. Trial on effects of grazing pressure showed that where manure was left on the grazed plots, with grazing pressure biomass productions increased and soil erosion reduced. Where manure was removed from grazed plots, biomass production declined and soil erosion was well in excess of the permissible limit. Moreover, feed shortage could be averted by synchronisation of grazing with seasonal herbage availability at different slopes and strategic fertiliser application could improve biomass productivity and protect soil.

4. From Vertisols and watershed management to integrated resource management

The component technologies described above have been initially tested at plot, animal or farm level, and their economic viability tested separately and partially in terms of e.g. yield and income, though it was a multidisciplinary project. Some farmers have participated in several interventions but their integrated effects have not been properly assessed. Improvement of human welfare – poverty alleviation, food security, better health and nutrition- and conservation of natural resources are ultimate goals of research of the consortium, so assessment of impact of various interventions should go beyond estimating profitability, productivity etc and explicitly consider the final goals as assessment criteria. So inter-relationships between biophysical and human dimensions needed to be integrated both spatially and temporally to identify ways to improve conditions of the ecosystems and human welfare. This required human, policy and technical dimensions to be integrated at household and watershed or community levels. To achieve this goal, the project is currently using agroecosystem health as a framework for analysis and synthesis that incorporates an integrated approach to assess the stability, resilience and efficiency of an ecosystem to improve human and

ecological welfare. In many ways its operational principles are those of a transdisciplinary nature (Smit et al., 1998).

6. Conclusions

To address complex problems of human development and environmental management, there is a need to move from disciplinary to transdisciplinary research. This is supported by the experience of an Ethiopian project in which a systems approach was adopted initially to diagnose problems, but discipline based component technology development and testing with farmer participation often separately, and assessment of impact mostly in bio-economic terms e.g. yield and income was the norm. Gradually the need for simultaneously assessing the economic, social and environmental effects of several technology interventions at plot, household and watershed/community levels were recognised. The research methods have been accordingly modified to adopt an integrated and holistic approach using the agroecosystem health approach as an integrative analytical framework. This evolution also meant a gradual shift from disciplinary to multidisciplinary to transdisciplinary research.

References

- Epstein, T. Scarlet (1975) The ideal marriage between the economist's macroapproach and the social anthropologist's microapproach in development studies. *Economic Development and Cultural Change*, 24(1): 29-46.
- Lipton, Michael (1970) Interdisciplinary studies in less developed countries. *The Journal of Development Studies*, 7(1): 5-18.
- Rosenfield, P L. (1992) The potential of transdisciplinary research for sustaining and extending linkages between the health and social sciences. *Social Science and Medicine*, 35(11): 1343-1356.
- Smit, Barry, Waltner-Towes, D, Rapport, D, Wall, E, Wichert, G, Gwyn, E and Wandel, J (1998) *Agroecosystem Health – Analysis and Assessment*. University of Guelph, Canada. 113p.

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