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Resource Management and Agriculture in the Periurban Interface of Karnataka, Belagavi: Problems and Prospects

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Abstract: *This paper outlines pressures on agricultural land in periurban Karnataka, Belagavi. A survey of agricultural practices underlines the recent and rapid transition from agricultural to urban land use in the periurban interface, and shows how farmers are reacting by reducing fallow periods. Farmers are also intensifying agriculture near streams and rivers through increased use of irrigation, in response to growing urban markets for a wider range of vegetables. We identify specific problems of water resource pollution and waste management, with particular reference to farmland irrigation. We report results of composting interventions as a community-based waste management strategy. We consider integrated organic waste recycling as a generic strategy to help protect periurban natural resources, to enhance food production through nutrient recycling, and to improve community sanitation.*

Keywords: Agriculture, Karnataka, Periurban Interface, Resource Management, Waste Management

I. Introduction

The periurban interface of cities in developing country contexts has received growing attention in recent years and was the focus of significant research effort by the UK Department for International Development's (DFID) Natural Resources Systems Pro- gramme from 1995 to 2006. Principal among effects of rapid urbanization has been conflict over land use in the periurban interface, between traditional forms of agriculture and the ever growing demand for housing and commercial premises. Loss of land for building has frequently marginalized periurban farmers, whose livelihoods are often prejudiced by insecure tenure. Short-term planning in this pressurized environment typically leads to agricultural intensification on remaining accessible land and insufficient attention to declining soil status. Significant challenges have emerged in terms of access to land, soil ameliorants, water and water quality (increasingly polluted by periurban waste, urban waste disposal and industrial activities).Yet urban and periurban agriculture is often claimed to be a key livelihood opportunity for many citizens.

The challenges to agriculture in the periurban interface include adapting farming systems sustainably, managing water resources for agriculture in the face of rising nonagricultural demand, and exploring opportunities for waste recycling in order to protect soil fertility. This paper considers these issues in relation to the periurban interface of Karnataka. Belagavi second city.

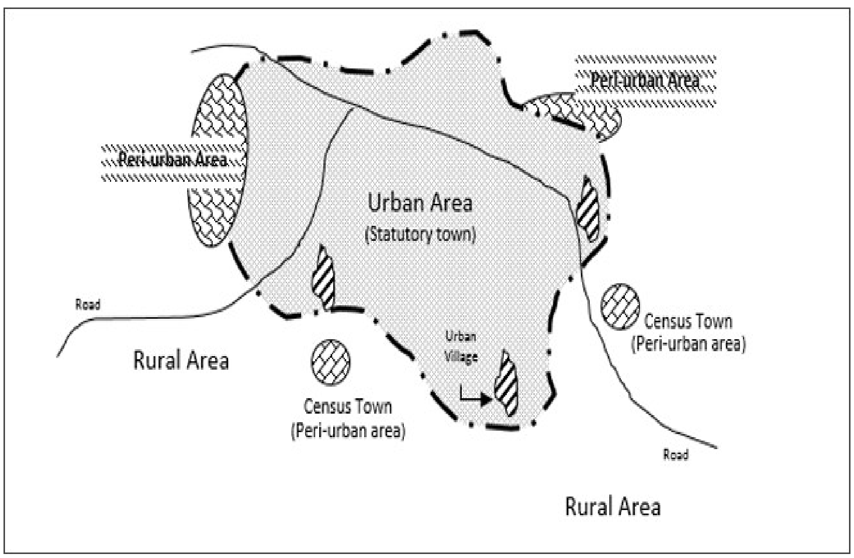
The increasing pollution and waste disposal problems found in many Belagavi cities, resulting from rapid growth and urbanization, widespread poverty, inadequate and weak local governance and limited financial resources have become distinctive features of Karnataka and its immediate periurban inter- face that pose major challenges to environmental protection, waste management, food security and urban and periurban agriculture. The pollution and waste disposal problems are most acute in periurban areas, where waste management services are seldom adequate or provided despite rapidly increasing settlement densities hence, substantial opportunities exist for community-based waste management strategies that promote nutrient recycling. These strategies turn organic waste into compost at community and household levels for use as agricultural fertilizer in urban and periurban agriculture. While not problem-free, such approaches have the potential to create a positive outcome overall by increasing urban and periurban agricultural production through appropriate soil fertility management; by protecting the environment through the recycling of organic waste; and by generating income and livelihoods, which in turn enhance urban and periurban food security

II. Periurban Karnataka

As in many rapidly developing urban regions, the Karnataka periurban interface is characterized by high rates of conversion of agricultural land to private housing and increasing pressure on natural resources through waste dumping, wood collection and sand winning/mining. Land tenure is a complex issue in periurban Karnataka as land may be held by the government for public facilities, by families ('family land'), by the community ('stool land', controlled by the community chief) and by individuals. The debates around pressures of development have focused to an extent on community land. The role of the chiefs in controlling and selling land for development is critical. Customarily, the proceeds of stool land sales should revert to the community, and those farming these community lands should be compensated by access to appropriate parcels of alternative farming land. This has not always been the case, especially with progressive monetization of transactions and as the extent of suitable land not covered by buildings declines. Numerous conflicts have arisen, leading some farmers to abandon agriculture, and generating insecurity and short-term planning strategies among remaining farmers, often resulting in exploitative soil 'nutrient mining' approaches.

The city and its suburbs lie across a major drainage divide (Figure 1). The main watersheds in the area flow from more rural catchments across the periurban zone and into the city. Having passed through the built-up area, the main streams then flow through periurban Karnataka and then further out into more rural areas. As a result, a range of water quality and supply problems affects the periurban interface. Further, budgetary pressures have resulted in the inability of public services to meet waste collection demands in the periurban interface adequately, despite the construction of two new waste collection facilities since 2000. This has been partially due to a process of 'peripheral neglect', in which municipal and district authorities focus their resources in core rather than peripheral areas such as the periurban interface

2.1 A Visualisation of Urban and Peri-Urban Areas



This is set against a pattern of declining rainfalls in the Karnataka area, from the 1960s average of 10000 mm to that of about 10,068 mm in the decade 1989–1998 (data obtained from Belagavi Meteorological Service, Shambra Airport station), a trend mirrored else- where in western ghat. However, rainfall totals have risen margin- ally since about 2000, if characterized by relatively high variability, with a fitted trend line rising from 9974 mm in 2010 to 9900 mm in 2011 (Shambra Meteorological Service, Belagavi Airport station). With significant population increase, from perhaps 10000 (1960) to substantially over 1 million, and increasing periurban house building and groundwater abstraction, the necessity to protect agricultural land and to better manage water resources for agriculture becomes apparent.

Soils of Karnataka periurban interface are developed over highly weathered phyllites, greywackes, schists and gneiss, and are predominantly reddish silty clays and silty clay loams, generally well drained but with low chemical fertility below a thin organic topsoil (Adu, 1992: 32). Adu (1992: 121–22) reports that these soils are deficient in phosphorus and that where cultivation has been carried out continuously for long periods soil nitrogen levels are 'very low'. Heavy leaching has depleted the soil of elements such as calcium and magnesium, resulting in relative concentrations of iron and aluminum compounds. Low organic matter content renders these soils susceptible to erosion and careful agricultural management is required.

The terrain is generally moderately dissected, with slopes of 5° to 15° and local amplitude of relief of up to 30 m. Summits are often relatively flat-topped, and under- lain by laterized concretionary gravels. Asserts that improper cultivation practices, particularly on steep upper and middle slopes, have led to widespread accelerated erosion, in turn leading to the exposure of subsoil gravel and to shallow soil depths.

III. Research Methodology

A range of scientific and social scientific research techniques was applied in studies carried out between 2001 and 2005 as part of a wider In order to determine the nature of the agricultural system, in-depth semi structured interviews, backed up where possible by systematic on-site observation, were held with a sample of 35 farmers (26 male, 9 female) in Savadatti, Chikodi, Raibag Following local custom, the village chiefs were approached to gain community access so that, inevitably, initial interviews were with their associates. But a cross-section of farmers was accessed subsequently via the snowballing method. Questions focused on identifying basic farming practices, including soil and water management, and investigating indigenous technical knowledge. Wherever possible, farmers were invited to conduct interview discussions in their fields, thus providing independent corroboration or otherwise of their statements via more participatory methods derived from participatory rural appraisal. All our interviews were conducted in English (while accompanied by a local interpreter).

Monthly water quality data were obtained for the period September 1999–September 2001. Samples were analyzed at the Karnataka-based laboratories of the Belagavi Water Company and Karnataka Environmental Protection Agency; both using standard procedures associated with the portable laboratory Niranjan Karagi’s Nirnal world’s cheapest portable water filter systems. Heavy metal determinations were carried out at the Chemistry Department laboratories of Angadi Institute of Technology Karnataka.

In order to conduct composting experiments, household surveys in 6 periurban Talukas Athani, Bailhongal, Belagavi, Chikkodi, Gokak, Hukkeri, Khanapur, Ramdurg, Raibhag and Saundatti. Were undertaken to identify behavioral patterns, with respect to disposal of household refuse. Villages were selected to ensure that a range of different periurban characteristics (environmental, geographical, social, eco- nominal and political) was represented. The single universal characteristic that applied to all selected Talukas was that open refuse dumps were used; that is, no waste collection services existed.Focus group discussions were also held in study Talukas, including discussions with separate subgroups comprising of chiefs and elders, farmers, women, and village youth. Focus group sessions/workshops were held specifically related to the composting initiatives. Following action planning discussions, specific designs and types of household level composting micro projects were chosen. Sketches and diagrams were used to illustrate the principles of container composting, and then suitable compost container designs were drafted for local construction. These consisted of simple and easily replicable demonstrations, distributed at prominent points in each village. Once the various containers had been constructed, their use was implemented, as noted above, through training workshops conducted by community- level facilitators and community-chosen representatives working with a S E V A K stands for Society for Empowerment through Voluntary Action in Karnataka on a - funded livelihoods project, thereby also contributing to local empowerment through enhancement of the community facilitators’ capacity to produce and analyze knowledge.

IV. Agriculture In Periurban Karnataka

The dominant farming system in periurban Kumasi is sedentary agriculture with mixed cropping and some rotation of cassava, maize, exotic vegetables, plantain and sugarcane, And relatively little monocropping. The most common rain fed strategy is intercropped maize and cassava. Cassava, maize and plantain are the main crops and urban and periurban backyard gardening features extensively. Many farmers around Karnataka have turned recently to irrigation particularly in bottom lands with access to water, and to year-round intensive cultivation of lettuce, tomatoes, Indigenous indicators of soil fertility sampled among 35 periurban farmers in Karnataka, 2001.

Indicator	No.	Percent
What shows that a soil is fertile?		
Soil color	24	67

Soil texture	16	44
Fallow trees	10	28
Crop growth quality	9	25
Crop growth yields	9	25
Established fallow	5	14
What shows that a soil is declining in fertility?		
Declining yields	21	58
Pest invasion	16	44
Weed invasion	15	42
Sandy or coarse topsoil texture	7	19
Changes in soil colour	5	14
Changes in greenness of fallow vegetation	3	8

In our interviews, limited use of organic fertilizers (2 farmers – both male – using mostly chicken manure) was reported, but there was relatively common use of chemical fertilizers (11 farmers – 9 male, 2 female), almost exclusively on relatively high value crops such as tomatoes, okra, 'garden eggs' (aubergines) and peppers. Inadequate finance was most often quoted as a constraint on chemical fertilizer use. Three farmers were using herbicides incorrectly as pesticides, while 9 farmers admitted to using (banned) DDT. It is clear that farmers here use low amounts of fertilizer overall, the main reasons being continued reliance on fallows to restore fertility and inadequate resources to purchase fertilizer. This low application estimate conceals possible hot spots such as intensive tomato production near Karnataka where excess fertilizers may well be applied and result in leaching into streams and groundwater. Use of fallow continues except in the most urbanized villages, although fallow periods are being reduced the average fallow period claimed by farmers was four–five years, though many said that this had reduced recently. On the other hand, one farmer had cultivated two plots alternately (one year fallow) for six years and three farmers admitted to a two-year fallow; the maximum fallow period claimed was six years. Permanent intercropping is more common in the relatively urbanized communities. Monocropping is uncommon, although many farmers perceive the market advantages of concentrating effort on cash crops such as lettuce and tomatoes.

V. Water Use And Agriculture In Periurban Karnataka

Although the secular trend in rainfall since about 1960 is downward, despite a slight rise and relatively high variability in the last decade, there is still sufficient precipitation for traditional forms of rainfed agriculture in Karnataka periurban interface. The trend towards irrigation to diversify and intensify cropping relies on use of Belagavi streams and rivers, which is problematic. In terms of chemical pollutants, farmers surveyed generally believe that river water provides detectable fertilizer benefit to irrigated crops, and it would be expected that the polluted waters downstream of Belagavi would make a significant contribution to the nitrogen requirements of irrigated crops there. However, the use of nitrogenous fertilizers leads to both the export of nitrogen in crops and the build-up of nitrate in groundwater. The maximum accumulation of nitrogen is likely to occur in water- saturated landscapes, such as those valley bottoms in and around Karnataka, and downstream at Malaprabha, where sugarcane and water cocoyam are grown. The role of these areas in nitrogen cycling deserves further investigation.

Wider use of irrigation for fresh vegetables, a distinct possibility in view of increasing markets in Belagavi and Dharawad, is a potential source of increased agricultural demand on water in the periurban interface, which also may present a significant threat to human health.

VI. Domestic Solid Waste and Agriculture

Due to inadequacy of municipal refuse collection services in Karanatak periurban inter- face, domestic solid waste accumulates in dumps in and around communities. Daily domestic waste is largely organic, consisting mainly of food scraps (cassava, yam and cocoyam peels, and plantain skins) and wood ash, and represents a potential source of nutrients for agricultural soils. Composting and reuse of organic waste is a means of recycling nutrients and restoring soil fertility (Drechsel & Kunze, 2001), particularly here with the high engagement (90 per cent) in local (less than 4 km from the house-hold) agricultural activities and the need for soil ameliorants in these same areas. Our household survey indicated high potential for a household- level waste separation and composting programme, reinforced by communities' willingness to participate and by their eagerness to improve village sanitation while also contributing to their agricultural livelihood. The main container composting method demonstrated was block-built compost bins, chosen because of the wide availability of building blocks, standard bricks or the traditional sun-baked blocks. Each double chamber compost bin is sufficient for a household with an extended family. Larger versions consisting of three high capacity chambers were also demonstrated, suitable for up to five households. Early spontaneous uptake of the technology was encouraging, with the number of installations almost doubling within three months of project initiation. However, the main obstacle to further uptake was cited as financial constraints. Furthermore, in the case of block-built compost containers, in the space of 12 months from micro project initiation the price of cement had doubled, thus placing these materials beyond the financial means of many periurban residents. Despite this, an element of longer-term sustainability was demonstrated and using locally resourced materials such as cane or bamboo for container construction could reduce costs. Aimed initially at the backyard gardening level, the potential of these methods to both reduce waste flows and enhance soil status has been demonstrated. The wider development potential of this strategy, based on concepts of integrated organic waste recycling, is now outlined.

VII. Integrated Organic Waste Recycling

Farmer responses to declining soil fertility have incorporated what are locally viewed as 'modern' farming methods including the adoption of monocropping techniques that are accompanied by the use of chemical fertilizers and pesticides. Furthermore, rapid land use changes have encouraged adoption of these so-called modern farming methods as farmers with insecure land tenure attempt to achieve short-term gains through nutrient mining rather than investing in alternative and longer-term soil fertility measures. Land tenure insecurity reduces the incentives for farmers to adopt organic-based soil amelioration measures. This then raises an important longer term sustainability issue that must be addressed when planning and developing integrated organic waste recycling strategies, particularly if there are no alternative markets to retail and distribute compost products.

In Karnataka, and indeed much of western ghat, closing the rural–urban nutrient cycle remains a largely theoretical concept, as municipal authorities have yet to exploit such options systematically. This situation contrasts with the outcomes achieved in the very different geopolitical and social conditions of Belagavi, and Some Forest regions where nutrient recycling principles have been implemented and have proven very successful in practice Besides increased capture and storage of carbon, nutrients and water, other potential advantages from closing the nutrient recycling loop include reduction in the volumes of foodstuffs that are imported, reduced need for commercial/inorganic fertilizers (and pesticides) and increased environmental protection.

VIII. Conclusion

This paper investigated problems of agricultural resource management in Karnataka periurban interface and, on the basis of empirical research, proposed potential solutions. There can be no doubt that rapid land use change – from agricultural to urban/built-up is having a profound effect on agriculture. In periurban areas where rainfed agriculture still predominates, the loss of agricultural land has resulted in reduced fallow periods and consequently lower overall soil fertility levels. Ongoing pollution of the river system has significant implications for irrigation agriculture. The field surveys showed that more farmers are accessing river water for irrigation in response to increasing opportunities for selling a range of vegetables to urban markets, although results reported here and elsewhere indicate that both river water and groundwater are being polluted from a wide variety of sources. Chemical pollution may be broadly neutral in that it provides a source of nutrients for plants, but the undesirable levels of coli form bacteria and heavy metals are a concern. However, the build-up of heavy metals in floodplain sediments is potentially problematic in the longer term.

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